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REGIONAL ECOSYSTEMS SURVEY OF THE SOUTH PACIFIC AREA

Arthur Lyon Dahl

Regional Ecological Adviser
South Pacific Commission
Noumea, New Caledonia.

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INTRODUCTION.

This survey of the ecosystems of the Pacific Islands included within the area of the South Pacific Commission (Fig.1) has been undertaken to summarise the available information on the need for and present progress towards the conservation of nature in the region and to provide an indication of the environmental framework within which sound development must take place. The study was recommended by the South Pacific Conference on National Parks and Reserves (Wellington, New Zealand, February 1975) which called for a survey of existing and potential protected areas in the South Pacific. This recommendation (No.7) invited UNEP and IUCN to work with the South Pacific Commission to support a project to :

(a) identify the various characteristic ecosystems and habitats of the region, including marine areas and determine the extent to which they are currently protected and/or endangered by exploitation;

(b) make proposals for the setting aside of additional areas so as to cover the range of characteristic ecosystems and habitats, and

(c) following consultations with the countries concerned, design projects for technical assistance to implement these findings.

The resolution proposed that this study should be reviewed at the present Symposium, and recommended that special attention be given to areas to be designated as Biosphere Reserves under UNESCO's MAB Project 8. It is hoped that this present report will lead to projects for technical assistance necessary to implement its findings.

The survey has been undertaken primarily by the author with travel and secretarial support provided by IUCN as part of a major UNEP-funded programme. Field visits were made as part of this study to French Polynesia, American Samoa, Guam, the Caroline, Mariana and Marshall Islands, Nauru, the Gilbert Islands, Papua New Guinea, the Solomon Islands, the New Hebrides, Fiji and New Caledonia. Data was also available from earlier visits to Western Samoa, the Cook Islands, Niue and Tonga. Large numbers of local and outside specialists also contributed essential information; their contributions are listed as appropriate in the country reports or in the Acknowledgements at the end of this report.

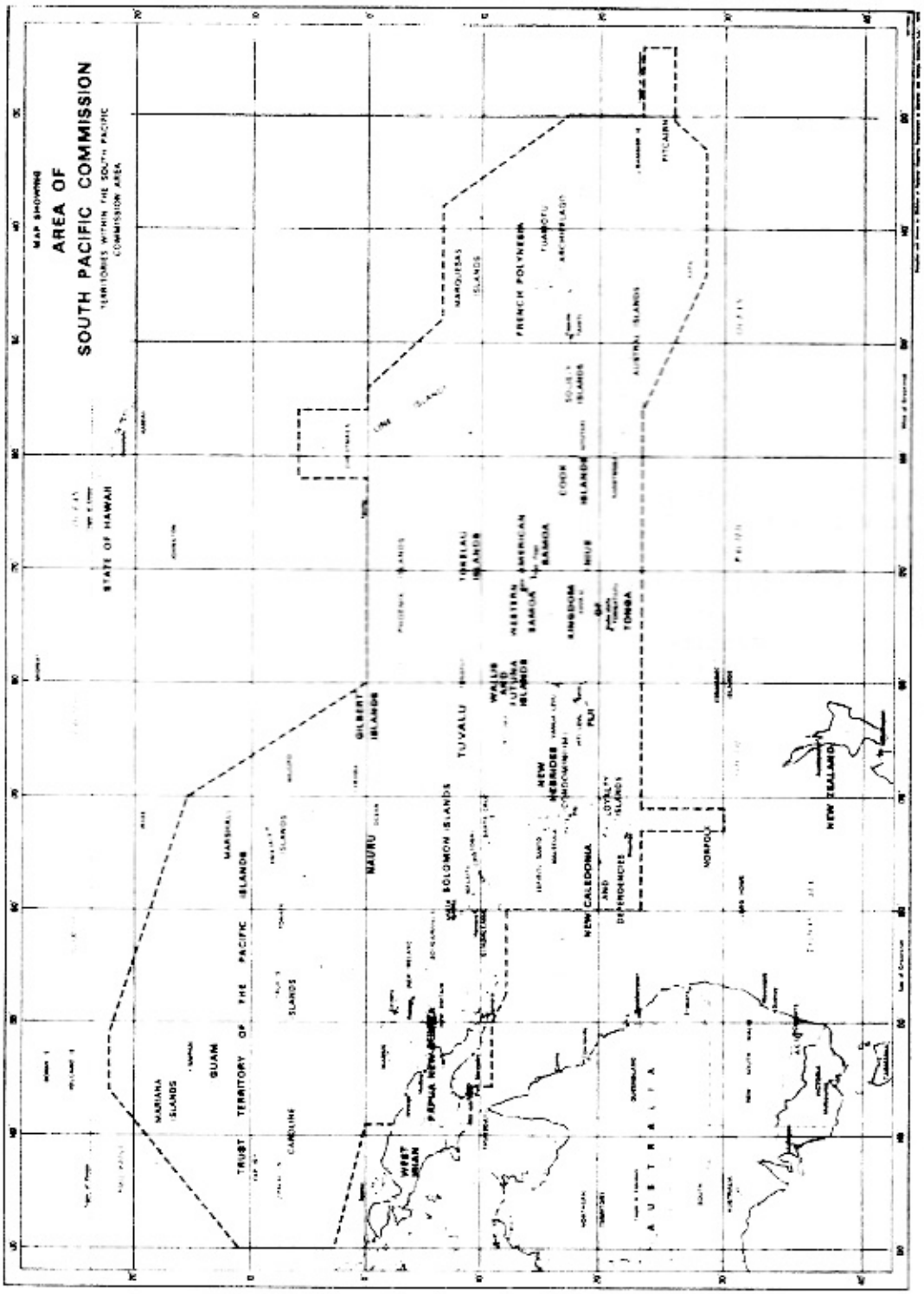

Fig. 1 AREA INCLUDED IN THE REGIONAL ECOSYSTEMS SURVEY

Any survey of this scope is subject to many limitations, including the lask of scientific knowledge of many parts of the Pacific, the difficulty of collecting and reviewing what information exists on such a vast area, the lack of ready access in the islands to much of the scientific literature and the failure of some recently-published reports and solicited contributions to reach Noumea in time for inclusion.

The South Pacific Commission would appreciate learning of errors or ommissions in this survey so that a revised version can be prepared soon for publication. Opinions and interpretations expressed are those of the author and not necessarily those of the South Pacific Commission or its member Governments.

What is Conservation ?

The word conservation refers to protection from change or destruction. Conservation of nature is therefore the protection of nature, including natural systems of plants and animals, from change or destruction. This can be done in many ways which will be discussed in more detail below. Why is nature conservation so important ? Man depends on nature for much of what he needs to live, and indeed lives within a natural system, the biosphere of the planet. While many of our modern needs are met from agriculture or manufacturing, agriculture inself is based on natural systems, on plants and animals originally found in nature and which were adapted to man's needs. As the world runs out of nonrenewable resources such as oil and minerals, we will need to turn more and more to natural systems to find alternative materials and processes on which to base our civilization. It is in natural systems that we frequently look for new medicines and chemicals, new biological controls for pests and diseases, new sources of food or materials for industry, and many other things. Natural systems are like genetic banks from which we can withdraw new biological materials when we need them. This is particularly true in islands where, because of their geographical isolation, evolution has produced many unique kinds of plants and animals found nowhere else in the world. It is therefore in the long term interests of island governments and territories to ensure that appropriate viable samples of all their natural systems are protected or conserved in some way to keep them available for future generations. It is not possible to put a monetary value on each unusual or endemic species (a species found only on one island or territory). We do not know in advance what use, if any, might be found for each of these species. However there are many examples of rare or endemic species which have had very great economic importance. The Monterey pine (Pinus radiata) is an endemic species of the California coast with little local economic value; however it has been introduced to New Zealand where it is now the basis for much of the New Zealand forest industry. An obscure insect in one area may be found to be the ideal biological control for an important agricultural pest somewhere else. Allowing our natural environments, habitats, and species to be destroyed is rather like throwing away a box of rocks because we cannot tell which ones are worthless and which ones are jewels of great value.

There are more immediate reasons for conserving nature. Many developing countries have found that conservation areas such as national parks can provide the basis for tourism, one of the important money-earners in many economies.

Many Pacific Islands have been trying to develop tourism, but few have taken the necessary steps to develop as attractions for tourists, areas of scenic beauty and natural interest appropriately protected in parks so that they will not be destroyed by the very visitors they are meant to attract. Conservation can therefore mean new jobs in the tourist industry as well as in the management and protection of reserve areas. Conservation also contributes to the quality of life of the local inhabitants by providing them with areas for rest and recreation where they can go to learn about the environment within which their traditional culture and island way of life evolved. Indeed conservation in the broadest sense is the continuation into the future of the same wise management of natural resources that was an important part of most island cultures.

Conservation is also essential to science. Reserve areas can provide natural laboratories in which biologists and other scientists can study the processes of evolution and the maintenance of natural ecosystems. Many great biological discoveries on which modern progress in medicine, agriculture and other fields have been based have been made in island areas. Governments should therefore, as a matter of policy, decide to set aside in some kind of appropriate reserve or conservation area, viable samples (i.e. samples able to maintain themselves) of each of the natural communities or ecosystems found in their country or territory. The purpose of this report is to provide a practical guide to conservation needs in the Pacific Islands. It should be regarded as an interim step in conservation planning. It is not possible in a survey of this scope to go into great detail in describing the natural systems of each island. Defined here are the <u>regional</u> needs for conservation. Each government should take this foundation and build upon it a detailed plan for national conservation areas. The steps necessary to develop a national conservation plan are included in the recommendations at the end of this report.

It should be emphasised that any system of classification such as this depends on scientific judgments that are constantly subject to modification and change in the light of new information. The conclusions of this report are preliminary and will need to be modified as more detailed surveys are undertaken of the natural resources of the Pacific Islands.

PREVIOUS WORK.

This is not the first attempt to review the need for, and progress of, conservation in the Pacific Islands. More than 40 years ago, the Standing Committee for the Protection of Nature of the Pacific Science Association began collecting information on the conservation needs of the Pacific Islands. Then, as now, conservation in the islands concerned the protection of island cultures and peoples as well as nature (Skottsberg, 1940). More recently the International Biological Programme conducted studies of Pacific Islands, producing a check list of Pacific Oceanic Islands (Douglas, 1969) and recommending certain remote islands for designation as Islands for Science (Nicholson & Douglas, 1970; Elliott, 1973). The Regional Symposium on Conservation of Nature - Reefs and Lagoons organised by SPC

and IUCN in Noumea in August 1971, also reviewed conservation needs and status for the Pacific (South Pacific Commission, 1973) and the South Pacific Conference on National Parks and Reserves in Wellington, New Zealand, in February 1975, provided the opportunity for updated conservation reports by many countries and territories of the region (National Parks Authority, 1975). This information has been drawn upon freely in this present report.

CLASSIFICATION AND CHARACTERIZATION OF ECOSYSTEMS

What is an Ecosystem ?

An ecosystem consists of all the organisms - plants, animals and microorganisms - that occur in a given area, together with the non-living elements of the environment. The term "ecosystem" is used because the living and non-living elements are closely interrelated in a functioning system with producing, consuming, decomposing and non-living components. An ecosystem has therefore a spatial definition (it occurs in a definable area) and a functional definition (the parts of the system are interdependent and maintain at least temporary stability).

Both of these ecosystem characteristics are essential for conservation. Parks and reserves are geographical units containing one or more ecosystems, but to be effective they must include enough of the ecosystem components to maintain the stability and continiuty of the system over time.

Because of the great interdependence of organisms within an ecosystem many species can only survive as part of the system within which they evolved. Conservation of species therefore generally means conservation of the ecosystems of which they form a part.

In islands, because of their small size and isolation, many unique ecosystems have evolved that are often limited in total size. Such ecosystems are particularly easy to destroy, and their conservation is therefore most urgent.

It may be helpful in picturing an ecosystem to make the comparison with an organism, perhaps some kind of animal. An animal is made up of many cells which depend on their relationship with other cells in the animal for their survival. In an ecosystem each individual organism would be like a cell. In an organism, the cells have different forms and different functions (bone, muscle and skin cells, for example); an ecosystem has many kinds or organisms with different roles (plants, producing food, trees producing shelter, insects pollinating plants, etc.). If part of an animal, say its stomach, is taken out it will probably die; if part of an ecosystem is destroyed (cutting the trees in a forest), the rest of the system will be degraded or lost. The different species of plants and animal and microorganisms are as important to an ecosystem as the various organs are to an animal.

Defining specific ecosystems is never easy since no natural system is ever totally independent of the others that surround it, and one almost always intergrades gradually into the next. It is only where there is a sharp distinction between physical environments, such as between water and land, that the boundaries can sometimes be clearly defined. Definitions of ecosystems can also be based on various criteria, such as structural similarities or species composition. A coral atoll in the Caribbean may have the same structure and functional organisation as one in the Pacific, even though the species that make it up are almost completely different. This problem of defining distinct ecosystems becomes particularly acute in islands where each biological community has its own unique characteristics varying slightly (or greatly)from those on neighbouring islands, and where isolation has frequently led to the evolution of endemic species (species found nowhere else). The question of how much of this variability and uniqueness to conserve is a subjective one that can only be answered by each government within a much broader context of present and future social, political and scientific needs.

Elements of ecosystem definition.

This survey is part of a world-wide project by IUCN to define the needs for the conservation of all the principal types of ecosystems in the biosphere. In developing this project, IUCN has prepared papers defining and classifying the biotic provinces of the world (Dassman , 1973; IUCN, 1974), and has produced a working system for the classification of world vegetation (IUCN, 1973). These terrestrial projects are now being paralleled by efforts to characterize marine ecosystems (Ray, 1975). These global studies have provided the basis for the approach to ecosystem definition used here.

GEOGRAPHY.

There are several different elements that contribute to the distinctiveness of ecosystems. The biogeographic dimension determines which organisms could colonise an island in the first place. The closer an island is to major centres of evolution and distribution such as Southeast Asia, the Indo-Malay Archipelago, Australia, or America, the greater the chance that species from those areas will have been able to colonise it. The amount of present and past isolation of the island is also important. During the changes in sea level and continental position that have occurred over geological time certain islands have been joined by land bridges to other islands or to continents, permitting the migration and establishment of many more species than could fly, swim or drift to more isolated areas. Once a plant or animal is established, its subsequent isolation may permit it to evolve into new and unique forms, or may allow it to survive long after it has been out-competed and become extinct elsewhere. These facts help to explain the great diversity of island ecosystems and the uniqueness and scientific interest of their faunas and floras.

It is possible to recognise various biogeographic groupings on the basis of similarities or differences between the organisms of adjacent islands, such as those proposed by Curry-Lindahl (1975) for terrestrial animals or the biotic provinces proposed by IUCN (1974).

A second geographic element defining ecosystems is climate, particularly temperature (air and ocean) and rainfall. Almost all the SPC area lies within the tropics, a region noted for its warm and relatively constant temperatures. Tropical organisms tend to be sensitive to temperatures below their normal range, and hence are limited in their distribution by the temperature gradients north and south of the equator. Ocean water temperatures are determined both by climate and by the patterns of ocean currents which are also important in determining marine organism distributions. Rainfall is one of the critical parameters for terrestrial ecosystems, and varies widely throughout the Pacific Islands (Fig.2). While average amounts of rain are very important, its distribution over time is also critical. Long dry spells interrupted by heavy downpours may provide the same total rainfall as frequent light showers, but will support a very different biological community. Even very rare extreme events can be significant (Stoddart and Walsh, 1975). A severe drought occurring once a century can permanently alter an island's population composition, as can a cyclone which flattens forests, pulverises reefs and floods low-lying areas. Some significant climatic factors in the Pacific are mapped in Fig. 3.

ISLAND STRUCTURE.

The physical structure of the island itself is also a major determinant of the ecosystems present. High volcanic islands will provide many more habitat types than low coral islands. Continental islands occurring west of the Andesite Line will tend to be larger and to have a greater variety of soil types and landforms than oceanic islands. Elevated atolls or coral platforms can support more varied populations than reef islands just at sea level. The islands of the Pacific represent a complex mix of all of these forms (Fig. 4) and even a single island may be composed of several structural types. These island forms also respond differently to climatic and geographic factors. Low islands are more likely to be flooded and their terrestrial populations exterminated at times of rising sea level. High islands produce their own climatic differences, such as increased rainfall in mountain areas, wet and dry sides of the island and temperature gradients with altitude, each of which can lead to distinctive ecosystem components. Marine habitats are similarly affected, with the many reef forms and lagoon types determined by the structure and history of the island substrate (Thomas, 1965; Dahl, Macintyre and Antonius, 1974).

BIOMES.

Finally as ecosystems evolve, they develop their own structural characteristics based on their physiognomies or life forms, which help to determine their own environments. They may be characterised by certain dominant species or functional types, or by a particular type of habitat with which they are associated. These distinctions of biological structure and habitat provide the principal basis for defining the biomes which constitute the largest scale of functional biological unit, and thus generally correspond to the ecosystem level in any given area.

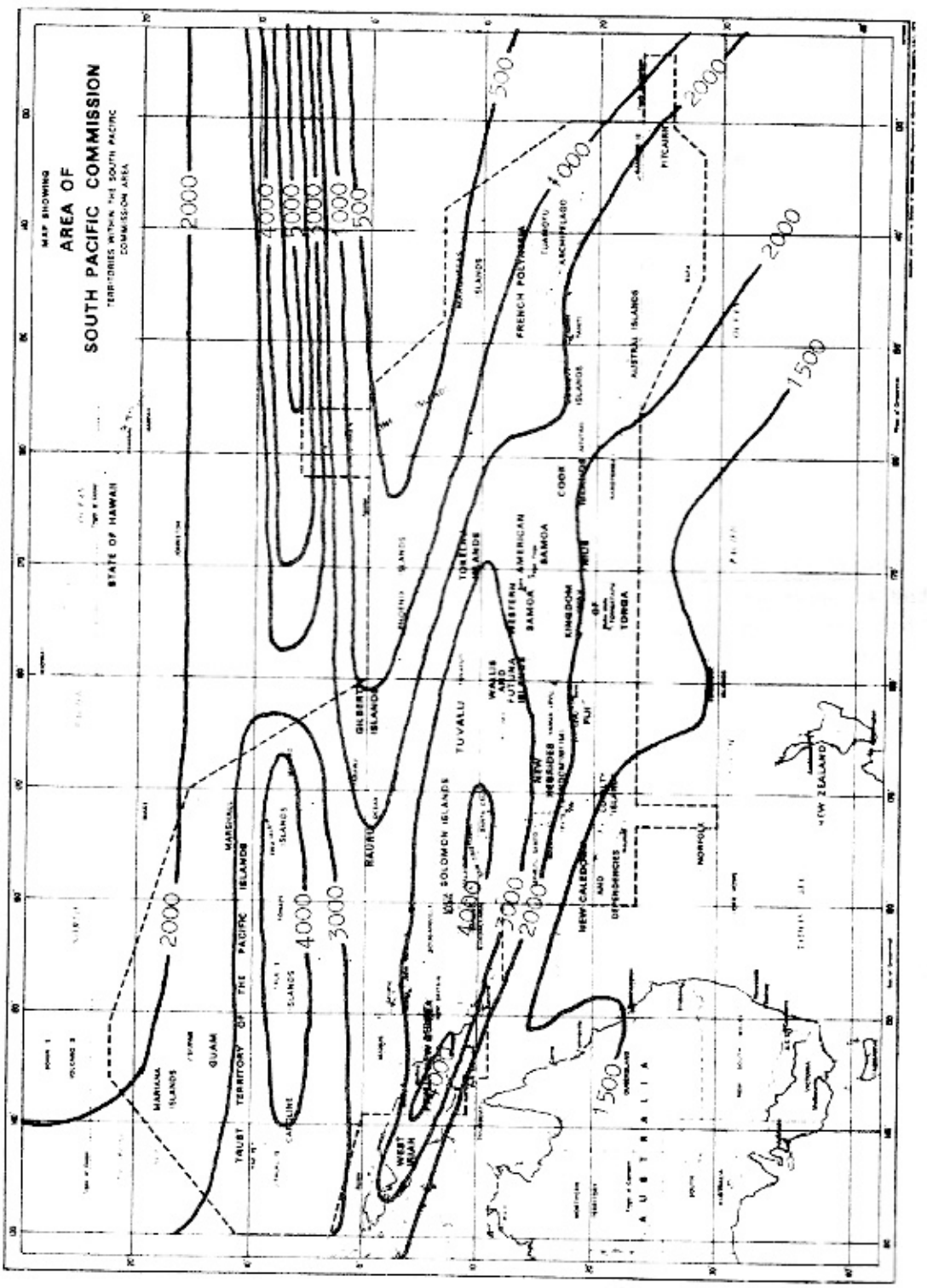

Fig. 2 AVERAGE ANNUAL RAINFALL

(after Sekiguchi, 1952, and Stoddart and Walsh, 1975)

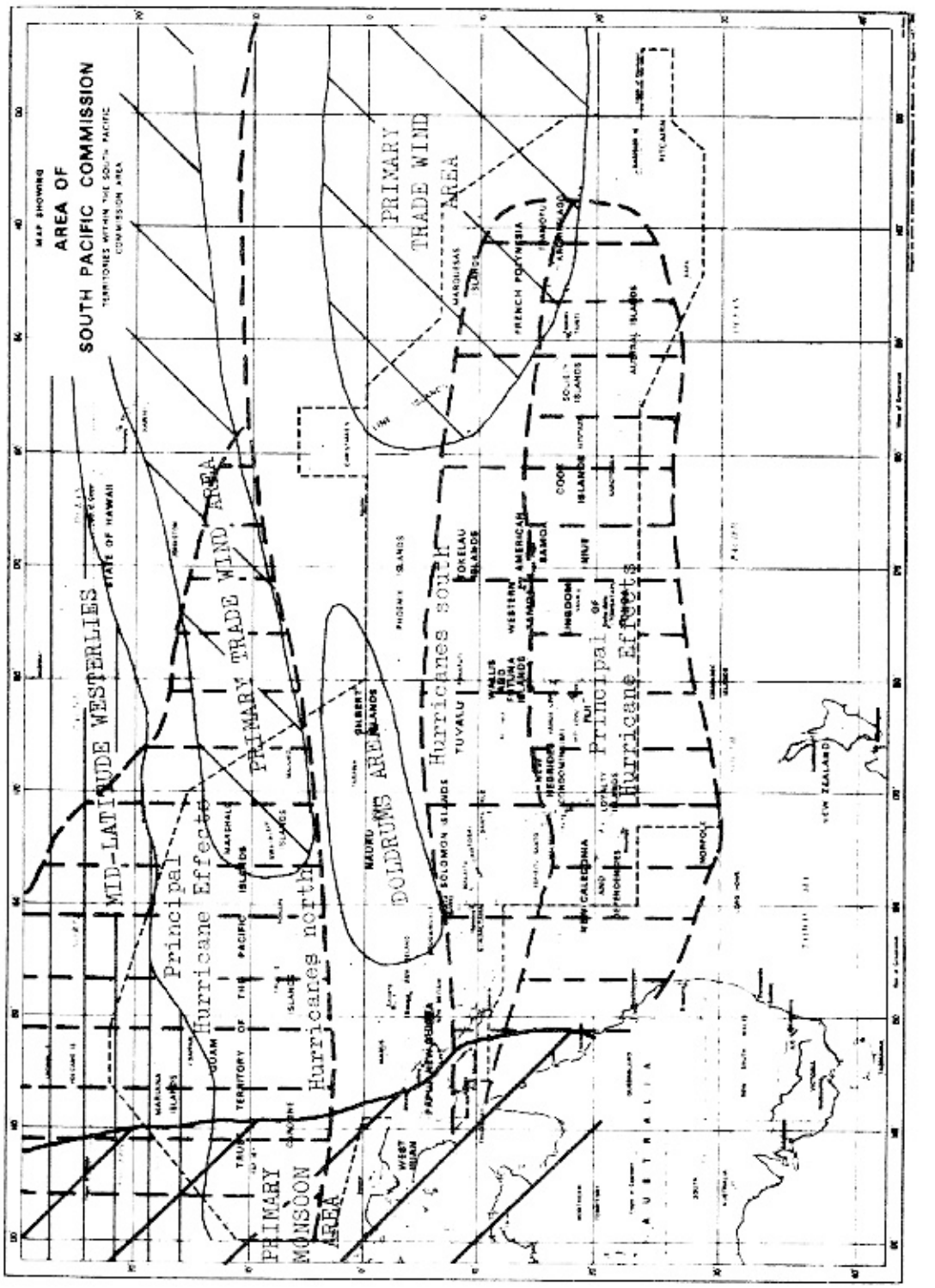

Fig. 3 CLIMATIC FACTORS

(after Thomas, 1963, and Stoddart and Walsh, 1975)

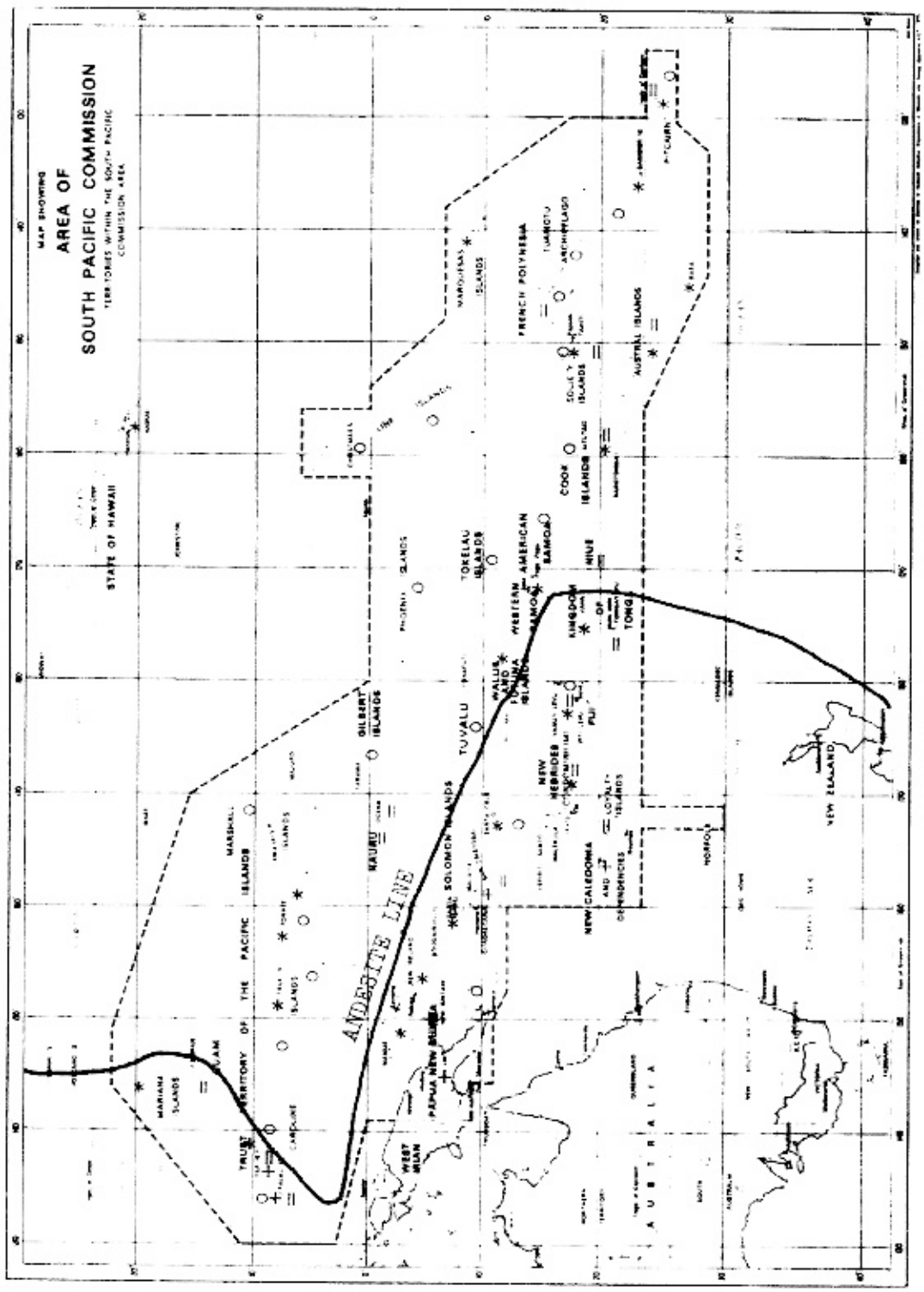

Fig. 4 DISTRIBUTION OF ISLAND TYPES

○ Atoll = Elevated reef
✱ Volcanic island + Continental island

A survey and classification of Pacific Island ecosystems must be based on all of these approaches, much as Ray (1975) has classified marine environments on the basis of zoogeographic regions, biotic provinces and habitats. This is because a biome such a lowland rain forest may be structurally and functionally similar in two geographically separate areas even though composed of different species of plants, and even in the same area may differ in composition depending on the side of the island or the kind of substrate. The following classification is based on such an approach, combining a biogeographic view embodied in a list of biotic provinces, a structural view incorporating the principal island types and a biome view catagorizing the principal vegetation units and habitats. In principle each biome type occurring on each island type or structural unit in each biotic province should be considered as a distinctive ecosystem.

REGIONAL ECOSYSTEMS SURVEY.

Biotic Provinces of the Pacific Islands.

IUCN (1974) has proposed 19 terrestrial biotic provinces for the SPC area, as follows : New Guinea, Bismarck Archipelago, Solomon Islands, New Caledonia - Loyalty, New Hebrides, Lord Howe - Norfolk, Fiji Islands, Tonga - Kermadec, Samoa - Ellice, Tokelau - Pheonix - Manihiki, Gilbert - Nauru, Mariana Islands, Caroline Islands, Marshall Islands, Johnston - Palmyra- Christmas, Cook - Austral, Society Islands, Tuamotus, and Marquesas. For the marine fauna, Ray (1975) placed the entire area within the Central Pacific Islands Subprovince of the Indo-West Pacific Tropical Warm Water Shelf Province. Ray comments that, relative to the very rich Indo-Malayan centre, the subprovince is somewhat impoverished in biota, becoming more so to the east. While there may be many marine species in common throughout the region, the biotic gradient is such that the resulting ecosystems may be quite distinctive in different areas. It would probably therefore be wise, pending firther research, to treat both marine and terrestrial ecosystems in accordance with the same series of biotic provinces. A modified list of biotic provinces is therefore proposed below and mapped in Fig. 5. Some alterations have been made in the IUCN (1974) proposals to provide more logical groupings by island structural types and climatic situations, both of which are principal biotic determinants. The Santa Cruz Islands (Solomon Islands) have been regrouped with the New Hebrides with which they have closer affinities. Tuvalu (former Ellice Is.) and the Tokelau Islands are similarly regrouped, as are the Northern Cook (Manihiki), Phoenix and Line Islands. An additional province has been created for the eastern, more temperate volcanic islands of Pitcairn, Rapa and the Gambier Islands. There may be some value in separating the Eastern and Western Caroline Islands, and in combining some of the strictly atoll provinces, but this should await further studies, particularly of the marine fauna and flora.

Biotic provinces can be most useful in suggesting the general species composition to be expected in an area. However, the high levels of endemism

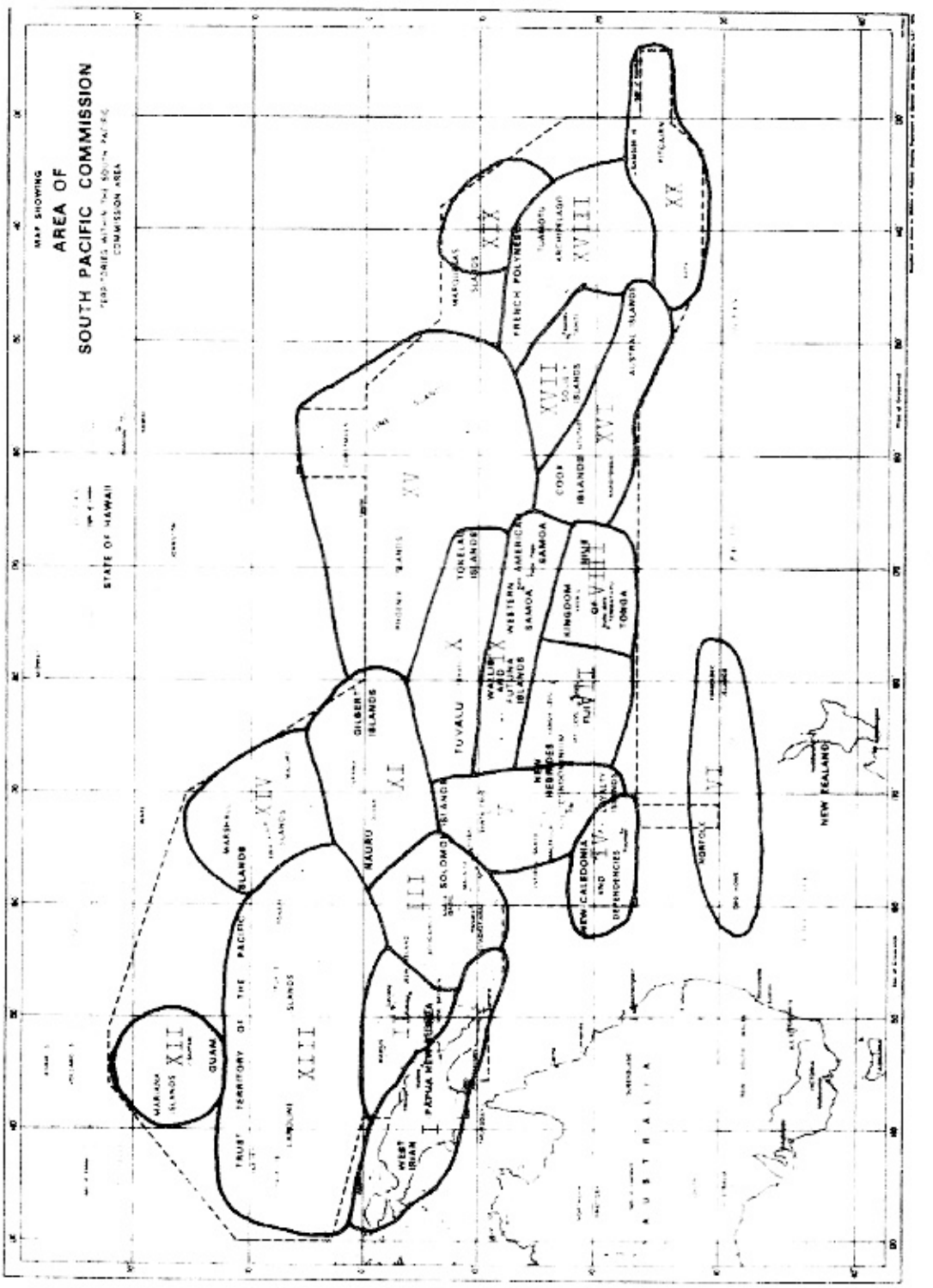

Fig. 5 BIOGIC PROVINCES

in certain islands greatly complicates matters, and requires that even within biotic provinces, each island must be considered as a somewhat distinct entity. Furthermore distinctions between provinces are not always clearcut with some islands (Loyalty Is. for example) representing intermediates between adjacent areas. This matter will be treated in more detail in the discussions of each island group.

Biotic Provinces of the South Pacific Commission Area.

(Australian Region)

Code No.	Biotic Province.	IUCN Code No.
I	New Guinea	6.12. 2
II	Bismarck Archipelago	6.12. 3
III	Solomon Islands	6.12. 4 (Modified)
IV	New Caledonia - Loyalty Islands	6.12. 5
V	New Hebrides - Santa Cruz Islands	6.12. 6 (Modified)
VI	Norfolk - Lord Howe - Kermadec	6.12. 7 (Modified)
VII	Fiji	6.12.10
VIII	Tonga - Niue	6.12.11 (Modified)
IX	Samoa - Wallis and Futuna	6.12.12 (Modified)
X	Tuvalu - Tokelau Islands	6.12.13 (Modified)
XI	Gilbert Islands - Nauru	6.12.14
XII	Mariana Islands	6.12.15
XIII	Caroline Islands	6.12.16
XIV	Marshall Islands	6.12.17
IV	Phoenix - Line - Northern Cook Islands	6.12.18 (Modified)
XVI	Cook - Austral Islands	6.12.19
XVII	Society Islands	6.12.20 (Modified)
XVIII	Tuamotu Archipelago	6.12.21
XIX	Marquesas Islands	6.12.22
XX	Pitcairn - Gambier Islands - Rapa	None

Structural Types.

The type of island on which a biological community occurs can have a major effect on the community composition, largely as a result of landform and substrate characteristics. There are four principal island types : continental, volcanic, elevated reef and sea level reef (Thomas 1965), each of which provides certain special structural characteristics. Islands are often composed of more than one type (such as an elevated coral platform or sea-level beach deposit on a volcanic island), in which case each type

should generally be considered as distinctive for purposes of ecosystem classification. The following list of structural characteristics is intended to be neither complete nor mutually exclusive, but merely to suggest certain factors which may delineate distinctive ecosystems.

Continental Type

Composed of sedimentary, metamorphic, igneous or other rocks of continental origin (occurring west of the Andesite Line), and of soils derived therefrom, generally of large size with complex landforms.

Serpentine or metalliferous soils occurring on such islands may have highly distinctive plant communities.

Slope-limited vegetation may be found in geographically active areas, where the steepness and instability of mountain sides result in specially adapted communities.

Orographic rainfall (produced by clouds rising over mountains) may be high or low depending on the situation.

Volcanic Type

Islands built by volcanic activity and therefore with substrates derived from lava (basalt) and volcanic ash.
Recent volcanic substrates may have specialised pioneer communities, and there may be many gradations between these and the mature ecosystems of weathered volcanic soils. Again there may be slope-limited communities as well as zones of high and low orographic rainfall (the wet and dry sides of many volcanic islands).

Elevated reefs

Islands or parts of islands composed of raised coral platforms or rock. Two significant types may be distinguished as having :
overlying non-calcareous soil derived from volcanic ash or alluvial deposits, or
little or no overlying soil, frequently with exposed rock in rugged karst or pinnacle formations.

Low Islands

Composed of sand and rubble accumulated on a reef platform at or near sea-level. This is the typical type on atolls and barrier reefs, and also occurs frequently as coastal or beach areas on other island types.

Similar structural criteria apply in the marine environment, particularly with respect to the nature of the substrate. The following catagories can be identified :

Rocky substrate
- calcareous
- non-calcareous

Sedimentary substrate (unconsolidated)
- gravels
- sands
- silts
- clays
- high organic content

Additionally, reef community structure can be significantly different if, over recent geological time, the island is : submerging, emerging, or apparently stationary relative to sea level. Exposure to waves and storms also alters ecosystem form, so distinctions between exposed and protected marine environments are appropriate in many instances.

The above catagories will generally be useful to subdivide the biome types described below where it is apparent that there is considerable ecosystem diversity within the biome. It is not, however, practical to introduce most of these distinctions at the level of the present study.

Pacific Island Biomes

A biome is the largest biological community unit and generally, either singly or in some combination, corresponds to an ecosystem type. Biomes are usually defined by major habitat distinctions, by dominant species or by aspects of the community structure. On land, most biomes are distinguished by the principal type of vegetation; in the sea, environmental or substrate factors may be as important as dominant plants or benthic (bottom dwelling) animals in determining a biome classification. The following biome classification for the tropical Pacific Islands is based on the vegetation classification prepared by IUCN (1973) for terrestrial environments, and the habitat list for marine areas proposed by Ray (1975), with major modifications and additions as appropriate to integrate the two and to adapt them to the regional situation. The vegetation classification, drawn largely from that for the humid tropics, has been simplified by the elimination of certain catagories; it may be that others can be deleted as well, or that some will need to be added for particular local situations (such as the barren desert catagories for recent volcanic deposits).

In classifying marine biomes, it is important to recognise that biological communities may exist in the water mass as well as on the bottom. These can sometimes be considered together as single ecosystems; in other situations it is more convenient to separate them. Certain coastal biomes such as mangroves and salt marshes have both terrestrial and marine components. A few organisms such as sea birds, sea turtles and migrating fish populations, move between biomes and thus must be given special treatment.

	IUCN Number.
FORESTS formed by trees at least 5m tall with crowns usually interlocking.	1.
Mainly evergreen	1.1.
Tropical rain forests Consisting mainly of evergreen trees, many with little or no bud protection, neither cold nor drought resistant. Truly evergreen, i.e. the forest canopy remains green throughout the year, but individual trees may stand leafless for a few weeks only and not at the same time with all others.	1.1.1.
Lowland rain forest Composed usually of numerous species of fast-growing trees, many of them exceeding 40m in height, generally with smooth, often thick bark, some with plank buttresses. Emergent trees often present or at least a very uneven canopy. Very sparse undergrowth, and this composed mainly of young trees. Palms and other tuft trees usually rare. Crustose lichens and green algae are the only constantly present epiphytic life forms; vascular epiphytes are usually not abundant except in excessively humid situations.	1.1.1.1.
Montane/submontane rain forest Emergent trees largely absent and canopy relatively even. Vascular epiphytes and pseudo-lianas abundant. Tree heights usually less than 50m; crowns extending relatively far down the stem. Bark often more or less rough. Undergrowth abundant often represented by tree ferns or small palms or bamboos. May be dominated by trees which are broad-leaved (commonest form), needle-leaved or small-leaved.	1.1.1.2.
Bamboo forest Dominated by bamboo. Common in tropical mountains but may occur also in temperate and tropical lowlands.	1.1.1.3.
Cloud forest Tree crowns, branches and trunks as well as lianas burdened with epiphytes, mainly bryophytes or lichens. Ground covered with club mosses and ferns. Trees often gnarled, with rough bark and rarely exceeding 20m in height. Most commonly broad-leaved but may be needle-leaved or small-leaved.	1.1.1.4.
Riverine forest Similar to submontane forest, but richer in palms and in undergrowth life-forms, particularly tall forbs (e.g. Musaceae); plank-buttresses frequent. Characteristic of areas which are: (1) riparian (on the lowest forested river banks, frequently flooded); (2) occasionally flooded (on relatively dry terraces accompanying active rivers); or (3) seasonally waterlogged (along the lower river courses, where the water accumulates on large flats for several months).	1.1.1.5.

IUCN Number.

Swamp and bog forest — 1.1.1.6.
Not along rivers, but on wet soils, which may be supplied with either fresh or brackish water. Similar to riverine forest, but relatively poor in tree species. Many trees with buttresses, stilt roots or pneumatophores; mostly taller than 20m, dominated by broad leaved trees or palms. Where organic surface deposits occur, poor in tree species and with canopy often forming a pattern of tall trees at the bog fringe and shorter trees near the centre.

Tropical/subtropical seasonal forest — 1.1.2.
This is transitional between rain forest and semi-deciduous forest. Consists mainly of evergreen trees with some bud protection. Foliage reduction during dry season is noticeable, often as partial shedding.

Tropical/subtropical semi-deciduous forest — 1.1.3.
Most of upper canopy trees drought deciduous. Understorey trees and shrubs evergreen, often sclerophyllous. Various mixtures occur (e.g. shrubs may be deciduous and trees evergreen). Trees rough-barked except for bottle trees which may be present.

Other evergreen forests.

Subtropical rain forest — 1.1.4.
Grading into tropical rain forest but marked by more distinct seasonal rhythms. Trees less vigorous than in tropical forest and more shrubs are present in understorey. Subdivisions similar to those of tropical rain forests may be noted.

Mangrove forest — 1.1.5.

Sclerophyll broad-leaved trees and shrubs with either stilt roots or pneumatophores. Occurs in tidal range along ocean shores and estuaries. Epiphytes, except lichens or algae, are rare.

Atoll/beach strand forest — none

Species-poor community of trees and shrubs occurring on calcareous sand and rubble deposits in islets and on coastal beach strand within a few metres of sea level.

WOODLANDS — 2.
Formed by trees at least 5m high, with most of their crowns not touching each other, but covering at least 30% of the surface; grass or shrub cover sometimes present. This formation class does not include savannas or parklands.

SCRUB — 3.
Shrublands or thickets. Mainly composed of woody shrubs to 5m high. Each of the subdivisions may either be :
shrubland - most of the individual shrubs not touching each other; often with a grass stratum; or
thicket - individual shrubs interlocked.

	IUCN Number.
SERPENTINE VEGETATION Plant communities adapted to metalliferous serpentine soils. This substrate condition can also be used as a subdivision of other vegetation types.	None.
DWARF SCRUB AND RELATED COMMUNITIES Woody plants rarely exceeding 50cms in height (sometimes called heaths or heath-like formations).	4.
Mainly evergreen	4.1.
Dwarf-shrub heath Closed or open cover of dwarf shrubs often with moss or lichen understorey. When open, often in clumps, colonies, or cushions and may have forb or grass cover in open areas.	4.1.1.
Bog Often sedges are abundant. Sphagnum or other moss cover; Peat accumulation. Some woody shrubs may be present.	4.3
HERBACEOUS	5.
Savanna Tropical or sub-tropical grasslands or parklands with trees and shrubs covering not more than 30% of the ground.	5.1.
Woodland savanna Dominated by grasses with forest islands or patches or woodland.	5.1.1.1.
Tree savanna Grass cover with isolated trees dispersed regularly over the area.	5.1.1.2. and 5.1.2.1.
Shrub savanna Thickets or shrublands in an area dominated by grass.	5.1.1.3. and 5.1.2.2.
Tropical grassland. Grass with few or no woody plants.	5.1.1.4. and 5.1.2.3.
Flood savanna Grass periodically flooded with tree or scrub islands.	5.1.1.5.
Wetlands	5.5.
Fresh water marsh Herbaceous formations on constantly or periodically flooded and waterlogged ground without or with few woody plants (Carex, Juncus, Cynerus, Scirpus are characteristic genera).	5.5.1.
Salt marsh Salt tolerant herbaceous or partly-woody formations in areas periodically or constantly flooded or waterlogged. Water saline or alkaline.	5.5.2.

IUCN Number.

Tidal salt marsh -
With marine environment subject to tidal flooding.

Non-tidal salt marshes and flats. -

BARREN DESERT 6.
(Should also be applicable to recent volcanic deposits).

Rock Desert 6.1.
Ground surface dominated by bare rocks or screes with occasionally plant cover in crevices, fissures etc.

Sand desert 6.2.
Ground surface dominated by wind-blown sand, often forming dunes. Vegetation scarce or absent.

FRESH WATER ENVIRONMENTS

Aquatic vegetation

Floating meadow 5.6.1.
Densely interwoven or matted forbs and/or mosses covering permanent fresh water. Woody plants may be present.

Reed swamp 5.6.2.
Tall reeds rooting in soil at bottom of shallow lakes, ponds, or slow moving rivers.

Submerged rooted aquatics 5.6.3.
Water areas dominated by rooted plants which are structurally supported by water and scarcely emergent.

Floating aquatics 5.6.4.
Water areas dominated by non-rooted floating plants.

Bodies of Water

Lake and pond

Open areas of standing water.
Permanent with more or less constant level.
Intermittent filling during rains, then gradually drying out.
Brackish - standing bodies of somewhat saline water without direct connection with the sea.
Man-made - artificial impoundments.

Mountain stream

Fast flowing steeply falling water courses often with rocky bed.

Lowland river and stream

Slow-moving water courses usually with sedimentary bottoms.

ANIMAL DOMINATED TERRESTRIAL HABITATS

Sea bird rookeries
Areas predominantly covered by seabird nesting sites.

Sea turtle nesting areas
Sand areas frequently used as nesting sites by sea turtles.
Similar catagories for other organisms may be developed where locally appropriate.

Cave
Subterranean passages with distinctive terrestrial or aquatic cave faunas.

SHALLOW COASTAL ENVIRONMENTS

Submarine vegetation bed
Plants rooted in sedimentary bottoms, attached to rock pavements, or in loosely-anchored mats.

Algae Bed

Dominated by benthic algae or seaweed.

Sea grass bed

Principal components marine vascular plants (Thalassia, Cymodocea, Syringodium, Halophila, etc.)

Animal dominated sedimentary bottom
Burrowing animals predominant life forms.

Coral Reef
Calcareous structures being actively constructed by skeletal deposition of organisms.

Algae dominated

Coralline algae principal contributor to reef construction and surface cover.

Coral dominated

Hermatypic corals major contributor to community and reef structure.

Reefs may also be subdivided by situation and form.

Atoll Reef

Reefs between the ocean and a lagoon unassociated with any major landmass.

Windward
Fronting on the ocean in the direction of the predominant winds.

Leeward
On the more sheltered side of the atoll downwind from and therefore frequently receiving outflow from the lagoon.

Barrier reef

Offshore from a major land mass and separated from it by a lagoon.

Fringing reef

Growing directly out from the coastline and not separated from it by more than a shallow depression.

Lagoon or patch reef

Reef structures developing in the sheltered waters of a lagoon.

"Dead" Reef

Calcareous reef structure now covered with organisms not contributing significantly to skeletal accumulation.

Drowned reef

Reefs submerged by subsidence below depths at which reef growth is sufficient to regain the surface.

Rocky coastline.

Non-calcareous or uplifted calcareous shorelines without significant reef development, including both the intertidal zone and the subtidal euphotic region (in which light penetration permits plant growth).

Beach

Shorelines with unstable sand deposits.

Lagoon

Bodies or water more or less cut off from the sea by reefs or other barriers. Amount of isolation best indicated by salinity.

Saline

Salinity greater than seawater. (Hyperhaline, over 40 o/oo salinity)

Open

Seawater - good mixing with open sea. (Euhaline, 30-40 o/oo)

Closed

Close to seawater in salinity, but little mixing or interchange with the sea. (Mixeuhaline)

Dilute

Dilute sea water. (Polyhaline, 18-30 o/oo)

Brackish

Brackish water. (Mesohaline, 5-18 o/oo)

Fresh water

Fresh or slightly salty water. (Oligohaline less than 5 o/oo)

Estuaries
Partly enclosed bodies of water where rivers or other inputs of fresh water flow into and mix with seawater, producing great and often variable salinity gradients. It may in some instances be appropriate to subdivide estuaries by salinity.

Close to seawater
Mixohaline (30-35 o/oo salinity)

Dilute seawater
Polyhaline (18-30 o/oo)

Brackish water
Mesohaline (5-18 o/oo)

Nearly freshwater
Oligohaline (0.5 -5.0 o/oo)

Marine lake
Inland bodies of seawater with subterranean connections permitting some exchange with the sea.

Marine cave
Caves partly or completely filled with sea water.

Man-made Environments

Spoil
Dredged spoil and other dumped sedimentary materials.

Reef
Artificial reefs and structures made of stable materials.

Maricultural
Enclosures and other structures created or modified for the cultivation of selected organisms.

DEEP OFFSHORE ENVIRONMENTS

Offshore terrace
Horizontal or gently-sloping bottom areas below 20m depth on the offshore slope.

Offshore slope
Vertical or steeply-sloping bottom areas of island margins below the euphotic zone.

Continental shelf
Submarine extensions of continental land masses.

Submarine canyon
Canyon-like features in the continental shelf margin.

Continental slope
Continental shelf margins.

Offslope environments.
Deep ocean bottom features.

Abyssal plain

Submarine trench

Submarine ridge

Seamount

WATER CIRCULATION BODIES

Inshore circulation cell
Biological communities maintained within an inshore current system.

Larger scale circulation cell

Upwelling system
Pelagic communities maintained by upwelling of nutrient-rich water from ocean depths.

Ecosystem occurrence.

A simplified list of over 70 ecosystem types has been prepared from the biome list deleting the man-made catagories and some sub-catagories. This list is presented together with the four principal island types, in a matrix with the biotic provinces of the SPC area to illustrate the distribution and occurrence of ecosystem types (Fig. 6). The approximately 600 ecosystems so identified are much less than the total probable number of about 2000, since the biomes occurring on the different island types, and those modified by substrate, slope exposure, rainfall, etc. have not been distinguished.

GEOGRAPHIC REPORT.

The following sections summarize the conservation situation in each Biotic Province of the South Pacific Commission area. Authoritative sources have been used whenever possible, but these are often incomplete or out of date. It would be appreciated if participants in the Symposium could correct and update any sections for which they have more information, as the report will be revised for publication immediately after the meeting.

For each biotic province, the following information is given:

responsible governments; island types and significant climatic factors; a list of biomes (as presently known) with notes on occurrence, significant features, and conservation status; general conservation interest of the region; a list of rare or endemic species; the status of conservation legislation; lists of existing reserves, proposed reserves (areas already identified locally as warranting some type of protected status), and recommended reserve types; and major references and sources from which the report was compiled.

An essential companion reference for major parts of the survey area (excluding New Guinea, Bismarck Archipelago and Solomon Islands), is the Draft Check List of Pacific Oceanic Islands by G. Douglas (1969). This list provides summary descriptive information on each island, which is therefore not repeated here. Other frequently-consulted references include the reports of regional meetings (SPC, 1973; National Parks Authority, N.Z., 1975) and the early Pacific Science Association survey (Skottsberg, 1940).

I. NEW GUINEA.

(Only eastern half of island is included in survey area).

Government: Papua New Guinea (Independent).

Island types: Large continental island of great complexity; low reef islands and volcanic islands occur in surrounding coastal areas.

Biomes.

Note: because of the great complexity of New Guinea, the following outline cannot be considered complete, but merely a suggestion of the types of ecosystems that occur in great diversity throughout the island. For further detail, see Specht, Roe and Boughton, 1974.

Biome type.	Description, occurrence.	Conservation status.
Lowland rain forest	Below 1200 m.	
	1) Valley lowland forest. Terminalia, Pometia. etc.	none
	2) Lowland slope forest. Terminalia, Celtis, Myristica, etc.	Variarta. Mt. Wilhelm.
	3) Mixed casuarina cunninghamiana fan forest: N.E. PNG.	none
	4) Eucalyptus delgupta/Casuarina forest N.W.PNG.	none
	5) Secondary lowland rainforest, Ficus, Vitex, Pipturus.	Variata
Montane rain forest	above 1,200m	
	1) submontane Araucaria/Arathis forest 600-1500m.	McAdam.
	2) submontane Lithocarpus forest 600-1800 m	none
	3) submontane Castanopsis forest 600-1800 m	McAdam
	4) submontane secondary forest, Ficus, Evodia Urticaceae, etc.	none
	5) submontane Gymnostoma forest, Owen Stanley Range 300 - 1200 m.	none
	6) submontane pioneer forest Casuarina papuana, Dacrydium, Neonauclea on rock slides and limestone pinnacles 300-1000 m.	none
	7) Nothofagus forest - 1500-2800 m	none
	8) Mixed montane fern forest, Syzygium, Cryptocarya Elaeocarpus, Garcinia, Schizomeria, Dryadodaphne 1200 - 2500 m.	Mt. Wilhelm.
	9) Mixed montane gymnosperm forest, Podocarpus Phyllocladus, Papuacedrus 2100-2800 m.	none
	10) Montane secondary forest, Evodia, Pittosporum, Urticaceae, Rhododendron, 1800 m. to tree line.	none
Bamboo forest	Montane areas, Bambusa, Cyathea.	McAdam
Cloud forest	2800 m. to tree line with Decaspermum, Syzygium, Xanthomyrtus, Olearia, Pittosporum, Rapanea, Rhododendron, Vaccinium.	Mt. Wilhelm
Riverine forest	1) Dillenia papuana	none
	2) Octomeles/Artocarpus on banks subject to flooding.	none

Biome type.	Description, occurrence.	Conservation status.
Swamp forest	Extensive in Sepik, Western and Gulf Provinces.	
	1) Calophyllum, Campnosperma, etc.	none
	2) Sago swamp, Metroxylon rumphii.	none
	3) Pandanus swamps	none
	4) Melaleuca swamp	none
Seasonal forest	Low hills slopes; slightly deciduous. Bombax, Erythrina, Tetrameles, Pterygota, etc, generally in monsoonal areas.	Variarta
Mangrove forest	Extensive areas in Gulf of Papua.	
	1) Rhizophora/Bruguiera	none
	2) Avicennia/Ceriops/Rhizophora	none
	3) Sonneratia - freshwater tidal areas.	none
Atoll/Beach forest	Cerbera, Calophyllum Hibiscus, Desmodium, Pandanus, Casuarina equisetifolia, Pemphis acidula.	Cape Wom
Woodlands	1) Eucalyptus or paperbark (Melaleuca) species on dry monsoonal regions of southern and north eastern PNG - variable density grading into tree savanna.	none
	2) Timonius woodland; Port Moresby, Kairuku area.	none
	3) submontane woodland, Eucalyptus tereticornis, 500 - 1200 m. monsoonal parts of S.E. PNG.	Variarta.
Scrub	1) Semideciduous scrub, Flindersia, Tristania, Mangifera, Syzygium, Acacia in monsoonal areas.	none
	2) Tidal plains scrub, Acacia/Myoporum in monsoonal areas.	none
	3) Lumnitzera scrub of low inner beach ridges.	none
	4) Batis argillicola scrub. Morehead-Kiunga area.	none
	5) Submontane scrub, Baeckea frutescens/Rhododendron, on siliceous soils at Green River, Telefomin and Normanby Island.	none
	6) Montane scrub (2000 - 3800 m) Rhododendron, Vaccinium, Pittorsporum, Trochocarpa.	none
Dwarf-shrub heath	1) Myrtaceous - ericareous heath, local in Morehead, Kiunga and Green River areas of Central PNG.	none
	2) Alpine dwarf-shrub heath, above 2,700 m.	none
Tree savanna	1) With Eucalyptus, Melaleuca; low monsoonal parts of S.E. PNG.	Variarta
	2) Pandanus savanna - Port Moresby, Kairuku areas.	none
Grassland	1) Lowland grassland up to 1800 m. with Imperata, Ophiures, Ischaemum, etc.	none
	2) Montane grassland, 1000-2500 m. Miscanthus, Ophiurus Themeda, both largely resulting from human activities.	

Biome type.	Description, occurrence.	Conservation status.
Grassland (contd)	3) subalpine and alpine grasslands, above 3000m.	Mt. Wilhelm.
Flood savanna	In S.W. PNG.	none
Alpine meadow	Meadow, fern meadows, mosses, bogs, above tree line from 3200 to 4100 m. mountain peaks all along central range.	none
Freshwater marsh	Sepik area and S.W. PNG.	none
Tidal salt marsh	with Nypa fruticans.	none
Non-tidal salt marsh	with Sporobolus, Triochloa.	none
Floating meadows	Leersia, Echinochloa, in lowland swamps.	none
Reed Swamp	Lowland swamps with Saccharum, Pragmites.	none
Submerged aquatics	Present.	none
Floating aquatics	Nymphoea/Azilla in swamps.	none
Permanent lake	Present.	none
Mountain stream	Common	in some parts
Lowland river	Common, some very large.	none
Seabird rookeries	Presumably present	none
Sea turtle nesting areas	Presumably present.	none
Cave	In highlands with distinctive terrestrial aquatic faunas	none
Algal bed	Common	none
Sea grass bed	Common and extensive.	none
Animals in sediments	Common	none
Algal reef	Present	none
Coral reef	Common and complex.	none
Windward atoll reef) Leeward atoll reef)	Conflict group, Torlesse Is., Redlick. Egum, Laughlan, etc.	none
Barrier reef	Extensive in eastern PNG both continental and insular types.	none
Fringing reef	Common	none
Lagoon reef	Many types	none
Dead reef	Present	none
Rocky coast	Present	none
Beach	Common	none
Open lagoon	Many types in complex of reefs in east PNG.	none
Estuary	Several, including large areas along Gulf of Papua.	none
Offshore environments.	No data available	none

Conservation interest.

Outstanding interest for fauna and flora, terrestrial and marine environments. Great diversity of biomes and species. Marine environment very little studied, so true conservation interest not yet known.

Rare or endemic species.

Many endemic birds, particularly Birds of Paradise and other unusual forms.

Some endangered species are :

Epimachus fastosus
Paradisaea rudolphi
Parotia spp.
Loria loriae.
Drepanornis spp.
Archboldia papuensis.
Astrapia rothschildi.
Astrapia stephaniae.
Pteridophora alberti.

There are numerous endemic plants, marsupials, insects and other forms of fauna and flora.

Conservation Legislation.

National Parks Ordinance, with parks placed under supervision of a National Parks Board.

Fauna Protection Ordinance allows establishment of sanctuaries and protected areas for particular species.

Wildlife Management Areas can be established under local management committees.

Existing reserves.

Variarta National Park, near Port Moresby.	Lowland slope forest, seasonal forest, secondary lowland forest, submontane woodland, tree savanna. Rich wildlife.	Declared.
McAdam National Park, near Bulolo.	Submontane *Castanopsis* forest, bamboo forest, submontane *Araucaria* forest with *A. cunninghamii* and *A. hunsteinii*. Bird of Paradise, marsupials.	Declared.
Cape Wom International Memorial Park near Wewak.	Historic site with Atoll/beach forest.	Declared.
Mt. Wilhelm National Park, near Goroka.	Alpine grassland, cloud forest, montane and lowland forest types, marsupials and birds.	Approved.
Kokoda National Walking Track.	Spectrum of vegetation types, grassland to Cloud forest, wildlife and butterflies.	Approved
Tonda Wildlife Management Area, Western District.	Deer, water birds, wallabies.	
Baniara Protected Area, Baniara Island, Milne Bay.	Wallabies.	

Proposed reserves.

Mt. Bosavi National Park, Western Province.	Typical lowland to montane forest types, Nothofagus forest, cloud forest.
Mt. Karamui National Park, Chimbu Province.	Lowland forest to Cloud forest, unique birds, kangaroos, and other wildlife.
Mt. Giluwe National Park, Southern Highland Province.	Alpine biomes. Nothofagus and cloud forest.
Long Island Provincial Park, off Madang.	Crater Lake, Megapode volcanic sands, Coral reefs, turtle nesting area.
Asuar Bluff Provincial Park, near Madang.	Caves with cave fauna, lowland rain forest.
Rempi Islands Provincial Park, near Madang.	Mangrove forests, secondary lowland rain forest coral reef, migratory birds.
Embi Lakes National Park, Northern Province.	Lakes with flood plain, swamp and rainforest, birds and crocodiles.
Kinikini Area Provincial Park, near Port Moresby.	Tree savanna.
Mt. Kemenagi Provincial Park, Southern Highlands Province.	Karstic limestone topography, swamp and montane forest.
Idlers Bay Provincial Park, near Port Moresby.	Grassland- woodland, beaches and coral reef.

Garu Wildlife Management Area.

Ialibu Wildlife Management Area, Mendi, Southern Highlands.

Maprik Bird of Paradise Management Area, East Sepik.

Dilava - Kubuna Management Area.

Wallaby Management Area.

Western District Deer Park.

Recommended reserve types.

For bird life, reserves in the following areas are recommended:

Southeastern islands of Papua New Guinea. Goodenough mountains, Goodenough lowlands, Fergusson, Kiriwina, and Tagula are major centers; Woodlark, Misima and Rossel, minor ones.

Mountains of Papua New Guinea. The Central Dividing Range includes three portions with somewhat distinct faunas: in the east, the Wharton Range and Owen Stanleys; in the center, the highland area from Tari and Wabag to Menyama (the area that includes Mts. Hagen, Giluwe, Karimui, Wilhelm, etc.); in the west the area from 142° E to the border of West Irian. In each area, altitudinal transects from 1500 ft. to the highest elevations should be provided, because each species lives in a characteristic altitudinal range (e.g., a reserve at 4000-8000 ft., no matter how huge, would not help the many species confined to elevations above 8000 ft. or below 4000 ft.) Also, in each area such transects should be provided both on the northern and southern watersheds, because of their distinct faunas. Three outlying mountain ranges have distinct montane faunas of their own that also require altitudinal transects: the mountains of the Huon Peninsula, the Adelbert Mountains, and the North Coastal Range (especially the Bewani Mountains).

Recommended reserve types (contd.)

Lowlands of Papua New Guinea. There are five major centers of endemism: the Sepik Basin; the Huon Peninsula, with the Markham and Ramu Valleys; the north slopes of southeast New Guinea, from Huon Gulf to Collingwood Bay; the south slopes of southeast New Guinea, from Samarai to the head of the Gulf of Papua; and the Fly River bulge. The Fly and Sepik regions have large water and swamp faunas, and the Fly and south-slopes-of-southeast-New-Guinea regions have large savanna faunas, that should be considered in addition to their forest faunas.

The following sites have been proposed by various authors:

Gulf district mangrove forest.
Mount Victoria.
Rossel Island - unique flora, coral reef habitats.
Morobe Islands - bird and turtle breeding area, marine life.
Lake Murray - lake fauna and bird life.
Lake Yimas and Sepic Plains, forest with orchids (Dendrobium ostrinoglossum.)
Murray Pass area, western slopes of Mt. Albert Edward, alpine swamps and orchids.
Middle Musa area - savanna; lake site for hydroelectric scheme.
Coastal forest S.E. of Lae opposite Lasanga Is., botanically interesting liana habitat.
Mt. Menawa, endemic birds.
Laba and eastern slopes of Herzog Ranges, to Mt. Missim.
Southern Coast of Huon Peninsula, lowland forest types, between Lae and Finschaffen.
Lake Wanum - lowland grassland types.
Bulolo, Lake Triste, Mt. Amungwiwa - Mt. Salawaket, for Araucaria, Podocarpus, and Nothofagus forests.

Purari River aquatic habitats.

The proposals by Haantjens (1975), too numerous to include here, include many biome types presently underrepresented in reserve proposals being considered.

Coastal West Sepik province - Dugong conservation area.
Possible further dugong conservation areas in Siassi Islands and D'Entrecasteaux Group.

An attempt should be made to include typical as well as rare biome types in reserve proposals. Many more marine reserve areas will eventually be needed but present information does not permit specific proposals.

References and sources.

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R.J. Johns, "Habitat Conservation in Papua New Guinea", paper presented at Symposium on Ecology and Conservation, Wau, 1975.
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II. BISMARCK ARCHIPELAGO.

Government: Papua New Guinea. (Independent)

Island types: Volcanic high islands and low reef islands.

Biomes.	Description.	Conservation status.
Lowland rain forest	Extensive, also Eucalyptus deglupta forest - New Britain.	Talele Is. Lake Dakataua.
Montane rain forest.	Parts of central New Britain, eastern New Ireland, including Nothofagus forest 1500 - 2800 m.	none none
Bamboo forest	Probably present	none
Cloud forest	Probably present.	none
Riverine forest	Present	none
Swamp forest	Coastal north-central New Britain. Terminalia brassii and Campnosperma.	none
Mangrove forest	North New Britain, New Ireland, New Hanover	Talele Is. Lake Dakataua.
Atoll/Beach forest	Common	Talele Is.
Scrub	Present	none
Grassland	Large areas of coastal, especially north coastal, New Britain.	none
Freshwater marsh	Present	none
Non-tidal salt marsh.	Presumably present.	none
Rock desert	Active Volcanic areas.	none
Permanent lake.	Lake Dakataua (crater lake) : Lake Hargy.	proposed L. Dakataua National Park.
Mountain stream	present	none.
Lowland river	Present.	none.
Seabird rookeries	Present.	Talele Is.
Sea turtle nesting areas.	Present.	Talele Is.
Algal bed.	shallow bottom areas.	?
Seagrass bed	Common	?
Animals in sediments.	Common	?
Coral reef	Common and diverse.	Talele Is.
Barrier reef	Present	?

Biomes.	Description.	Conservation status.
Fringing reef	Common	Talele Is.
Lagoon reef	Many types.	Talele Is.
Rocky coast	Present.	none
Beach	Common	Nanuk Is.
Open lagoon	Present.	?
Estuary	Present	none.
Offshore environments.	No data available.	none.

Conservation interest.

There is little data on these large islands with a considerable diversity of habitats.

Rare or endemic species.

Considerable bird endemism, and presumably also for other forms.

Conservation legislation.

see New Guinea.

Existing reserves.		status.
Talele Islands National Park, New Britain.	Mangrove, Beach forest, lowland secondary forest, coral reefs, seabird and turtle nesting areas.	Declared.
Nanuk Is. Provincial Park, New Britain.	Marine life and island vegetation, recreation area.	Declared.
Lake Dakataua National Park, New Britain.	Crater Lake, hot springs, mangrove, secondary rain forest Crocodiles, Megapode.	Approved.
Pokili Wildlife Management Area, West New Britain.	Megapode.	

Proposed reserves.

Lake Hargy National Park, New Britain.	Lake, lowland and slope rain-forest, Megapode.
St. Andrew Islands. S.E. of Manus Island.	Dugong conservation area.

Recommended reserve types.

Kapiura River area, New Britain. hot springs, Megapode.
Talasea Peninsula, hot springs, megapode.
Mount Langia, West New Britain, semi-active volcano.
Central mountain areas of New Britain and New Ireland for montane biomes.
Swamp forest, marsh, river and grassland examples.
A selection of coastal, lagoon and reef environments.
For birds, and probably other forms, New Britain, New Ireland, St. Matthias-Mussau, and Manus are the four major centers. New Britain requires a reserve on the Gazelle Peninsula (because of some endemism there) as well as on the main body of the island. New Ireland requires separate reserves at the northern and southern ends, because of significant faunal differences

Recommended reserve types (contd.)

Like Bougainville, and New Caledonia, New Britain and New Ireland have distinct montane and lowland faunas, and both need montane as well as lowland reserves. Dyaul, Lihir, Feni, and Tabar are significant minor centres. Long should be a reserve because of the interest of its colonist fauna (it was defaunated by volcanic explosion in the 18th century, like Krakatau).

References and Sources.

See New Guinea.

II SOLOMON ISLANDS.
(Santa Cruz Islands included in V.)

Government: Solomon Islands (Self government, U.K.) except Bougainville (Papua New Guinea.)

Island Types: High volcanic islands both old and recent, and elevated reef islands. Subject to hurricanes.

Biomes.	Description.	Conservation status.
Lowland rain forest.	1) Kauri forest,	none
	2) Campnosperma forests - probably late stage following cyclonic disturbance	none
	3)Calophyllum Kajewskii forest, mostly logged; Gizo Is. and small patches, and on Bougainville	none
	4)Dillenia/Calophyllum/Campnosperma forest, New Georgia, Kolombangara.	small sample on Kolombangara
	5)Dillenia - dominated forest	small sample on Kolombangara.
	6)Terminalia calamansanai/Campnosperma/ Calophyllum forest, only Northern Kolombangara.	Kolombangara controlled forest.
	7)Pometia/Vitex/Calophyllum forest. coastal areas largely disturbed; inland Guadalcanal.	Queen Elizabeth National Park, ? degraded.
	8)Vitex - dominated forest - rare. Tetepare.	none
	9) Casuarina papuana forest of high ridges.	none
	10) Rennell forest, Terminalia sepicana, Elaeocarpus, Endospermum.	none
Montane rain forest.	1) Mixed species with indistinct zonation, possibly several types on upper slopes of Kolombangara, Vanguna and Bougainville.	small example on Kolombangara
	2)Neonauclea/Sloanea forest only Bougainville 450-750 m	none
Cloud forest	Present on mountain peaks	none
Riverine forest	with Dillenia ingens.	none
Swamp forest	1) Sago swamp forest (Metroxylon salomonense)	none
	2) Terminalia brassii forest	none
	3) Mixed species swamp forest.	none
Mangrove forest	1) Tall (Rhizophora, Bruguiera, Dolichandrone)	none
	2) Low (Rhizophora.)	
Atoll/Beach forest	Typical Indo-malesian species	none
Woodland	Casuarina - dominated.	none
Scrub	San Jorge - variant of Casuarina woodland.	none

Biomes.	Description.	Conservation status.
Serpentine vegetation	Open woodland on ultrabasic soils, southern Santa Isabkel San Jorge, southern Choiseul; also Guadalcanal, Florida, San Cristobal.	none
Dwarf-shrub heath.	Nggatokano and elsewhere	none
Grassland	Large areas of Guadalcanal, fire maintained.	Queen Elizabeth National forest disturbed.
Freshwater marsh	Mainly Phagmites karka and low shrubs.	none
Permanent lake	Guadalcanal	none
Brackish lake	Lake Te Nggano with highly diverse fauna and flora, including endemic species.	none
Mountain stream	Common	none
Lowland river	Common	none
Sea turtle nesting areas	Turtles still common.	none
Algal bed	Common in lagoon areas and reef flats.	none
Sea grass bed	Extensive in lagoons.	none
Animals in sediments	Common on lagoon bottoms.	none
Algal reef	Present.	none
Coral reef	Present	none
Barrier reef	New Georgia.	none
Fringing reef	Common.	none
Lagoon reef	Common and variable.	none
Rocky coast	Common	none
Beach	Common	none
Open lagoon	Common, especially New Georgia Islands.	none
Dilute lagoon	Layering of brackish water over sea water occurs in more enclosed lagoon areas such as Roviana.	none
Estuary	Present	none
Offshore environments.	No data available.	none

Conservation Legislation.

SOLOMON ISLANDS.

National Parks Ordinance - poorly defined and not well enforced.
Wild Birds Protection Ordinance, old but extensive coverage.
Forestry Ordinance provides for controlled forest areas.
New conservation legislation under discussion.

BOUGAINVILLE.

See New Guinea.

Conservation interest.

Many endemic species with considerable differentiation between inslands; textbook examples of island speciation. Extensive areas of undisturbed rainforest, but increasingly subject to development.

Rare or endemic species.

Porpoises are locally hunted for their teeth which have traditional value.

Dugong - still common but danger of increased hunting.

Crocodile - large animals protected, but sometimes become dangerous.

72 endemic bird species and 62 endemic subspecies in Solomon Islands, often differentiated between islands: largely in forest habitats.

White eye Zosterops different forms on Gizo, Vella Lavella, Rendova and Tetepare.

Existing reserves.

Queen Elizabeth National Park, Guadalcanal , 6080 ha. now major parts of low conservation value because of forest clearing for gardens.

Kolombangara forest reserve (controlled forest) narrow strip of lowland rain forest along Shoulder Hill from sea level to crater.

Proposed reserves.

Kolombangara reserve, Terminalia calamansanai/Campnosperma/Calophyllum forest.

Kolombangara ecological survey plots with buffer zones. Dillenia forest and Dillenia/Calophyllum/Campnosperma forest.

Viru (a) Dillenia/Calophyllum/Campnosperma forest
(b) Casuarina forest.
(c) Terminalia brassii swamp forest, Dillenia/Calophyllum/Campnosperma forests.

Santa Cruz: Kauri forest and Campnosperma forest.

Tetepare: Vitex forest.

Allardyce: Campnosperma forest.

Gizo: Calophyllum forest.

Vangunu: Dillenia forest, Campnosperma forest.

Vanikolo: Kauri forest and Campnosperma forest.

Guadalcanal: Pometia/Vitex/Calophyllum forest in upland area.

Santa Isabel (S.E.): Casuarina woodland.

Santa Isabel or New Georgia: mangrove forest.
Rennell: Rennell forest and brackish lake, endemic fauna.

Guadalcanal: grasslands.

San Jorge and Nggatokano: dwarf-shrub heath.

Serpentine woodland.

Recommended reserve types.

Montane and lowland reserves on Bougainville, endemic birds, Calophyllum forest.

Large forest reserves on Guadalcanal (perhaps Mt. Gallego), San Cristobal and Choiseul or Santa Isabel.

Reserves on Rennell (lake and adequate area of forest habitat), Kolombangara (central montane forest above 500m. and sample of lowland forest to coast), and Malaita (central forest above 1000m and some lowland forest).

Forest and bird reserves on New Georgia, Rendova, Tetepare, Ranongga, Gizo, Uki Ni Masi.

Reserve for breeding pigeon colonies on Oema (Shortlands).

Reef reserve in Manning Strait, and selection of reef and lagoon reserves elsewhere.

Mangrove reserve and small botanical reserves for other vegetation types (scrub, serpentine).

References and sources.

Visits to Guadalcanal, New Georgia, Russell Islands, Kolombangara, and Malaita.
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Mike Hoyle, University of Papua New Guinea.

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IV. NEW CALEDONIA - LOYALTY ISLANDS.

Government: France.

Island types: New Caledonia is a continental high island of complex geology; the Loyalty Islands are elevated reefs with small volcanic areas; low reef islands occur in the lagoon surrounding New Caledonia. Subject to hurricanes.

Biomes.	Description.	Conservation status.
Lowland rain forest.	1) Coastal forest - only a few remnants remaining (Bourail, Hienghene)	none
	2) *Araucaria cookii* coastal forest of elevated limestone (Isle of Pines: Kuebeni peninsula	Oro Peninsula reserve.
	3) Limestone forest, (dominated by *Intsia*, *Manilkara*, *Schefflera* and *Albizia*) Mare, Lifou, Isle of Pines.	Isle of Pines.
Montane rain forest.	1) Submontane rain forest, principally on slopes 400-1000m. 2) Dry coniferous forest - 1000-1500m, various *Araucarias* and other gymnosperms.	Several reserves.
Bamboo forest	Scattered examples, largely in disturbed areas.	none
Cloud forest	higher mountain peaks	Mont Mou, Mont Panie etc.
Riverine forest	Present along lower reaches of watercourses: Plaine des Lacs with *Dacrydium guillauminii*.	none
Swamp forest	Dominated by *Melaleuca leucadendron* (Niaouli)	none
Mangrove forest	extensive along south west coast.	none
Atoll/beach forest.	Common on coasts and islets	none
Scrub	Walpole (raised limestone); Isle of Pines. (most New Caledonia scrub is serpentine vegetation).	Isle of Pines.
Serpentine vegetation	highly variable with elevation and in different parts of New Caledonia, many localised endemics; also includes Gum Oak forest type; also on Isle of Pines.	several reserves but not all types included.
Dwarf-shrub heath	Isle of Pines plateau.	Isle of Pines.
Woodland savanna	*Melaleuca* (Niaouli) dominated, common in areas subject to fire, grades into tree savanna	none
Tree savanna	Large areas of Niaouli (*Melaleuca*) savanna fire maintained on lower elevations; also Hunter Is.	Povila reserve.
Grassland	present in frequently burned areas of south west New Caledonia - grades into tree (Niaouli) savanna.	none

Biomes.	Description.	Conservation status.
Fresh water marsh.	Plaine des Lacs and many localised areas characterised by Xyris pancheri and Schoenus brevifolius.	
	Wabao, Maré, only Melaleuca in Loyalty I.	none
Rock desert	Matthew (active volcano); strip mined areas of New Caledonia.	none
Permanent Lake	Plaine des Lacs (with endemic lake species)	none
Mountain stream	Common	in several reserves
Lowland river	Common Fresh water fauna distinctive but poorly known.	none
Seabird rookeries	Matthew, Walpole, Chesterfield.	none
Sea turtle nesting areas	Islets: Belep and elsewhere.	nests are protected by law.
Cave	Poya, Hienghene, with rivers and cave fauna.	none.
Algal bed	Common, lagoon bottoms and reef flats.	none
Sea grass bed	Common in lagoon	none
Animals in sediments.	Common	none
Algal reef	Present	none
Coral reef	Common	Yves Merlet Reserve.
Windward atoll reef) Leeward atoll reef)	Conway, Surprise, Fabre/Leleizour, Huon, and Beautemps Beaupre.	none
Barrier reef	Probably windward and leeward types and considerable diversity in local community structure.	Yves Merlet Reserve.
Fringing reef	Both exposed and lagoon forms; also Walpole Is.	none
Lagoon reef	A variety of types are to be expected within the complex lagoon environment.	Yves Merlet Reserve.
Dead reef	Presumably present.	none.
Rocky coast	Few areas, north shore.	none
Beach	Common	Cap N'Doua reserve.
Open lagoon	encircling much of New Caledonia, also Ouvea.	Yves Merlet Reserve.
Estuary	Common, including Baie St. Vincent.	none
Offshore environments.	No data available.	none.

Conservation interest.

One of the world's most distinctive floras, with many relic species of highly localised distribution. Many separate reserves are needed to encompass all the endemic species. Several endemic birds of considerable interest. Largest island barrier reef complex with many diverse marine habitats; again a number of reserves will be needed.

Rare or endemic species.

PLANTS.

80% of 3500 species are endemic, including many of great botanical interest.
80% of native flora is woody, including 35 species of conifers, all endemic.
Agathis lanceolata near extinction in south N.C.
13 species of Araucaria with restricted distributions, mostly in mining areas.
Podocarpus ustus - unique parasitic gymnosperm. Riviere bleu and Montagne des Sources.

BIRDS.

16 of 68 species are endemic, including
Cagu Rhynochaetos jubatus
Cloven feathered dove Drepanoptila holosericea.
Giant imperial pigeon Ducula goliath.
Horned parakeet Eunymphicus C. cornutus.
Cyanorampus novaezelandiae saisseti

Two endemic general of gekkos Rhacodactylus and Eurydactylus

Conservation Legislation.

Laws exist establishing complete reserves, botanical reserves, a marine reserve and the National Park, prohibiting hunting and fishing in certain areas, and prohibiting or restricting mining prospecting in some areas. Reserves are not protected against mining activity unless specifically listed as mining reserves. The National Park does not meet internationally accepted definitions of that term.

Endangered birds are completely protected, and hunting of most others is controlled.

Turtle nests are protected.

A review of existing park and reserve legislation is now being undertaken.

Existing reserves.	Catagory.
Montagne des Sources, 5870 ha.	Complete and mining reserve.
Isle of Pines National Park, 141,400 ha. low serpentine scrub, forest clumps, caves, past and present forest cutting.	National Park but poorly defined; classification now being re-examined.
including Oro Peninsula, 848 ha. with lowland forest	Complete reserve but subject to customary rights.
Mont Panie , 5080 ha. Rich forest type with many endemics.	Botanical reserve and temporary mining reserve.
Mont Humboldt, 1,600 ha. Araucaria humboldtensis Cloud forest, Araucaria rulei	Botanical reserve.

Existing reserves (contd)	Catagory.
Mont Mou 675 ha. and 5038 ha.	Botanical reserve. Forest reserve.
Yves Merlet Marine Reserve, 16,500 ha. Barrier and lagoon reef.	Marine reserve.
Ouenarou, 1171 ha.	Forest reserve.
Povila, 600 ha. Niaouli savanna with forest along streams.	Forest reserve and temporary mining reserve.
Tiponite, 1100 ha.	Forest reserve.
Col d'Amieu, 12,368 ha.	Forest reserve.
Koumac, 1016 ha.	Forest reserve.
Haute Yate, 16,300 ha. Including Riviere Bleue 9000 ha. forest, scrub and fresh water marsh, Podocarpus, some forest exploitation in past.	Hunting and fishing reserve. Mining reserve.
Ilot Lepredour, 560 ha. Hunting area for Governor.	Hunting and fishing reserve.
Ile Pam, 450 ha.	Hunting and fishing reserve.
Yate, 546 ha. Lowland forest, serpentine scrub.	Mining reserve.
Fausse Yate, 386 ha. Lowland rain forest and serpentine scrub.	Mining reserve.
Mont Oungone, 307 ha. Lowland forest and serpentine scrub.	Mining reserve.
Foret Nord, 282 ha.	Mining reserve.
Cap N'Doua, 861 ha. Coastal rainforest, 80 m cliffs, serpentine scrub, beaches, springs.	Mining reserve.
Pic du Pin 1491 ha. 25% forest, 75% serpentine serpentine scrub with many endemics; springs and streams.	Mining reserve.
Foret Cachee, 635 ha. Forest and serpentine scrub.	Mining reserve.
Duthio, 7000 ha.	Temporary mining reserve.
Nord Cote Est, 89,400 ha.	Temporary mining reserve.
Amoa - Tchamba, 43,000 ha.	Temporary mining reserve.
Ponerihouen, 33,880 ha.	Temporary mining reserve.
Branche Nord Dumbea et Couvelee	Mining and water reserve.

Proposed reserves.	Proposed classification.
Massif du Kouakoue, 17,500 ha. many rare plant species.	Part mining reserve and part temporary mining reserve.
Dent St. Vincent et Pic Comoui, 10,100 ha. many rare plants	Mining reserve.

Proposed reserves (contd.)	Proposed classification.
Foret Koum et Comboui, 2400 ha. 50% forest, rare plants and large kaori (11m circ.)	Mining reserve.
Foret de Saille, 1060 ha. half rainforest, half dry forest of Casuarina and Acacia, some scrub and riverine forest, sole remaining site of Pseudosciadium balansae.	Mining reserve.
Foret de Ningua, 600 ha. Montane rain forest, 1000m to 1350 m.	Mining reserve.
Foret de Mt. D'O. 1300 ha. Araucaria forest and serpentine scrub.	Mining reserve.
Zone Centrale	Part mining reserve and part temporary mining reserve.
Me Maoya, 9300 ha. 66% forest	Part temporart mining reserve with summit mining reserve.
Boulinda, 2600 ha. above 1000 m. partially burned over by mining prospectors.	Mining reserve.
Massif des lèvres, low forest with many epiphytes and lianas.	Mining reserve.
Massif du Panie	Mining reserve and expansion of botanical reserve.
Dome de la Tiebaghi, Localised endemic Araucaria forest, light scrub and forested stream banks with many endemics, threatened by mining activity.	Mining reserve.
Presqu'ile de Kuebini - elevated with endemic coastal forest. Reserve for Oceano papaver highly localised plant, near Koné.	Forest reserve.

Recommended reserve types.

Chesterfield.
Atolls of Conway reef, Surprise, Fabre/LeLeizour, Huon and Beautemps Beaupre.
Hunter, Matthew and Walpole Islands. for seabirds, small island vegetation.
For birds, New Caledonia should have both montane and lowland reserves; there should be an appropriate reserve or sanctuary on Lifou and also on Maré and Ouvea.
Plaine des Lacs, for lake fauna and marsh flora.

Reserves with good stands of each gymnosperm, particularly Araucaria, Agathis and Podocarpus, and other significant endemic species in areas where their reproduction is possible.
Areas of remnant coastal forest (east and west coast types) perhaps at Bourail and Hienghene.
Additional reserves for localised endemic species.
Reef and lagoon reserves on north, east, and west coasts.
Mangrove and estuarine reserves, perhaps including Baie St.Vincent.
One or more river systems with well-developed freshwater fauna.

References and sources.

Visits to several parts of New Caledonia.

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J.P. Cherrier, Forester.
P. Rancurel.
Inventaire des Ressources Forestieres de la Nouvelle - Caledonie (1974-1975)
Carlquist, 1974.
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Sarlin, 1954.
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7. NEW HEBRIDES - SANTA CRUZ.

Government: New Hebrides are a condominium of France and U.K., Santa Cruz Islands are part of Solomon Islands (self-governing, U.K.)

Island types: Principally volcanic islands, some still active, with portions of elevated reef and some low reef islands. Hurricanes frequent but localized.

Biomes.	Description.	Conservation status.
Note: twelve forest types were identified by Royal Society Expedition, but details not available for this report.		
Lowland rain forest.	Both limestone and volcanic types common, especially Erromango and Northern Santo; dominants vary, Castanospermum, Evodia, Laportea, Hernandia, Pangium, Dracontomelum, Gyrocarpus, etc. Dynamic structure with succession after hurricanes.	none
Montane rain forest	with Metrosideros, many epiphytes; 1000-1500 m on Santo.	none
Cloud forest	Present above 1500m. on Santo	none
Riverine forest	Presumably present	none
Swamp forest	Tekopia with Pandanus; Barringtonia and bog soils around Duck Lake, Efate.	none
Mangrove forest	Present, including Lo, east Malekula, and scattered elsewhere.	none
Atoll/beach forest	Common with Casuarina, Hibiscus, Pandanus.	none
Scrub	North Santo	none
Grassland	North of Mele Bay, Efate; Tanna plateau; West Erromango.	none
Fresh water marsh	Present on Santo, Efate and Tanna.	none
Non-tidal salt marsh	Lo.	none
Rock desert	Active volcanic slopes and Fatutaka	none
Sand desert	Active volcano slopes and Fatutaka.	none
Permanent lake	Crater lakes, Gaua and Tekopia, Aoba, others including Duck Lake on Efate, Santo, Maewo and Tanna.	none
Mountain stream	Common	none
Lowland river	Common	none
Hot springs	With algae, North Efate.	none
Seabird rookeries	Fatutaka; shearwaters nest in interior of Tanna and Aneityum	none
Sea turtle nesting areas	Present	none

Biomes	Description	Conservation status.
Cave	Santo, Aore, Malo, Malekula, North Efate, Tanna, Aneityum, Erromango.	none
Algal bed	Common	none
Sea grass bed	Common	none
Animals in sediments	Common	none
Algal reef	Probable	none
Coral reef	Present	none
Windward atoll reef	Reef Island.	none
Leeward atoll reef	Reef Island	none
Fringing reef	Common	none
Lagoon reef	Present	none
Drowned reef	Utupua, Santa Cruz.	none
Rocky coast	Present	none
Beach	Common	none
Open lagoon	Havana Harbour area	none
Closed lagoon	Efate (disturbed by urban development)	none
Marine cave	Present	none
Offshore environments	No data available	none

Rare or endemic species.

White flying fox Pteropus anetianus. Closed season needed February to October.
Five species, five allospecies and twenty-four subspecies of birds are endemic, including Starling, Aplonis santovestris restricted to cloud forest of Espiritu Santo.
pigeons Ducula bakeri and Ptilinopus fannensis - both hunted.
About one third of insects are endemic.
Three endemic skinks, including Emoia nigromarginata only on Pentecost, and E. aneityumensis only on Aneityum.
One endemic gecko.
Over 70 endemic species of plants including Kauri Agathis obtusa - one major stand remaining on southern Erromango.

Conservation Legislation.

New Hebrides: controls on turtles, lobster, trochus.
Santa Cruz Islands: see Solomon Islands.

Existing reserves.

None.

Proposed reserves.

Reef Island reserve. 92 ha. Only atoll in New Hebrides. Joint regulation agreed to by Governments but negotiations never completed with owners.

Duck Lake reserve Efate. Lake with swamp forest, freshwater swamp and lowland forest, excellent bird habitat. Prospects for establishment not good at present.

Kauri forest sanctuary, Erromango. Only high canopy forest in New Hebrides with endemic Agathis obtusa. Formerly threatened by logging. No steps taken to establish reserve, but logging will not be permitted.

Reccommended reserve types.

Examples of major forest types, grasslands, swamps, lakes and marine habitats.
Forest reserves on each of main islands for vegetation and birds.
Cloud forest reserve on Santo.
Northwest coast of Malekula or Santo, where reefs elevated over m in 1965.
Forest and bird reserves on Nendö and Vanikoro (Santa Cruz Is.).

References and sources.

Visits to Efate.

Martin Bennet, Forestry Officer.
Reece Diacombe.
H. Bregulla.
J.M. Diamond, personal communication.
A. Marshall, Biol. Cons. 5:67-69 (1973) and personal communication.
Lord Medway, personal communication.
M. Schmid, Note sur un projet de reserve naturelle dans le centre de Vate.
K.E. Lee, 1975.
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The report of the Royal Society expedition to the New Hebrides was not received in time to be included in this report.

VI. NORFOLK- LORD HOWE - KERMADEC.

(Only Norfolk Island is included in the SPC survey area)

Government: Australia (Norfolk, Lord Howe)

Island types. Raised undulating platform of weathered volcanic material surrounded by cliffs.

Biomes.	Description.	Conservation status.
Sub-tropical rain-forest.	Norfolk Island pine only clumps on ridges and in scattered groves remaining from original forest.	not known.
Scrub	probable.	none.
Grassland	Present, largely man-modified.	none
Mountain stream	Common	none
Seabird rookeries	Present	none
Coral Fringing reef	Small fringing reef near Kingston.	none
Rocky coast	Common	none
Beach	Present	none
Offshore environments. No data available.		none.

Rare or endemic species.

Norfolk Island pine. Araucaria excelsa.
Norfolk Island cabbage(palm).
Presumably other endemic plants.

Conservation Legislation.

Not known.

Existing reserves.

Not known.

Recommended reserve types.

Remaining areas of native vegetation.

VII. FIJI.

Government: Fiji (Independent).

Island Types: High volcanic islands, including two very large islands (Viti Levu and Vanua Levu); elevated reef islands and areas sometimes combined with volcanic island centres; and low atolls and reef islands. Distinct wet and dry sides on high islands. Occasional hurricanes.

Biomes	Description	Conservation status.
Lowland rainforest	Light undergrowth, few epiphytes or lianas, widespread species. On limestone islands, one tree layer of Pan pacific species. Apparently largely lost to development.	Small sample on Cave Is., Bay of Islands.
Montane rain forest	Not always readily distinguished from lowland rainforest, but with heavier epiphytes and undergrowth, more endemic species. Several types distinguished:	Samples reserved in Nadarivatu; Naqararibuluti.
	1) *Agathis* dominant, 3 tree layers with other species (*Syzygium*, *Palagium*, *Cleistocalyx*, *Calophyllum*, *Podocarpus* etc.) in second layer.	
	2) *Dacrydium* dominant, some *syzygium* in pockets.	none
	3) *Agathis* emergent with *Dacrydium* dominant and angiosperms.	none
	4) *Agathis* emergent with *Decacarpus* dominant and angiosperms	none
	5) Mixed species forest, 3 tree layers, may be characterized by emergents such as *Endospermum* or *Canarium*.	Examples on Taveuni (Ravilevu); Mt. Tomaniivi.
	6) Ridge thicket, a slope-limited form on narrow ridges with one layer of stunted trees.	none
Bamboo forest	low forest with *Bambusa*, *Bischofia*, *Parasponia*.	none
Cloud forest	Stunted wet forest with tree ferns, *Metrosideros* abundant epiphytes and mosses.	Tomaniivi Nature Reserve; Taveuni (Ravilevu).
Riverine forest	Along rivers, sometimes characterized by distinctive species such as *Neoveitchia storckii*.	none
Swamp forest	On wet soils with Sago Palm (*Metroxylon vitiense*), *Pandanus* etc.	none

Biomes	Description	Conservation status.
Mangrove forest	Three types distinguished : 1) Rhizophora mangrove 2) Bruguiera mangrove 3) Mixed species mangrove, with composition varying with topography, and including above species, Xylocarpus, Intsia and Excoecaria.	Classed as reserved forest, but subject to development pressures.
Atoll/beach forest	One tree layer with pan-pacific strand species, light undergrowth. May be segregated by type of island; sand cay, small volcanic and large volcanic (with Metrosideros).	Small sample (1ha) on Vuo (Admiralty) Island Nature Reserve.
Woodlands	Hernandia, Gyrocarpus and Casuarina on sand dunes at Sigatoka River mouth.	none
Scrub	Three forms: 1) Limestone island scrub (Messerschmidia, Scaevola, Desmodium).	1 ha. on Snake Island.
	2) Miscanthus scrub with Piper aduncum (tall reeds and shrubs) in wet upper catchment areas.	none
	3) Slope-limited scrub in mountain areas where slopes are too steep for forest trees (Bischofia, Alpinia, Heliconia, Piper, Cyathea).	none
Bog	Peat swamps with sedges; where Pandanus and Barringtonia aquatica occur, may grade into swamp forest. Coastal and inland types.	none
Woodland savanna	Areas of mixed grassland and woodland on dryer slopes and valleys. Bambusa may occur in pockets.	none
Tree savanna	Open grassland with Casuarina.	none
Shrub savanna	Grassland with Cycas.	none
Grassland	Pennisetum-dominated grassland common on dry side of high islands.	none
Fresh water marsh	Fern/sedge swamp with Athyrium in inland areas.	none
Non-tidal salt marsh.	Brackish areas, usually behind mangroves with sedges and ferns (Acrostichum) and occasionally Pandanus.	none
Floating meadows	Floating, peat-based sedge mats which will support walkers, on Lake Tagimaucia.	none
Submerged aquatics	Pond and river bottoms with Hydrilla, Potamogeton, Ceratophyllum.	none
Permanent lake	Lake Tagimaucia, crater lake at 800 m elevation.	none
Mountain stream	Common in mountain areas, with algae, eels, snails, prawns, ika droka.	example in Taveuni (Ravilevu) Nature Reserve.

Biomes	Description	Conservation status
Lowland river and stream	With freshwater mussels, snails, eels, crabs, ika droka and sometimes submerged aquatic vegetation.	none
Seabird rookeries		none
Sea turtle nesting areas	Makodrogo Is. and other areas.	none
Breeding areas for other animals	Balolo (Eunice viridis).	none
Cave	Present in Sigatoka valley, near Nasinu (bats and swiftlets).	none
Algal bed	common in shallow reef and lagoon areas	none
Seagrass bed	Three types reported: Syringodium iseotifolium Halodule uninervis Halodule pinifolia	none
Animals in sediments	common	none
Coral reef	common	none
Windward atoll reef	present	none
Leeward atoll reef	present	none
Barrier reef	Great Sea Reef and other examples	none
Fringing reef	many examples	none
Lagoon reef	common	none
Beach	common	none
Open lagoon	North Astrolabe reef and others	none
Closed lagoon	Cakau Lekaleka, near Oneata Is.	none
Estuary	Several such as Suva Harbour, Laucala Bay, Nadi Bay, Savusavu Bay. but major areas man-modified.	none
Marine Lake	Centre of Wangavu Island (used as turtle pen by Kambaru islanders).	none
Marine Cave	Presumably common in raised limestone areas Yaswas, Qaranitoa, Fulaga Is.	none
	Red prawn pool-cave on Vatulele Island and Red turtle pool-cave on Koro Is of special interest.	
Offshore environments	No data available.	none

Conservation interest.

Fiji has a great variety of ecosystems and a considerable number of endemic species. It will therefore need some large parks providing adequate protection for endemic birds, plants, and marine ecosystems, and many smaller reserves for more

Conservation interest (contd.)

restricted ecosystems.

Rare or Endemic Species.

PLANTS	biomes	status
Neoveitchia storckii endemic genus of palm	Riverine forest at Naqali, (Waidradra) Viti Levu	Single population of less than 200 trees.
Goniocaldus petiolatus (Palmae)	Montane forest central plateau of Viti Levu.	rare on Nadrau plateau
Goniosperma (2 species) (Palmae)	Taveuni; Mt. Mariko.	
Taveunia trichospadix (Palmae)	Taveuni and Nadarivatu	
Degeneria vitiensis (Degeneriaceae)	tall tree of mixed species montane rain forest	scattered individuals on Viti Levu, Vanua Levu and Taveuni.
Readea (3 species) (Rubiaceae)	small rain forest trees: Nadarivatu; Mt. Vakarogasiu; Viti Levu, Vanua Levu and Taveuni.	
Sukunia pentagonioides (Rubiaceae)	small rain forest tree from Vanua Levu and Taveuni.	
Gillespiea speciosa (Rubiaceae)	Rain forest, Vanua Levu.	
Hedstromia latifolia (Rubiaceae)	Montane rain forest, Korotasere, Vanua Levu.	
Pimia rhamnoides	Forest margin, north coast of Vanua Levu.	
Medinella waterhousei (Melastomataceae)	Flower of montane areas.	Only found at Mt. Seatura, Vanua Levu and Crater Lake Taneuni.
Pullea perryana (Cunoniaceae)	small tree	Viti Levu, Ovalu and Nargani.
Santalum vasi (Santalaceae)	Sandlewood of Lowland forest of Vanua Levu	Cut nearly to extinction. Now protected.

BIRDS

Of 54 Fijian bird species, 19 are confined to one or more of the five largest islands (Viti Levu, Vanua Levu, Taveuni, Kandavu, Ovalau). Viti Levu, Vanua Levu, Taveuni and Kandavu each have numerous distinctive endemic sub-species. Three species are endemic to Viti Levu, three more to Kandavu. Viti Levu, Vanua Levu and Taveuni each have some bird species confined to the mountains. The Golden Whistler (Pachycephala pectoralis)has several sub-species, including distinctive forms on

the eastern and western parts of both Viti Levu and Vanua Levu. Only Ngau and Koro of the other main Fiji islands, have endemic sub-species restricted to one island. Three species are confined to the Lau Archipelago, including one found only on Ongea Levu. Seven more species have endemic sub-species in the Lau group, and three of these have different endemic sub-species on the northern and southern islands. Rotuma has an endemic honey-eater. Almost all of these birds occur in forest.

Endangered birds include:

Banded rail (Rallus phillippensis))	
White-browed rail (Poliolimnas cinereus))	Subject to predation by cats
Sooty rail (Porzana t. tabuensis))	and mongoose.
Purple swamp-hen (Porphyrio porphyrio))	
Pink-billed parrot finch (Erythrura kleinschmidti)	Rare on Viti Levu.
Peregrine falcon (Falco peregrinus nestiotes)	cliff areas.
Red-throated lorikeet (Vini amabilis)	montane rainforest.
Long-legged warbler (Trichocichla rufa)	rainforest.
Peal's pigeon (Ducula latrans)	lowland and montane rain forest.
Petrels	ground-nesting seabirds subject to mongoose predation.

Endangered animals:

Fiji snake (Ogmodon vitianus)	endemic.protected.
Pacific boa	more common on smaller islands.
Banded iguana (Brachylophus fasciatus)	in forest trees, still common on Kadavu, subject to predation by cats.
Tree frogs (two endemic species) (Platymantis vitianus)	more common on smaller islands, still found on Ovalu.

Conservation Legislation.

National Trust of Fiji created to develop parks and reserves. Forestry Ordinance(1953) provides for establishment of Nature Reserves within Reserved Forest areas.

Existing Reserves.(Nature Reserves)

	size	biomes
Nadarivatu, Viti Levu	92 ha	Montane rainforest (Agathis)
Tomaniivi, Viti Levu	1308 ha	Montane rainforest (mixed), cloud forest.
Waqarabuluti, Viti Levu	276 ha	Montane rainforest (Agathis)
Draunibota (Cave) and Labiko (Snake) Islands in Suva Harbour.	1.9 ha & 0.25ha	Limestone island forest and scrub.
Taveuni (Ravilevu)	3972 ha	Montane rainforest (mixed), Cloud forest, mountain stream.
Vuo (Admiralty) Island in Suva	1.2 ha	Atoll/beach forest.
Vunimole	20 ha	Rainforest.

Proposed reserves (listed by National Trust)

Malamala Island, Nadi Bay	Reefs
Namena Island, between Wainunu and Savusavu Bay.	Barrier Reef
North Astrolabe Reef near Kandavu	Atoll reef, open lagoon.
Wailagilala, north of Lau Group	Windward and Leeward atoll reefs.
Mt. Voma, Namosi	Rainforest with unusual ferns.
Rama-Korobaba, Suva	Rainforest with endangered pink-billed parrot finch.
Nausori Highlands	Dacrydium and Agathis-Dacrydium rain forest; grassland.
Nadrau Plateau	Rainforest grading to grassland; swamp forest; bamboo forest; includes pink-billed parrot finch and palm. Goniocladus.
Nakaavadra	Swamp forest.
Dreketi	Gymnosperm-dominated rainforest and Cycas.
Ra/Rewa delta	Rhizophora and mixed species forests.
Manaulau Island	Lowland rainforest and sea bird rookery.
Makogai Island	Lowland rainforest and birds.
Yabu Island	Lowland rain forest and birds.
Mt. Washington	Petrel breeding area.

Recommended reserves (in addition to proposed reserves)

For birds relatively large tracts of undisturbed native forest will be needed to provide adequate habitats. Viti Levu and Vanua Levu require both mountain and lowland forest reserves (preferably continuous) and separate eastern and western reserves. Taveuni needs both mountain and lowland rain forest reserves. A forest reserve on Kandavu is also a high priority. Additional forest reserves should be considered on Ongae Levu, Rotuma, and eventually on Ngau, Koro, and one of the larger islands of the northern Lau Group.

The following are the biome examples potentially suitable for protection:

S.E. slopes of Mt. Tomaniivi (Mt. Victoria)	Agathis rain forest.
Namosi Hills	Dacrydium rain forest
Serua Forests	Agathis - Decacarpus and Dacrydium rainforest.
Waimanu River catchment	Mixed rain forest and pink-billed parrot finch.
Nadarivatu	slope-limited montane forest (ridge thicket)

Upper Wainimala	Bamboo forest.
Lake Tagimaucia	Cloud forest, swamp forest and bog, lake floating meadow.
Makaluva Island	Atoll/beach forest.
Leleuvia Island	Atoll beach forest.
Beqa Island	Atoll/beach forest, lowland rain forest.
Ra Coast	Lowland rain forest.
Ovalau coastal forest	Lowland rain forest.
Sigatoka River mouth	Dune woodlands.
Sawanika/Waidalice river mouths	Bruguiera mangrove forest.
Between upper Sigatoka Valley and Nadrau	Grassland
Between Nadi Hills and Nausori highland	Grassland
Near Muanasavu Falls	Scrub
Swamps near Navua	Bog
Between Sigatoka and Nadi	Tree savanna (Casuarina)
Bua Province, Vanua Levu	Shrub savanna
Lokia swamps, Navua River flats	Pandanus Swamp forest and bog.
Moturiki Island	Swamp forest and bog.
Tailenu (north coast and inland valleys)	Non-tidal salt marsh, freshwater marsh.
Deuba - Sawani - Serua Road forests.	Sago palm swamp forest.
Waidradra Agricultural Station	Riverine forest (Neovitchia storckii)
Naisogocaucau Creek, Vanua Levu mountains	Mountain stream.
Upper Wainimala	Mountain stream.
Wainibuka River mullet "hole"	Lowland stream.
Sigatoka Valley caves	cave.
Cakau Lekaleka, near Oneata Island	Closed lagoon.
Tai Island	Fringing reef.
Mana Island	Fringing reef.
Sections of Coral Coast.	Fringing reef.
Yasawa-i-rara Island	Fringing reef.
Makodroga Island	Fringing reef, turtle nesting area.
Part of the Great Sea Reef	Barrier reef.
Off Naselai, Rewa delta.	Syringodium sea grass bed.
Fulaga Island	Halodule sea grass bed; land crab breeding area; marine caves (Qaranitoa).

Wangavu Island	Marine lake.
Yasawas	Marine caves.
Vatulele Island	Red prawn pool-cave.
Koro Island	Red turtle pool-cave.
Balolo Point, Ovalau Island	Balolo rise area.
Moturiki Island	Land crab breeding area.

Additional reserves will also need to be considered, especially for scrub, lowland river, estuarine, mangrove, lagoon and reef habitats. Protection will be important for seabird and sea turtle breeding areas, and for significant habitats of rare or endangered species (see list above).

References and sources.

Visits to sites near Viti Levu.

Graham Baines and Suliana Siwatibau,"Fiji Ecosystem Survey"(unpublished list of terrestrial and marine ecosystems and proposed reserves).

Jared M. Diamond (information on bird endemism, species distributions and conservation needs).

Suliana Siwatibau (list of endemic plants in need of protection.)

National Trust of Fiji.

Department of Forestry, Government of Fiji.

Douglas, 1969.

Gorman and Siwatibau, 1975.

Parham, 1964.

VIII. TONGA - NIUE.

Government: Tonga (Independent); Niue (Self Governing, N.Z.)

Island types. Elevated reefs with or without overlying volcanic ash soil; volcanic islands, some still ative.

Biomes.	Description	Conservation status.
Lowland rain forest	Limestone forest on Niue and several other elevated reefs, mostly destroyed on Tongatapu; Calophyllus common. Also forest on some volcanic islands (Toku, Late, Kao, Tafahi, Ata, Tofua.) Best examples of forest on 'Eua.	Tabu area on Niue; none in Tonga.
Mangrove forest	Present	none
Atoll/beach forest	Common	none
Scrub	Regrowth on poor soils. Niue; volcanic mountains (Late).	none
Tree Savanna	Casuarina on new volcanic areas.	none
Shrub savanna	Secondary vegetation	none
Grassland	Tongatapu, 'Eua and 'Uta Vavau with Sorghum and Panicum; Hunga Ha'apai.	none
Freshwater marsh	Near Tuaruku, 'Uta Vavau.	none
Non-tidal salt marsh	with Cyperus on Nomuka, Tongatapu.	perhaps in lagoon Tongatapu.
Rock desert	Lava on Fonualei	none
Reed swamp	Cyperus in Niuafo'ou crater lake.	none
Permanent lake	Niuafo'ou crater lake with hot springs; crater lake on Kao, brackish lake on 'Uta Vava'u.	none
Seabird rookeries	Ata, Nuku	Ata may be bird sanctuary.
Sea turtle nesting area	Common especially on Maninita, Taula, Fonua'-one'one, Fangasito, Luahoko, Luanamu, Nukulei, Fonuaika, Nukufaiau, but threatened by over collecting - nesting populations reported extinct on several islands.	Protected but not enforced.
Cave	Common on Niue and probably other limestone islands.	proposed.
Algal bed	Present	none
Seagrass bed	Present	none
Animals in sediments	Common	none

Biomes	Description	Conservation status.
Algal reef	Present	none
Coral reef	Common	two reef parks near Tongatapu.
Barrier reef	Niuatoputapu, Ofolanga	none
Fringing reef	Fonualei, Nomuka, etc.	none
Lagoon reef	Common	none
Rocky coast	Present	none
Beach	Common	none
Open Lagoon	Common	Tongatapu lagoon but not typical
Marine lake	Nomuka	none
Marine cave	several on Niue	proposed
Offshore environments	no data available	none
Submarine trench	Present	none

Conservation interest.

Considerable endemism; several distinctive biomes in volcanic and elevated reef habitats.

Rare or endemic species.

BIRDS

Megapodus pritchardi endemic on Niuafo'ou.
Three endemic sub-species on Tafahi and Niuatoputapu.
Two endemic sub-species on Niue.

ANIMALS

Flying fox Pteropus tonganus, protected by custom.
Tongan iguana Brachylophus brevicephalus

PLANTS ENDEMIC TO TONGA

Uhiuhi Podocarpus pallidus - tree
Ponga Cyathea rugosula - tree fern
Hunivau Ixora yunckeri - flowering shrub, only on 'Eua.
Mo'ota Kula Dysoxylum tongense - only on 'Eua.
Kahikahi Freycinetia urvilleana - liana.
Lauteau Pittosporum yunckeri - 'Eua and Tongatapu.
Langakali Aglia heterotruka - now grown as ornamental.
Tamanu Manilkou amoxium - timber tree of 'Eua and Vava'u.
Lala Vau Wickstroemia rotundifolia - shrub, widespread.
Dryopteris euanensis and D. macroptera - ferns only on 'Eua.
and many others.

Conservation legislation.

Tonga : Natural Parks established by Royal dedication - legislation needed to define status. Bird and Fish Preservation Act, protects birds and sea turtles; not well enforced.

Niue: Environmental Protection Ordinance with conservation provisions under consideration in 1975; current status not known.

Existing reserves.

Hakaumama'o, 260 ha. 4km. north of Nuku'alofa, Tonga. Reef habitats.
Hakaulea, 260 ha. 4km west of Nuku'alofa, Tonga. Reef habitats.
Muihopohoponga, 2 km. of coastline along east Tongatapu. Scenic coastline.
Ha'amonga trilithon. 23 ha. on east Tongatapu. Cultural and archaeological site.
The lagoon on Tongatapu has been declared a protected area.
Ata Island, Tonga, reported by Douglas (1969) as ? bird sanctuary.

Proposed reserves.

NIUE.

Huvalu Forest tapu area, 160 ha., undisturbed forest and endemic birds.

Anapala-chasm and freshwater pool.

Anatola - cave with many birds (martins) and traditional importance.

Avaiki - cave with pools (fish breeding area).

Fatiau Tuai - deserted village near distinctive coral reef formation.

Hikutavake Reef - reef with large pools.

Hio - cave and beach

Limu - complex of caves and marine pools - scenic example of coastal erosion.

Makalea Cave - large domed cave.

Makape Cave - coastal cave.

Makato chasm - erosion feature.

Makatutaha - swimming hole and cave used for storing canoes.

Matapa Chasm - scenic deep cleft in rock with freshwater stream.

Motu - reef and caves used as canoe landing.

Omea - cave with legendary associations.

Opaahi - Historic site (Captain Cook's landing place).

Palaha - caves with stalactites.

Peniamina's grave - Historic site (first Christian).

Tahileleka - sink-hole with underground connection to sea.

Talava - The Arches - complex of caves, beaches and marine pools - good stalactites and stalagmites.

Tepa Point - Tabu area with coastal karst topography and vegetation, of legendary importance.

Togo - beach caves and fresh water pool.

Proposed reserves (contd)

Tuo - reef and cave area of traditional importance.

Ulupaka - cave with stalactites and stalagmites, also black fungus.

Uluvehi - early landing spot.

Vaihoko - caves and reef channels.

Vaikona - chasm and cave with series of deep brackish pools.

Vaitafe - broad reef with pool and freshwater springs.

Vaotoi - freshwater pool in chasm.

TONGA.

Seasonal turtle sanctuaries on Luanamu, Nukulei, Fonuaika in Ha'apai, and Maninita in Vava'u.

Pangaimotu, Ha'atafu and Malinoa as marine reserves.

Recommended reserve types.

Forest reserves on Tafahi or Niuatoputapu (endemic birds) and perhaps other volcanic islands (Tofua, Kao, Late Ata or Toku).
Major forest reserve along eastern ridge of 'Eua and perhaps other areas of 'Eua of botanical interest.
Samples of other terrestrial biomes not yet protected.
Marsh, lake and lagoon habitats (Niuafo'ou, Kao, 'Uta Vava'u).
Further marine areas to include a full range of marine biomes.

References and sources.

Visits to Niue and Tongatapu.

A.P. Thomson. 'Notes on natural forests of Tonga with particular reference to a proposed 'Eua National Park', unpublished report.

Map of Niue (NZMS 250 NIUE), Dept. of Lands and Survey, N.Z. 1970.

National Parks Authority, N.Z., 1975. (Address by Young Vivian).

Douglas, 1969.

IX. SAMOA, WALLIS AND FUTUNA.

Government: Western Samoa (Independent); U.S. (American Samoa); France (Wallis and Futuna.)

Island types: Volcanic islands,(Savai'i still active) and two atolls, Rose and Swains.

Biomes.	Description	Conservation status.
Lowland rain forest.	Common, much disturbed, only a few good examples remaining: Tahua peninsula and near Cape Puava, Savai'i.	none
Montane rain forest.	1) Submontane forest. 2) Montane forest, Savai'i, Upolu, Tutuila, Futuna;many endemics.	none
Cloud forest	Savai'i, many endemics.	none
Riverine forest	Along streams, with Barringtonia samoensis in Samoa.	none
Swamp forest	Lake Lanoto'o	none
Mangrove forest	Bruguiera and Rhizophora, scattered sites W. Samoa, and Pala lagoon (also with Xylocarpus)	none
Atoll/beach forest.	Common behind beaches; remnants on Swains; on Rose atoll with 3 plant species.	none
Scrub	Atoll scrub on Swains. Fern scrub on Uvea, Futuna.	none
Grassland	Mid-elevations on Futuna.	none
Fresh water marsh.	Lake Lanoto'o, lake Otomaga, Faimulivai; marsh Aunu'u crater; most others disturbed for taro cultivation.	none
Rock desert	Recent lava flows on Savai'i, also various stages of colonization.	none
Permanent lake	Ponds in Aunu'u crater. Pala (mud) lake, "quicksand" on Aunu'u.	none
Mountain stream	Common	none
Lowland river	Several	none
Seabird rookeries	Rose atoll, Nu'utele Islands.	none
Sea turtle nesting area	Nu'utele and Nu'alua islets	none
Cave	Several on Savai'i, Tutuila, with cave fauna.	none
Algal bed	Common, reef flats, entrance to Pala lagoon.	none
Animals in sediments	Common	none

Biomes.	Description.	Conservation status.
Algal reef	Rose atoll	none
Coral reef	Common	none
Windward atoll reef	Rose, Swains.	none
Leeward atoll reef	Rose, Swains.	none
Barrier reef	Uvea (Wallis)	none
Fringing reef	Common, both narrow and wide.	none
Lagoon reef	Common	none
Dead reef	Pago Pago harbour	none
Drowned reef	Taema bank, off Tutuila	none
Rocky coast	Savai'i, north Tutuila, Alofi.	none
Beach	Common	none
Open lagoon	Rose atoll	none
Dilute lagoon	Pala lagoon, Tutuila.	none
Freshwater lagoon	Swains I.	none
Estuary	Leone, Tutuila, mud flat with mangrove.	none
Offshore environments	no data available.	none

Conservation interest.

Considerable plant endemism, in montane and cloud forest; a number of unique birds; several largely undisturbed forest sites.

Rare or endemic species.

Sooty rail Porzana tabuensis;
White throated pigeon Columba vitiensis;
Samoan ground dove Gallicolumba stairii - Western Samoa only;
Island thrush, Turdus poliocephalus samoensis, Western Samoa only;
Mao, Gymnomyza samoensis, endemic to Samoa; all in lowland scrub habitats.

Grey duck, Anas superciliosa in freshwater marshes.
Halcyon chloris mannae)
Aplonis Tabuensis mannae) endemic to Manua group.
Clytorhynchus vitiensis powelli)

Five endemic subspecies of bird in Futuna, two shared with Alofi.

Erythrina Rusca and Xylocarpus moluccensis - trees at their easternmost limit in Samoa.
Ifilele tree Intsia bijuga - beach and lowland forest.
Palacca palm.
Sea tree Parinari insularum.

Conservation Legislation.

American Samoa: some U.S. federal legislation applies.
Western Samoa: National Parks and Reserves Act adopted 1974;
pigeon hunting controlled, other birds protected (enforcement not good).

Wallis and Futuna : none known.

Existing Reserves.

Rose Atoll (National Wildlife Refuge).

Proposed reserves.

WESTERN SAMOA
(From UNDAT-IUCN study announced at South Pacific Conference on National Parks.)

Nu'utele Island Group, off eastern Upolu, beach and lowland forest, fringing reef.
O Le Pupu, south central Upolu, lowland forest, coastal scrub, rocky coast.
Lake Lanoto'o, central Upolu, montane forest and three crater lakes.
Lake Olomaga, south east Upola, lowland and sub-montane forest, two crater lakes good bird populations.
Mount Silisili, central Savai'i, sub-montane, montane and cloud forest and recent lava flows (rock desert) with vegetation appropriate to various elevations.
Tafua, south east Savai'i, largely undisturbed lowland forest
Mount Vaea, Upola, lowland and submontane forest.
Lata forest, Savai'i, submontane and montane forest.
Cape Puava Forest, Savai'i, lowland forest, rocky coast and fringing reef.
Apolimafou, Upola, freshwater swamp and fringing reef.
Vaipa, Upola, freshwater swamp and swamp forest.
Mangaloa, Savai'i, swamp forest.
Taupou's Grave Lava Flow, Savai'i, lava flow (rock desert) with traditional significance.
Lake Mafane, Savai'i) Crater lake with montane and swamp forest.
Lake Mautalano, Savai'i)
Tiavi, Upolu.)
Fuipisia/Sopo'aga, Upolu) riverine forest and birds.
Matautu, Upola)
Tufutafoe, Savai'i) lowland swamp forest.
Vailoa Savai'i, coastal swamp forest and mangrove.
Pata, Upola, mangrove forest.
Fusi/Tafitoala, Upolu, mangrove forest and fringing reef.
Sa'anapu, Upolu, mangrove forest.
Sato'alepai, Savai'i, mangrove forest.
Palolo Deep, Upolu, lagoon reef.
Aganoa, Upolu, rocky coast and fringing reef.
Nu'usafe'e Island, Upolu, coral reef and islet.
Salamumu, Upolu, fringing reef and palolo breeding area.
Leanamoea, Savai'i, fringing reef with freshwater spring.
A'opo Cave, Savai'i, with cave fauna.
Satuimalufilufi/Fuailolo'o, Upolu.
Fusi/Tafitoala, Upolu.

Recommended reserve types. (in addition to above)

AMERICAN SAMOA.
Faimulivai Marsh (Aunu'u Crater) only remaining undisturbed coastal marsh in American Samoa and habitat for Grey Duck - 14 ha.
Lowland and montane forest areas on Tutuila and Manua group.
Pala lagoon, Tutuila, mangrove and dilute lagoon.
Pala (mud) Lake Aunu'u - unique habitat with Mangrove, Grey duck area.
The marine and lagoon environments of Swain Is. should be surveyed for possible conservation interest.
Coastal and reef reserves at Lepisi Point, Ogegasa Point and perhaps other sites on Tutuila.
Cave behind Anapeapea Cove, Tutuila.

WALLIS AND FUTUNA.
Lowland and montane forest, grassland and coastal reserves in Wallis and Futuna.

References and sources.

Visits and detailed studies in Western and American Samoa, including participation in UNDAT-IUCN survey for a National Parks System for Western Samoa, by C.W. Holloway and C.H. Floyd.(Report yet to be released).
W. Art Whistler, "Inventory and mapping of wetland vegetation in the Territory of American Samoa", Report to U.S. Army Corps or Engineers, April 1976.

A terrestrial inventory for conservation is being undertaken in American Samoa, but the results have not been available for this report.

X. TUVALU- TOKELAU ISLANDS.

Government: United Kingdom (Tuvalu); New Zealand (Tokelau Islands.)

Island Types: Inhabited atolls; subject to hurricanes.

Biomes.	Description.	Conservation status.
Mangrove forest	Rhizophora, central swamp of Funafuti.	none
Atoll/beach forest	Small areas on Nukunono	none
Scrub	Present	none
Seabird rookeries	Probably present	none
Sea Turtle nesting areas	Probably present	none
Algal bed	lagoon bottoms, reef flats.	none
Animals in sediments	Lagoon bottoms.	none
Algal reef	Common	none
Coral reef	Common	none
Windw rd atoll reef	Common	none
Leeward atoll reef	Common	none
Lagoon reef	Common	none
Drowned reef	Nui ?	none
Beach	Common	none
Open lagoon	Common	none
Closed lagoon	Nanumanga	none
Offshore environments	No data available	none

Conservation Legislation.

Tuvalu: Birds probably protected under former Gilbert & Ellice Island Wildlife Ordinances; enforcement difficult.
Tokelau Islands: none.

Existing reserves.

none.

Proposed reserves.

none.

Recommended reserves.

Small samples of native vegetation.
Appropriate series of reef and lagoon environments, perhaps including Kosciusko Bank.
Seabird and turtle breeding areas, if any.

References and sources.

Douglas, 1969.

VI GILBERT ISLANDS - NAURU.

Government: Gilbert Islands (U.K.) including Ocean Island; Nauru (Independent)

Island types: All atolls except Ocean Island and Nauru which are elevated reefs. Rainfall decreases southward; occasional droughts.

Biomes.	Description.	Conservation status
Mangrove forest	on Tarawa, Abemama	none
Atoll forest	Remnants principally on small islets	none
Scrub	Common on small islets, undeveloped areas, and on Nauru and Ocean Island.	none
Permanent lake	Buada lagoon on central plateau of Nauru.	none
Seabird rookeries	On some small islets, with some human predation.	planned
Sea turtle nesting areas	On some small islets.	planned
Algal bed	Common in lagoon and on reef flats.	none
Seagrass bed	lagoon bottoms	none
Animals in sediments	Lagoon bottoms	none
Coral reef	Common	none
Windward atoll reef	Common	none
Leeward atoll reef	Common	none
Fringing reef	Around Nauru and Ocean Island, and several reef islands without lagoons	none
Lagoon reef	Common	none
Drowned reef	N.W. side of Tarawa	none
Beach	Common	none
Open lagoon	Most atolls	none
Closed lagoon	Central Nikunau, landlocked	none
Offshore biomes	No data, seamounts present	none

Conservation Interest.

Inhabited and thus largely disturbed islands of little terrestrial conservation interest. The few remaining patches of atoll forest are some value, as are the few small islets used by turtles or seabirds for breeding. Not enough is known of the marine environments to assess their significance, but typical samples of the different types should be conserved. Seabirds are considered a desirable item of diet and hence are subject to human predation, and sometimes wanton destruction, whereven access to rookeries is possible.

Rare or endemic species.

None reported.

Conservation legislation.

Gilbert Islands: recently revised Wildlife Protection Ordinance (1975), largely for sea bird protection (most birds fully protected throughout the area), but enforcement difficult; plans for improved Fisheries Ordinance.

Nauru : none.

Existing reserves

None.

Proposed reserves

Kotabu and Nabini Islets, Butaritari (Atoll forest (Pisonia) and breeding seabirds rookery).

Noumantong Islet, Nonouti. (Pisonia)

Teirio Islet, Abaiang. (Turtle nesting area).

These could be managed by island councils, with some exploitation permitted under controlled conditions.

Recommended reserve types

Any remaining areas of natural atoll vegetation.
Seabird and sea turtle breeding areas.
Examples of marine ecosystems.
Land crab reserves.

References and sources

Visits to Tarawa and Butaritari (Gilbert Islands), and Nauru.

Mark Goodwin, Assistant Secretary, Ministry of Local Government and Rural Development;

R.N. Bryden, Chief Agricultural Officer;

and many other government officers and individuals, whose assistance is appreciated.

M.A. Hoyle, "Conservation in the Gilbert and Ellice Island Colony" unpublished report, 1975.

Douglas, 1969.

XII MARIANA ISLANDS.

Government: Guam, United States Territory; Northern Marianas, United States Trust Territory in process of becoming United States Commonwealth.

Island Types: Northern Mariana Islands, Uracas (Farallon de Pajaros) to Anatahan are a series from an almost barren active volcano to densely colonised young volcanic islands. Islands from Farallon de Medinilla to Guam are largely raised coral platforms. Weathered volcanic soils are found in southern hills and plains of Guam which has a limestone cap on the highest southern volcanic ridge. There are several raised coral islands within the Guam reef and low islets on reefs of Guam and Saipan. Rainfall is somewhat seasonal and hurricanes occasional.

Biomes.	Description.	Conservation status.
Lowland rain forest	Lowland forest of small stature occurring in areas of mostly limestone rock, little soil, humus accumulation from trees. 'Limestone forests' of similar physiognomy and species composition found on both limestone rock in southern Mariana Islands and, with fewer species on lava in Northern Mariana Islands.	On Guam reserves include: Anao, Y-Piga, an area behind the University of Guam, Ritidian and Pati point reserves.
	Forests of the S. Mariana Islands especially Guam, are a rich mixture of broadleaf trees up to about 25m., sometimes of 2 strata, with little to dense undergrowth. A few of the major species include: Artocarpus mariannensis, Elaeocarpus sphaericus, Merilliodendron megacarpum, Ficus spp., Pandanus fragrans, P. dubius, Cycas circinalis, the endemic genus Guamia mariannae and rare endemics such as Serianthes nelsonii, Tabernaemontana rotensis, Hernandia ovigera and Heritiera longipetiolata. These forest contain the greatest percentage of endemics and provide habitat for endangered and threatened species of birds as well as fruitbats and coconut crabs.	No reserves in North Mariana Is.
Bamboo forest	Limited areas of tall bamboo.	none.
Cloud forest	Limited area on top of Mt. Lamlam, Guam, and possibly Mt. Tapachau, Saipan, cauldera of Agrihan, Alamagan and Anathahan.	none
Riverine forest	Forests of moist ravines are mostly gone on Guam except for areas of Fena dam and some southern rivers and ravines. Trees are generally below 25 m. with abundant undergrowth including Areca catechu, Pandanus fragrans, P. dubius, Cycas circinalis; some forests of Heterospathe elata palms and one Barringtonia racemosa swamp along river.	Some ravine forest included in Cotal reserve.
	In Northern Mariana Islands, ravines on outer slopes of at least Anatahan, Alamagan, S. Pagan and Agrihan represent little explored forests in which endemic tree ferns, Cyathea alamagensis, seeded bananas, and other rare and probably yet to be described species occur.	Area about Fena lake, though not declared a natural reserve is protected as

Biomes.	Description.	Conservation status.
		it is in a military reserve.
Mangrove forest	Limited areas of Mangrove in S. Mariana Is. including Rhizophora stylosa, R. apiculata, Lumnitzer littorea, Bruguiera gymnorrhizia.	none
Atoll/beach strand forest	Beach forests occur inland of beach scrub in S. Mariana Islands, especially Guam and include mostly Pan-Pacific species as well as some endemic species including Piper guahamense and Taeniophyllum mariannense. These forests usually grade into limestone forests. Leucanna insularum var. guamense occurs in scrub and low forest on Cocos Island and a few areas of the southeast coast of Guam.	Some forest included in Ritidian and Pati point reserves. No Leucaena insularum areas protected.
Woodland	Limited areas of low forests of N. Mariana Is. in lee areas on relatively deep, dry, organic rich soils. Also man-created areas of exotic species, especially on Guam.	none
Scrub	1) beach along coasts of S. Mariana Is., especially Guam, Saipan, Tinian, made up of Pan-Pacific species such as Scaevola taccada, Messerschmidia argentea, and in some areas Leucaena insularum var. guamense.	Parts of Ritidian, Anao, Pati Point reserves on Guam.
	2) Scrub occurs on rocky limestone coasts of S. Mariana Islands and small area of west coast of Pagan in N. Mariana area, the predominant species being Pemphis acidula.	
	3) Scrubland and thickets occur on volcanic rock and soils in coastal areas and shallow ravines of N. Mariana Is., including a curious low form of Scaevola taccada, and Pandanus tectorius Ficus spp. and Hibiscus tiliaceus.	none
	4) Scrubland thickets and low forests of introduced Acacia confusa, especially on Saipan.	none
Serpentine vegetation.	Possibly some areas of savanna in southern Guam.	Possibly in Cotal reserve.
Dwarf scrub	Pemphis acidula and other low growth on coastal limestone in S. Mariana Is.	parts of Ritidian Pati Point reserves on Guam.

Biomes.	Description.	Conservation status.
Woodland savanna	Dominated by Miscanthus floridulus, Dimeria chloridiformis and other grasses and sedges with forest islands of Pandanus fragrans and Casuarina equisetifolia and areas of ravine forest in parts of S. Guam.	Possibly parts of Cotal reserve.
Tree savanna	Dominated by Miscanthus floridulus with scattered Casuarina equisetifolia and/or Pandanus fragrans, and in volcanic N. Mariana Is., Trema orientalis and other small trees. A few upper areas of Guam and N. Mariana Is. with tree ferns of genus Cyathea.	none
Scrub savanna	Community of mostly native low scrub and bushes in limited areas of southern Guam including some endemics. Dominant species Wikstroemia elliptica, Melastoma marianum, Geniostoma micranthum Timonius nitidus and Phyllanthus saffordii, amid tall Miscanthus floridulus grass and lower Dimeria chloridiformis. On volcanic N. Mariana Is., thickets of Pandanus, Ficus and Hibiscus tiliaeceus amid Miscanthus grassland.	Cotal reserve Guam.
Tropical grassland	Extensive fire adapted areas of almost pure Miscanthus floridulus in S. Guam and N. Mariana Is., and extensive areas of introduced Pennisetum purpureum, especially on Saipan.	Perhaps part of Cotal reserve, Guam.
Flood savanna	Possibly limited areas in some caulderas of N. Mariana Is.	none
Fresh Water Marsh	Limited areas of fresh water marsh with Scirpus littoralis and Cyperus spp. and some Achrosticum aureum in Guam, Saipan and possibly other Mariana Is.	none
Salt marsh	Limited area of salt marshes with grasses including Sesuvium portulacastrum, along coasts and on limestone rock subject to tidal flooding.	none
Barren desert	Limited areas of barren limestone rock and sand occur in S. Marianas. Extensive areas of barren recent volcanic rock and sand occur in N. Mariana Is.	Some sand beach in Ritidian, Anao reserves on Guam. none in N. Mariana Is.
Reed swamp	Extensive Phragmites karka reed swamps, especially in Agana, Guam, and in smaller patches scattered in low areas of savannas and about lake Susupe, Saipan.	none

Biomes.	Description.	Conservation status.
Submerged rooted aquatics	Very limited areas in at least Guam including rare native plants and endemic water fern	none, except possibly Agana Springs on Guam which is of uncertain status and portion of Cotal reserve.
Permanent lake	Lake Susupe, Saipan; freshwater lake with hot sulfurous springs on Pagan; and man-made lake Fena on Guam.	none, Fena lake is protected by being water reservoir and within military reservation.
Intermittent lakes	Scattered temporary small lakes possibly including limited area of cauldera of Anatahan.	none
Brackish lake	Fairly large brackish lake on Pagan and scattered small areas elsewhere	none
Mountain stream	Few at least in S. Guam.	none, except part of Cotal reserve which is subject to use as re-creation area.
Lowland river and stream	Largest include Talafofo, Pago, and Umatac rivers on Guam.	none
Seabird rookeries	At least Anae islet and Orote Point on Guam, Bird Island on Saipan, and most volcanic N. Mariana Islands especially Farallon de Medinilla Guguan, Maug and Uracas.	none, Farallon de Medinilla used as bombing range.
Sea turtle nesting areas	No recent reports, formerly at least at Ritidian beach, and possible southern beaches of Guam, and Tanapag beach, Saipan.	none, except part of Ritidian Point beach area which is subject to recreational use and disposal of munitions.
Cave	Dry, freshwater and marine caves at least on Guam and Saipan, with cave adapted biota.	none
Algal bed	Common on lagoon bottoms and reef flats.	none
Seagrass bed	Present	none
Animals in sediments	Common	none
Coral reef	Common	none

Biomes.	Description.	Conservation status.
Fringing reef	Common, often broad approaching barrier reef	none
Lagoon reef	Present	none
Dead reef	Guam, Saipan, etc. often the result of Acanthaster or fishing with explosives.	none
Rocky coast	Common	none
Beach	Common	none
Open lagoon	Some examples, Guam, Saipan, Tinian.	none
Marine lake) Marine cave)	Grotto on Saipan	none
Offshore environments	No data available.	none

Conservation interest.

Limestone forest and scrub savanna areas of Guam contain many uncommon to rare endemic and native species. There is no protection for a number of very limited biomes including cloud forest where many uncommon native and endemic species occur and freshwater habitat which provides habitat for very rare birdlife.

Saipan, Tinian and Aguiguan are much disturbed, Rota less se. Remaining areas of natural vegetation, most of them on cliffs contain rare native and endemic species of plants and birds.

The islands of the Northern Marianas from Farallon de Medinilla to Uracas are of prime interest for the study of biotic colinization under natural conditions.

Rare or endemic species.

PLANTS

Serianthes nelsonii	only 2 trees known - in limestone forest of Ritidian area.
Tabernaemontana rotensis	only one tree known, limestone forest.
Hernandia ovigera	limestone, Guam, Rota
Heritiera longipetiolata	limestone forest, some trees present above Asanite bay.
Merrilliodendron megacarpum	limestone forest, known from one unprotected area.
Xylosma nelsonii	Guam, Rota savanna, mangrove coast.
Lysimachia mauritiana	Maug.
Fagraea galilai	Mt. Lamlam limestone forest.
Solanum guamense	few plants known from savanna and along rivers.
Styphelia mariannensis	forests of Alamagan
Boerlageodendron mariannense	forests of Rota

Ceratopteris gaudichaudii	freshwater areas, Guam.
Potamogeton mariannensis	freshwater, Cotal area.

and a numer of others. Even the especially rare plants have no legal status. A list of these and other rare plants is being developed as the endangered and threatened species of Guam under the Endangered species act.

BIRDS

Marianas crimson crowned fruitdove.	limestone forest.
Nightingale reed warbler	marsh and reed swamp.
Marianas mallard (Possibly extinct)	freshwater areas.
Marianas crow	limestone forest
Marianas megapode	found only in N. Mariana Islands probably extinct in southernmost Mariana Is.

These are a few of many rare and endangered birds.
An official listing of the rare and endangered animals of Guam is being prepared in accordance with endangered species act.

REPTILES

Perochirus aciculatus	Micronesian gecko known from atoll forest of Cocos Island and one specimen from limestone forest.
Emoia slevinii	known only from Cocos Is., Ritidian (one specimen) and Tinian (one specimen), atoll and possibly upland forest skink.
Sea turtles	all but green sea turtles rare on Guam and N. Mariana Is. Endangered species law makes it illegal to sell hawksbill shell on Guam.

MAMMALS

Dugong	only one ever reported from Cocos lagoon, Guam.
Fruitbat	probably not more than several hundred left on Guam where they are confined to remote limestone forests but may once have also inhabited ravine forests, savannas and other biomes. Present also in N. Mariana Is. in decreasing numbers due to hunting ressure. Illegal to hunt fruitbats on Guam where they nevertheless command high prices.

OTHER

Coconut crabs	becoming less common, especially on Guam and Saipan. Natural populations of other islands including volcanic N. Marianas under constant to sporadic hunting pressure.

Conservation Legislation.

The Government of Guam has established hunting seasons which are closed for the more rare species. Federal Endangered species law applies to Guam and there have been some efforts to implement and enforce it on Guam. Fishing with poisons and explosives is illegal.

Existing reserves.

GUAM.
Conservation areas totaling 1,150 ha. were established in November 1968. Others have been established or considered since making the expected area to be devoted to conservation 4.46%. Conservation areas include Cotal, Anao, Y-Piga, and an area behind the University of Guam established by the Government of Guam, and Ritidian Point and Pati Point by the Navy and Air Force. Reserves are largely uninventoried, some are subject to damage or recreational development. Military reserves have uncertain legal conservation status.

NORTHERN MARIANAS.
No reserves.

Proposed reserves.

Facpi Point, Mt. Lamlam, Fouha Point and Puntan dos Amantes are being considered for the National Registry of Natural Landmarks. There is also interest in setting aside the Chalan-Palii, Shroeder-Sasalaguan areas as natural areas. The Guam Science Teachers Association has had 2 sites set aside as natural areas for ducational purposes. One is George Washington High School Limestone forest Nature Trail, the other the Agana Springs park. Other natural areas in the vicinity of schools are anticipated.

The IBP has placed the N. Marianas islands of Uracas, Maug, Gugan and Farallon de Medinilla on 'List A', recommendations for International Scientific Reserves, with the protection of areas of the rest of the chain also recommended.

The Mariana District Planners' Office of the Trust Territory Government has suggested that all of the Northern Marianas from Anathan to Uracas be protected, except for Pagan on which large areas including the northern volcano and fresh and brackish lakes and the southern peninsula, are proposed In the limestone N. Marianas, the District Planning Office has suggested the protection of a number of areas including Bird Island, Forbidden Island, cliff and strand areas of Rota, Tinian and Saipan, the Susupe lake and a number of coastal areas and reefs of Saipan. This would protect the few areas of natural vegetation and habitat left on these islands.

Recommendations.

The boundaries of established and proposed reserve areas are not well known or defined and their biota is uninventoried. There is no programme to administer natural reserve areas as protected areas. In the Ritidian Point area, one of the three specimens of Serianthes nelsonii known to exist was recently bulldozed. Part of the reserve behind the University of Guam was also bulldozed and the rubble dumped on the portions of the reserve on the cliff and terrace below. The unique Cotal reserve area is subject to reafforestation with exotic species and development as a recreation-tourist area.

Recommendations (contd)

There is a need to map and inventory conservation reserves on Guam to determine unrepresented biomes such as freshwater areas and undisturbed savanna shrub communities. The distinctions between reserves and natural areas and public and tourist recreation areas should be clarified and the areas administered accordingly.

In addition to those areas proposed, at least three other areas should be considered for protection or limited use as natural areas. These include an additional representative area of savanna shrub community and ravine forest comparable to that found at the Tarzan River area in the Cotal reserve. While the individual species making up this shrub community vary from scattered to rare, areas where they exist as a natural co munity are rapidly disappearing. The protection of this type of community which consists almost wholly of native and endemic species should take priority as should the maintenance of the Tarzan River area as a nature reserve.

Other areas include the Asiga area which provides spectacular examples of limestone forest including a portion dominated by Guamia marianae, atoll beach forest, coastal shrubland and shallow water marine habitat. Cocos Island has good populations of organisms not common in other areas such as large Leucaena insularum, coconut crabs and reptiles.

The uninhabited N. Mariana Islands from Farallon de Medinilla to Uracas are prime areas for natural reserves, and should receive top priority. Recent field visits to the island of Asuncion give grounds for giving it more complete protection than earlier realized. This is a recommendation on the basis of : 1) a new species of tree,

2) Much of the summit of Asuncion is covered not with swordgrass as on other islands but predominantly with ferns. This may represent the original upper cover of summits before the advent of human burning activity which encourages swordgrass.

3) Asuncion is the only uninhabited island with fairly natural vegetation which is large enough to permit the development of a relatively homogeneous forest biome. Other islands in the chain are either too disturbed or too small and exposed to the elements to allow such development.

4) Although the endangered species Megapodius laperouse is found on other islands, Asuncion represents the largest area in the world where it is not threatened by man, pig or monitor lizards.

5) Because of its height, Asuncion offers a natural situation which might be compared with the other highest peaks in Micronesia which are much more subject to disturbance.

References and Sources.

M.V.C. Falanruw, Yap Institute of Natural Science.

Visits to Guam and Saipan.

Douglas, 1969.

Fosberg, F.R. 1973. On Present Condition and Conservation of Forests in Micronesia. In Planned Utilization of the Lowland Tropical Forests, Symposium of the Pacific Science Association, Bogor, Indonesia.

Fosberg, F.R. Falanruw, M.V.C. and Sachet, M-H. 1975. Vascular Flora of the Northern Mariana Islands. Smithsonian Contributions to Botany.

Stone, B.C. 1970. The Flora of Guam. Micronesica (6).

XIII CAROLINE ISLANDS.

Government : United States Trust Territory.

Island Types: Continental high islands (Yap and Palau), volcanic high Islands (Truk, Ponape and Kusaie), at least Ponape with high orographic rainfall; raised coral (Fais, rock islands of southern Palau), and wide variety of atoll situations. Extremely wide variety of marine types.

Biomes	Description	Conservation status.
Lowland rain forest	Mixed broadleaf forest on old weathered basalt in Palau, Truk and Ponape and metamorphic and volcanic soils on Yap. Forests of Palau and Yap are dense, species rich (especially on Palau) with trees less than 25 m. tall presenting uneven canopy. Undergrowth is limited to abundant in areas where canopy is broken. Epiphytes uncommon to common, especially in Palau. Common trees are Campnosperma brevipetiolata, Manilkara, Calophyllum, Eugenia and Ficus. Tree ferns are present in Palau.	none
	Limestone forests are rich mixture of trees generally below 20 M. on raised coral island of Fais and "rock island" of S. Palau growing on recrystalized coralline limestone with very little soil. Endemics include palm Gulubia palauensis.	some limestone forest in Ngerukewid reserve.
Montane rain forest	Forests on top of Mt. Winibot, Tol (Truk) and lower and middle elevations of Ponape and Kusaie, are moist tall dense mixed broadleaf forests including Campnosperma, Myristica, Eugenia, Couthovia, sometimes with palms Clinostigma spp., Metroxylon amicarum and Ptychosperma ponapensis which also form palm forests at middle elevations.	none
Bamboo forest	Some limited areas dominated by bamboo	none
Cloud forest	moist tops of Ponape and Kusaie. Trees not over 20 m., including endemic Pandanus patina and Lepinia, many ferns, mosses and orchids.	none
Riverine forest	Dense forest along rivers on all high islands. Trees include Campnosperma, Semicarpus, Barringtonia racemosa , Pandanus, Hibiscus tiliaceus and Piper betle.	none
Swamp forest	Inland of mangrove and in other low areas. Species include Barringtonia racemosa, Terminalia carolinensis, Pandanus spp. Hibiscus tiliaceus, Samadera indica and Meteroxylon.	none

Biomes.	Description	Conservation status.
Mangrove forest	Well developed mangroves along coasts and estuaries of all high islands, very limited areas on some low islands (Elato, Pingelap, Woleai and others). Species include Rhizophora mucronata, M. apiculata, Bruguiera gymnorhiza, Sonneratia alba, Lumnitzera littorea, Nypa fruticans, and Xylocarpus granatum.	none
Atoll/beach forest	Mixed broadleaf forests of central portions of atoll and other islets and level areas behind sand beaches of high islands made up of common widespread species including Ochrosia oppositifolia, Guettarda speciosa, Pisonia grandis, Thespesia populnea, Hernandia sonora, Casuarina equisetifolia, Pandanus tectorius, Cordia subcordata.	none
Woodlands	1) Patches of woodland in some savanna areas	none
	2) Man planted areas with exotics	none
Scrub	1) Tall thickets on outer edges of limestone forests including much Pandanus, Ficus spp. and Hibiscus tiliaceus.	some in Ngerukewid reserve.
	2) Coastal shrubland and thickets of mostly Pan-Pacific species including Scaevola taccada & Messerschmidia argentea on sandy beaches and Pemphis acidula on rocky coasts.	"
	3) Scrub of savanna and shallow ravines including Myrtella, Decaspermum, Melastoma, Pandanus.	none
	4) Scrubland of laterized and stripmined soils generally consisting of stunted trees	none
Dwarf shrub heath	1) along rocky exposed coasts, especially Pemphis acidula.	none
	2) On laterized and stripmined soils, including Gleichenia linearis, prostrate Sycopodium cernuum and stunted scrub.	none
Bog	None reported	
Woodland savanna	Open savanna areas on clay with sometimes extensive areas of tall shrubland and woodland.	none
Tree savanna	Low growth of grasses, sedges and ferns on clay soils with isolated trees scattered over area including Pandanus and sometimes Casuarina and other species.	none
Shrub savanna	shrubs such as Myrtella, Decaspermum, Melastoma	none
Grassland	Open areas predominantly of grasses and sedges generally resulting from repeated burning	none

Biomes.	Description	Conservation status
Flood savanna	Areas of savanna generally predominated by sedges, ferns and grasses which are easily waterlogged and flooded. Utricularia spp. may often be found in these moist areas.	none
Fresh water marsh	Constant to usually flooded areas often filled with sedges and Hanguana. Often utilized for taro patches.	none
Non-tidal salt marsh	Low, usually muddy areas near coast or mangroves, often with large woody fern Achrosticum aureum.	none
Tidal salt marsh	Low, muddy areas near coasts and mangroves subject to tidal flooding supporting salt resistant grasses and species such as Sesuvium.	none
Rock desert	1) limited areas of laterized clay rocks and stripmined areas with little vegetation in Palau.	none
	2) some boulder strewn shores and rock accumulations on reef islets mostly devoid of vegetation.	none
Reed swamp	Scattered small to large swamps, generally filled with Phragmites reeds.	none
Submerged aquatics	Water ferns and other aquatic vegetation in lakes, ponds and taro patches.	none
Floating aquatics	Limited areas of mostly introduced species in some lakes, ponds and taro patches.	none
Lake and pond	Permanent, intermittent, saline, fresh and brackish natural and man-made impoundments, ponds and lakes. Some found in the middle of limestone islets in Palau are especially interesting biologically.	none
Mountain streams	Present in all high islands, especially Ponape. Macrobrachium shrimp and eleotrid fish live in some.	none
Lowland river	Present on all high islands. Macrobrachium shrimp, eleotrid fish and freshwater eels are found in some	none
Seabird rookeries	Many rookeries on uninhabited outer islands such as Gafrut, East Fayu and Helens reef.	none
Sea turtle nesting areas	Most important include Ngulu, Ulithi, West Fayu, Gafrut, Pikelot, Elato, Oroluk in Yap district, probably similar numbers in other districts.	none except traditional practices.

Biomes	Description	Conservation status.
Cave	present	none
Algal bed	Many kinds, lagoon bottoms, reef flats, etc.	none
Seagrass bed	Many varies and extensive seagrass beds especially on silted sands fringing mangroves around high islands including Thalassia, Enhalus, Ruppia, Halophila.	none
Animals in sediments	Common	none
Algal reef	Common	none
Coral reef	Common	none
Windward atoll reef	Many types and examples	none
Leeward atoll reef	Many types and examples	none
Barrier reef	Extensive, (Palau, Truk, Ponape)	none
Fringing reef	Yap, Kusaie, Truk.	none
Lagoon reef	common	none
Dead reef	Probably present	none
Drowned reef	Present	none
Rocky coast	Present, Palau, Fais.	none
Beach	Common	none
Open lagoon	Common	none
Closed lagoon	Namoluk, Eauripik.	none
Estuary	Present on High islands.	none
Marine lake	Limestone islands of Palau, have distinctive limited fauna.	none
Marine cave	Present	none
Offshore environments	All present but little data.	none

Conservation Interest.

Very great. Very rich area of Pacific. Limited research which has been conducted reveals rich flora and fauna with many unique forms. This area is under development pressure and many biomes are currently threatened.

Rare or endemic species.

Floras are incompletely inventoried so it is difficult to list rare plants at this time. Many endemics are present.

Endangered species include : Micronesian Megapode, Scops owl, Nicobar pigeon, Yap white eye, Large Micronesian Pigeon, Truk greater white eye, Ponape greater white eye, brindled white eye, mountain starling, short eared owl and Micronesian crimson crowned fruit dove: leathery turtle, ridley turtle, dugong and others many of which are endemic. See also IUCN red data book.

Conservation legislation.

Trust Territory wide law prohibits the taking of sea turtles from June - August 31, and 1 December - January 31. It is illegal to take hawkbills under 27 inches or green turtles under 34 inches. It is also illegal to take any eggs. Little publicity or enforcement of this law.

Federal Endangered Species Act prohibits the import of hawksbill shell and products of other list endangered species to the United States. Little enforcement.

Palau Code: section 202 protects most birds and their eggs, section 203 protects dugongs, section 205 prohibits use of explosives in marine waters, section 206 creates a Fish and Game Commission.

Yap District Legislature recently established fruitbat hunting season but research is needed to determine most effective seasons for protection.

Yap Magistrates of some Municipalities have prohibited spearfishing at night with flashlights in certain areas.

Some traditions regulating resource use are observed in Yap district but there is some pressure to change them. They are often transgressed by non-Yapese and not often backed by written legislation.

Similar legislation probably exists in the rest of the Carolines, but means for enforcement are variable or completely lacking.

Existing reserves.

The Ngerkewid Islands (Seventy islands) Wildlife reserve was established in Palau by District Order since 1958. Enforcement is variable.

Proposed Reserves.

The IBP has proposed Helen's Reef and East Fayu as International "Islands for Science" reserves, and the establishment of a National Marine Park to include the Ngerukewid Reserve, other rock islands, coasts and lagoons from Koror to Peliliu and westward to the barrier reef.

An acting Fisheries Officer for Ponape proposed that Oroluk be protected as a sea turtle reserve.

Recommended reserve types:

There is an urgent need to inventory the biomes of the Caroline Islands and their indigenous biotic resources as this is a rich area subject to great development pressure in the near future.

Priorities for resource protection based on our present limited knowledge include at least :

Native cloud forests on Ponape and Kusaie.

Native forest on top 100 metres of Mt. Winibot, Tol, Truk.

Native forest areas on Babeldoob, Palau and Yap.

Turtle rookeries, and sea bird rookeries.

Those islets and areas recommended by the IBP.

Examples of all biomes present including atoll and reef types.

References and Sources.

M. V.C. Falarruw, Yap Institute of Natural Science.

Visits to Palau, Kyangle, Angaur, Yap, Truk, Ponape, Ant, Pakin.

Code of the Palau District, Palau District Legislature, 1971.

Memorandum of April 11, 1974 from Acting District Fisheries Specialist, Ponape to District Administrator, Ponape regarding the establishment of District Law making Oroluk Island a turtle Sanctuary.

Notice from J.B. Mackenzie, District Administrator, Ponape to all residents and visitors regarding Trust Territory laws for Conservation of Sea Turtles and Black Lip Mother of Pearl Oyster Shell.

Douglas, 1969.

Fosberg, F.R. 1973. On Present Condition and Conservation of Forests in Micronesia. In Pacific Science Association Standing Comm. on Pacific Botany. Symposium: Planned Utilization of the Lowland Tropical Forests. Agu.1971. Bogor, Indonesia.

XIV MARSHALL ISLANDS.

Government : United States Trust Territory.

Island Types: Large variety and number of atolls.

Biomes.	Description.	Conservation status.
Mangrove forest	Limited in small depressions in few areas, Jaluit, Ailinglaplap, Mejit. Some Bruguiera planted in taro pits.	none
Atoll/beach forest	Variety of types of forest in central parts of islets, usually dominated by planted coconuts, breadfruit, etc. Small remnants of natural forest made up of Pan-Pacific species persist on some northern atolls such as Wotho. Forests may contain Ochrosia oppositifolia, Guettarda speciosa, Pisonia grandis, Intsia bijuga, Hernandia sonora, Scaevola taccada, Thespesia populnea, Casuarina equisetifolia. Pandanus tectorius, Cordia subcordata.	
	In some forests, one species stands may develop including Pisonia grandis, Ochrosia oppositifolia and, on limestone rock Pemphis acidula.	none
Scrub	Scrublands and thickets of common Pacific strand species including Scaevola taccada, Tournefortia argentea and Pemphis acidula occur along shores of most islands. In some cases there is scrub forest consisting almost wholly of Pemphis or Messerschmidia.	example of Messerschmidi scrub forest on N. Marshall Is. reserve area.
Grassland	Smaller islets of Ujelang, Rongerik, Ailinginae, Jaluit, Wotje.	none
Tidal salt marsh	Some strand species of mainly grasses on coast and in depressions subject to tidal flooding.	none
Rock desert	Limited areas of bare rock and sand present on low islets, sometimes awash at high tide	none
Permanent lake	Freshwater pond on Lib, man-made depressions for wells and taro patches.	none
Sea bird rookeries	At least on Ujelang, Pokak (Taongi), Bikar.	none
Sea turtle nesting areas.	Bikar, Jemo, formerly Rongerik.	none
Algal bed	Present	none
Seagrass bed	Present	none
Animals in sediments.	Common in lagoons	none

Biomes.	Description	Conservation status.
Algal reef	Common	none
Coral reef	Common	none
Windward atoll reef	Common	none
Leeward atoll reef	Common	none
Lagoon reef	Common	none
Beach	Common	none
Open lagoon	Common	none
Closed lagoon	Namorik	none
Man-made environments	include dredged spoil, landfills and some planned maricultural areas.	none
Offshore environments		none

Conservation interest.

Turtle and sea bird rookeries especially valuable, also examples of relatively undisturbed atoll development.

Rare or Endemic Species.

Endemic species of grass Lepturus gassaparicensis present on Pokak, possibly Micronesian pigeons on Wotje. Many locally developed varieties of Pandanus.

Conservation Legislation.

Trust Territory wide law prohibits taking of sea turtles between June 1 - August 31 and December 1 - January 31. No hawksbills under 27 inches carapace length may be taken nor green turtles less than 34 inches carapace length, no taking of turtle eggs at any time. Little enforced.

Federal endangered species law prohibits the import of hawksbill shell into the United States.

Existing reserves.

Pokak (Taongi) bird rookery and location of endemic grass, and Bikar Bird rookery, turtle nesting area and atoll forest, are supposed to be protected by Order of the District Administrator.

Proposed reserves.

Wotho	atoll forest
Taka	sea bird rookery
Jemo	sea bird rookery and turtle nesting area

Recommended reserve types.

The recommended reserves above, and improvement of the status of Pokak and Bikar. Appropriate habitat area on Wotje for Micronesia pigeon if it still occurs. Samples of undisturbed windward and leeward atoll reefs, mangrove and lagoon environments.

Inventory of atoll types and biota, especially marine, to determine if additional reserves are needed.

References and sources.

M. V.C. Falanruw, Yap Institute of Natural Science.

Visit to Majuro.

Douglas, 1969.

Fosberg, F.R. 1973. On Present Condition and Conservation of Forests in Micronesia. In Planned Utilization of the Lowland Tropical Forests, Bogor, Indonesia.

XV. PHOENIX - LINE - NORTHERN COOK ISLANDS.

Government: Gilbert Islands (Phoenix and Line Is.): U.S.A. (Palmyra, Howland Baker, Jarvis and claims to others): Cook Islands (Northern Cooks).

Island Types: Atolls. Phoenix receive low rainfall, with periods of drought. Line Islands wetter to north.

Biomes.	Description.	Conservation status.
Semi-deciduous forest	Reported on Puka Puka.	none
Atoll forest	Common in small isolated areas, and On wet atolls (Palmyra, Washington, Fanning). Variable in composition with rainfall.	none
Scrub	Common and extensive	none
Bog	Washington, small area on Flint and probably elsewhere	none
Grassland	On drier islands	none
Freshwater marsh	Washington - around freshwater lake.	none
Permanent lake	Freshwater pools on Phoenix. Large lake on Washington.	none
Seabird rookeries	Common and extensive. Some of most important in the Pacific.	several sanctuaries.
Sea turtle nesting areas.	Common, especially Flint.	none
Algal beds	Common	none
Animals in sediments	Common	none
Algal reef	Probably common	none
Coral reef	Common	none
Windward atoll reef	Common	none
Leeward atoll reef	Common	none
Lagoon reef	Various types	none
Beach	Common	none
Saline Lagoon	Sydney (Partly modified for aquaculture), Malden, Christmas.	none
Open lagoon	Hull, Gardner, Carcline, Suvarov. Also various intermediates with closed lagoon.	none
Closed lagoon	McKean.	none
Brackish lagoon	Birnie	none
Offshore biomes	No data other than below	none
Offshore terrace	Malden	none
Inshore circulation cell	Christmas (eddy S.W. side)	none

Conservation Interest.

These islands contain the principal breeding areas of seabirds (and probably sea turtles) for the central Pacific, with rookeries containing many thousands and sometimes millions or birds. Their protection from undue disturbance is therefore most important.

There is an extreme gradient in rainfall across the province, with some of the wettest and driest atolls included within the group. The resulting range of atoll vegetation types is therefore of some interest, as are the distinctive saline and brackish lagoon biomes, and the freshwater habitats on Washington. A number of islands would benefit from control programmes to eliminate introduced predators, especially rats and feral cats.

Rare or endemic species.

Christmas Island or Reed Warbler (Conopoderas aequinoctialis) common on Washington (may be represented by sub-species on each of the Line Islands).

Red-tailed tropic bird (Phaethon rubricauda) not uncommon but subject to heavy human predation.

Sea turtles - populations decreasing - more management and protection needed.

Conservation Legislation.

See Gilbert Islands for Phoenix and Southern Line Islands, (most birds and Green turtle (chelonia mydas) fully protected throughout area; Cook Islands for Northern Cooks. Conflicting territorial claims may present problems in establishing reserve areas.

Existing Reserves.

Birnie	(Wildlife Sanctuary, Gilbert Is.)	seabird rookery.
McKean	(" " "	" "
Phoenix	(" " "	" "
Christmas	(" " "	" " (Proposed IUCN/WWF project assistance)
Malden	(Wildlife Sanctuary, Gilbert Is. and closed area)	" "
Starbuck	(Wildlife Sanctuary, Gilbert Is.)	" "
Canton	(Bird refuge, U.S.)	" "
Suvarov	(Bird Sanctuary, Cook Is.)	" "

Proposed Reserves.

Phoenix Islands National Park (possibly excluding Gardner, Sydney and Hull Islands.

Recommended Reserve types.

National or international reserve in Phoenix Islands (upgraded from wildlife sanctuaries), with Canton Island as communications link and surveillance centre, and including Enderbury, Birnie, McKean, Phoenix and Hull Islands, and possibly Sydney because of its saline lagoon. Gardner is apparently of little scientific interest, so the decision to include or exclude it should be made on other grounds. Regular enforcement visits (without landing on the island)

could be undertaken by government ships going to and from Christmas Is.

Improved protection of parts of Christmas needed, with proper surveillance. Most of the Line Islands, especially Vostok, Caroline, Howland, Baker, Jarvis, Malden and Kingman reef are candidates for reserve status, especially if existing predators can be controlled so that sea bird populations can recover.

Flint and Caroline deserve protection as turtle breeding areas, and other protective measures for turtles are needed.

On Washington, the bogs and perhaps the lake, including adequate areas of Christmas Island Warbler habitat, should be protected.

Forest area and Motu Kotawa (seabird rookery) on Pukapuka may deserve protection.

Appropriate samples of atoll forest, marine, and lagoon environments should be included in reserves to be established. Further studies of all marine environments are needed to determine areas of significance.

References and sources.

Line Islands Expedition, August - October 1974 (Government Report)

David R. Stoddart, unpublished report on scientific importance and conservation of Central Pacific Islands, January 1976.

Chave and Kay, 1974.
Douglas 1969.

Stoddart & Walsh, 1975.

NOTE: Clipperton Atoll, a dependency of French Polynesia, might well be included in this Biotic province, even though much further to the east. Because of its position, it may well have some conservation interest for its marine biomes.

XVI. COOK - AUSTRAL ISLANDS.

(Northern Cook Islands are included in province XV.)
Government: Cook Islands (Self governing, N.Z.), for Southern Cook Islands
French Polynesia (Austral Islands).

Island types: High volcanic islands, often with elevated reef surrounding central volcanic area; low islands (atolls).

Biomes.	Description	Conservation status.
Lowland rain forest	Raivavae, Tubuai, Mauke; remainder largely disturbed. Limestone forest on Rurutu	none
Montane rain forest	Central Rarotonga, Raivavae	none
Swamp forest	Probable	none
Atoll/beach forest	Present, particularly on atoll and reef islets	none
Scrub	Bracken scrub in frequently burned areas, Rarotonga, Tubuai, Rurutu.	none
Grassland	Tubai, upper mountain slopes and Rurutu.	none
Freshwater marsh	Mangaia, Rarotonga, Mauke, Mitiaro, Atiu.	none
Tidal salt marsh	Ngatangiia Harbour, Rarotonga.	none
Permanent lake	Centre of Mitiaro, with endemic eel; lake Tiriara on Mangaia	none
Mountain stream	On Rarotonga.	none
Seabird rookeries	Takutea.	none
Turtle nesting areas	Presumably present.	none
Algal bed	Lagoon bottoms and reef flats.	none
Animals in sediments	Lagoon bottoms.	none
Algal reef	Present.	none
Coral reef	Common	none
Windward atoll reef	Manuae, Palmerston.	Manuae.
Leeward atoll reef	Manuae, Palmerston.	Manuae.
Barrier reef	Aitutake, Raivavae, Tubuai.	none
Fringing reef	Common	none
Lagoon reef	Common	none
Beach	Common	none
Open lagoon	Aitutake, Palmerston.	none
Closed lagoon	Manuae	Manuae
Offshore environments	No data available	none
Seamount	present	none

Rare or endemic species.

Several endemic birds on Rarotonga in Montane forest, including:
Fruit dove Ptilinopus rarotongensis - common.
Starling Aplonis cinerascens - common.
Flycatcher Pomarea dimidiata - rare.
Mangaia kingfisher Halcyon rubicollaris on Mangaia.
Atiu swiftlet Collicalia sawtelli on Atiu.
Endemic sub-species of warbler Acrocephalus vaughani.
Endemic eel in lake Mitiaro.

Conservation Legislation.

Cook Islands: Conservation Act recently passed.
Austral Islands: (French Polynesia) See Society Islands.

Existing Reserves.

Manuae (offered as world marine park): atoll reef and closed lagoon biomes.

Proposed reserves.

Recommended reserve types.

Major mountain and forest reserve in central Rarotonga.
Takutea for seabirds.
Higher areas of Raivavae.
Limestone forest on Rurutu, and possibly a mountain grassland and ravine site.
Lake on Mitiaro.
Appropriate swamp and marsh biomes, and other terrestrial vegetation types.
Endemic bird habitats on Rarotonga, Atiu, Mangaia.
Barrier and fringing reef and lagoon examples.

References and sources.

Visit to Rarotonga.
S. Kingan and other Government officials.
Douglas, 1969.
Stoddart, 1972.
(The Australian Government has recently assisted with conservation studies in the Cook Islands, but the results have not been available for this report.)

XVII. SOCIETY ISLANDS.

Government: French Polynesia (France)

Island types: high volcanic islands, elevated reefs and five atolls.

Biomes.	Description	Conservation status.
Lowland rain forest	In coastal areas. Subject to much human disturbance.	Good example in Presqu'ile reserve, Tahiti.
Montane rain forest	Extensive in island interiors, several types may exist.	Mt. Marau reserve Tahiti.
Bamboo forest	Valley area of Raiatea and probably elsewhere.	none.
Cloud forest	On mountain peaks.	Mt. Marau reserve, but disturbed by road construction.
Riverine forest	In valley bottoms, largely disturbed	Presqu'ile reserve.
Atoll/beach forest	Common	none
Scrub	Often fern-dominated, on steep or disturbed slopes. Common	none
Grassland	On dry disturbed slopes.	none
Freshwater marsh	Two on Maiao.	none
Permanent lake	Two on Huahine, with interesting faunas: Lake Vaihiria, Tahiti.	none
Mountain stream	Common	Presqu'ile reserve.
Lowland river	Pepenoo, Tahiti.	none
Seabird rookeries	Islets on Tetiaroa, Tubai. Mophiaa, Fenuaura, Motuone.	proposed on Tetiaroa.
Sea turtle nesting areas	Mopihaa, Fenuaura, Motuone.	none.
Algal bed	Lagoon bottoms and reef flats.	none
Animals in sediments	Lagoon bottoms.	none
Coral reef	Common	none
Windward atoll reef	Present, Tetiaroa, Tubai, Mopihaa, Fenuaura, Motuone.	none
Leeward atoll reef	Present, Tetiaroa, Tubai, Mopihaa, Fenuaura, Motuone.	none.
Barrier reef	Common	none

Biome.	Description.	Conservation status.
Fringing reef	Common. ? Meetia	none
Lagoon reef	Common.	none
Beach	Common.	small example Presqu'ile reserve.
Rocky coast	Presqu'ile of Tahiti.	Presqu'ile reserve.
Open lagoon	Common	none
Estuary	Present.	none
Offshore environments	No data available.	none
Offshore terrace	Reported off N.W. Moorea	none

Rare or endemic species.

Apetahia, Kadua, and other endemic plants on Raiatea plateau.

Conservation Legislation.

Sites can be legislated as a strict nature reserve (reserve integrale). Hunting of birds and introduction of alien bird species prohibited.

Existing reserves. (Reserve integrale)

Mt. Marau	about 1000 ha.	Mountain peak and upper slopes. Montane rain forest, Cloud forest and scrub. Disturbed by road and television transmitter.
Presqu'ile	about 2000 ha.	Several complete watersheds along inaccessible section of coast without reef; archaeological sites. Access controlled: accommodation for researchers.

Proposed reserves.

Tetiaroa islets. 6 motus with bird rookeries and 400 m protective belts on privately owned atoll.

Recommended reserve types.

Tahiti - montane forest types and cloud forest in such areas as upper Papenoo (perhaps some combination of conservation and recreation areas if dam is constructed, improving access), Lake Vaihiria (also lake biome), Tamanu plateau and other areas of central Tahiti; some marine biomes associated with the Presqu'ile reserve might also be protected.

Moorea - a representative selection of reef and lagoon habitats should be reserved.

Raiatea - montane forest areas such as the Mehani Plateau: a complete estuary - lagoon - reef sequence in one of the least devastated bays, such as Faatema (with some controls on adjacent terrestrial development to maintain the natural characteristics of the watershed); archaeological sites and sites of traditional cultural significance.

Maupiti - May deserve protection as a good example of the high volcanic island type.

Meetia (Mehetia) - Mountain areas above 160 M.

Tubai - seabird rookery, internal lagoons and barrier reef.

Recommended reserve types (Contd)

Motuone (Bellingshausen)	)	sea bird rookeries and turtle nesting areas and a selection of atoll marine biomes.
Fenuaura (Scilly)	)	
Mopihaa (Mopelia)	)	

References and sources.

Visits to Tahiti, Moorea, Tetiaroa, Riatea, Tahaa.

Denis Capitaine, Service d'Amenagement et Urbanization, Government of French Polynesia,
and many other government officers and individuals.

Douglas, 1969.

XVIII TUAMOTU ARCHIPELAGO.

Government: French Polynesia (France)

Island Types: atolls and one elevated reef (Makatea).

Biomes:	Description	Conservation status.
Lowland rain forest	Formerly on Makatea	none
Atoll/Beach forest	Common	Taiaro Atoll reserve.
Mangrove forest	Northern Tuamotus	none
Scrub	S. Marutea and presumable elsewhere.	none
Grassland	Presumably present.	none
Freshwater marsh	Niao	none
Seabird rookeries	Pukapuka, Tekokota, Kauehi. Apataki.	none
Sea turtle nesting area	Pukapuka, Napuka, Mataiva	none
Algal bed	Lagoon bottom and reef flats	Taiaro
Animals in sediments	Lagoon bottoms and terraces	Taiaro
Algal reef	Common, especially on windward reefs.	none
Coral reef	Common, especially on more sheltered reefs.	Taiaro
Windward atoll reef	Common.	Taiaro
Leeward atoll reef	Common.	Taiaro
Fringing reef	Makatea	none
Lagoon reef	Common	none
Drowned reef	N. Marutea.	none
Beach	Common.	Taiaro
Saline lagoon	Taiaro and probably other closed lagoons	Taiaro
Open lagoon	Common	none
Closed lagoon	Probably common, salinity may vary quite abruptly.	none
Offshore environments	No data available.	none

Conservation interest.

Many variations on the atoll type, with a variety of distinctive lagoon ecosystems. Important areas for seabird and sea turtle breeding.

Rare or endemic species.

Conservation Legislation.

French Polynesia. (see Society Islands).

Existing reserves.

W.A. Robinson Sanctuary, Taiaro Atoll complete atoll with closed saline lagoon - Reserve Integrale.

Proposed reserves.

None.

Recommended reserve types.

A range of open and closed lagoon types including perhaps Hereheretue, Anuanuraro, Anuanurunga, Nukutipipi or Iles des Duc de Gloucester.

Makatea lowland forest, if remnants can be found.

Samples of atoll forest, mangrove and other vegetation types.

Atoll untouched by ciguatera fish poisoning (perhaps Toau).

Sea bird and turtle breeding areas such as Pukapuka, Tekokota, Kauehi, Apataki, Napuka, Mataiva.

References and sources.

M. Delarce, Administrator of Tuamotu Archipelago.
D. Capitaine, Service d'Amenagement et Urbanization, Government of French Polynesia.
"Taiaro Reserve" (privately printed brochure).
Douglas, 1969.

XIX. MARQUESAS ISLANDS.

Government: French Polynesia (France).

Island Types: Volcanic islands without reefs.

Biomes.	Description.	Conservation status.
Lowland rain forest	Up to 500m elevation, many introduced species.	none
Montane rainforest	500-650m, Hibiscus sp., Cordyline terminalis with Gleichenia and Paspalum.	none
Cloud forest	Above 650m, with endemic birds; Nuku Hiva, Ua Pou, Hivaoa, Tahauta, Fata Hiva.	none
Scrub	Ua Pou	none
Dwarf shrub heath	Smaller islands with seabirds.	Hatutu reserve.
Grassland	Motuoa, Montane (Mohotani).	Montane reserve.
Rock desert	Low islets, Motu Iti, Fatuuka.	none
Mountain stream	Presumably present	none
Seabird rookeries	Smaller islands, Hatutu, Motuoa, Fatuuka, Ilot de Sable and islets around Ua Huka and Ua Pou.	Hatutu reserve. Ilot de Sable reserve.
Algal bed	Presumably present	none
Animals in sediments	Probably present	none
Coral reef	Around Ilot de Sable	Ilot de Sable reserve.
Rocky coast	Present	none
Beach	Present	none
Offshore environments	no data available	none

Conservation Interest.

Distinctive flora and fauna; vegetation heavily damaged in places by introduced animals.

Rare or endemic species.

80% of Bird species endemic, several already extinct; some such as Parrots, swallow, and cockoo restricted to Cloud forests: (list in Salvat).

Pigeon, Ducula galeata, perhaps 100 remaining on Nuku Hiva.
Many endemic plants including endemic genus Lebronnesia on Tahuata.
Marquesas Palm Pelagodoxa henryana, 30 individuals on ½ ha. of Ta'ipiva'i valley, Nuku Hiva.

Conservation Legislation.

French Polynesia (see Society Islands.)

Existing reserves.

Montane (Mohotani), 1554 ha., central dry forest, grassland to south, north overgrazed by feral sheep.

Ilot de Sable, seabirds and dwarf-shrub heath.

Eiao, 5180 ha., formerly forest ?, vegetation devastated by feral sheep, pigs.

Hatutu, 1813 ha., seabirds and dwarf-shrub heath.

Proposed reserves. (in Salvat Report).

Motu Papa (Ua Huka) and Motu Oa (Ua Pou) for bird rookeries, with controlled access to other islets.

Mt. Fe'ani, Mt. Temetiu and Mt. O'otu'a on Hivaoa, for montane and cloud forest and endemic birds.

To'ovi'i plateau (Nuku Hiva) and an adjacent valley (Hakanu, Ha'a'opu or Haka'o'a) for montane forest and endangered pigeon Ducula galeata.

Tahuata, summit forest above Va'itahu.

Fatuhiva, forest area on summit.

Small (6 ha) reserve for Marquesas palm on Nuku Hiva.

Recommended reserve types.

Example of lowland rainforest, and other terrestrial biomes.
Examples of marine biomes, including rocky coast types.

References and sources.

E. Salvat, Mesures en faveur de la Protection de la Nature aux Iles Marquises. (unpublished report 1974).
Douglas, 1969.

XX PITCAIRN - GAMBIER ISLANDS - RAPA.

Government: French Polynesia (Gambier Islands and Rapa): United Kingdom (Pitcairn, Oeno, Henderson, Ducie).

Island types: High volcanic, elevated reefs and atolls. Subtropical climate.

Biomes	Description	Conservation status.
Lowland rain forest	presumably present	none.
Montane rain forest	probable on Pitcairn	"
Cloud forest	Rapa (Tree ferns and epiphytes).	"
Atoll/beach forest	Ducie, Oeno, Timoe	"
Scrub	presumably present	"
Tree savanna	probably present	"
Grassland	Rapa; Pitcairn Miscanthus reed grassland on Mangareva	"
Rock desert	Marotiri (Bass Rocks)	"
Mountain stream	present Pitcairn	"
Seabird rookeries	Marotiri (Bass Rocks): Rapa.	"
Algal bed	present	"
Animals in sediments	Present	"
Coral reef	absent from Rapa	"
Windward atoll reef	Ducie, Oeno, Timoe.	"
Leeward atoll reef	Ducie, Oeno, Timoe.	"
Barrier reef	Mangareva (Gambier)	"
Fringing reef	Henderson	"
Lagoon reef	Ducie, Oeno, Timoe.	"
Rocky coast	Rapa, Pitcairn.	"
Beach	Present	"
Open lagoon	Ducie, Oeno, Timoe.	"
Offshore environments	No data available.	"

Conservation Interest.

Atolls and reefs of interest because of extreme distance from centres of reef distribution; high terrestrial endemism on Henderson and Rapa. Many aspects not well studied. Introduced species and fires a problem on some islands; Gambier Islands 98% devastated.

Rare or endemic species.

Sandlewood (Santalum hendersonensis) plus ten angiosperms including Bidens hendersonensis endemic on Henderson. Many endemics on Rapa (62% of 66 ferns and 86 angiosperms).

Conservation Legislation.

French Polynesia (see Society Islands) for Gambier Is. and Rapa; unknown for Pitcairn.

Existing Reserves.

None.

Proposed reserves.

Ducie atoll (proposed as island for science).

Henderson Is. (proposed as island for science) elevated reef and endemic species.

Oeno atoll (proposed as island for science).

Recommended reserve types.

Mts. Mota and Poranu and other inacce sible peaks, Rapa Island.

References and Scurces.

Douglas, 1969.

Harold St. John," Floristic needs in the Pacific basin: Polynesia" abstract of paper presented at 13th Pacific Science Congress, 1975 .

REGIONAL RESERVE NETWORK

In addition to the conservation requirements of each country or territory of the region, there are certain needs encompassing the whole Pacific region, and indeed the global ecological system or biosphere.

The Pacific is largely an oceanic area, and the marine ecosystems and organisms associated with them, including sea birds and sea turtles, are largely international. The conservation of such systems and species must therefore be planned on a regional basis, and that is one of the purposes of this Symposium. In particular, there needs to be a coordinated development of a regional network of sea bird sanctuaries and of sea turtle breeding areas. Many appropriate sites for such a network have been identified in the geographical section of this report. Ideally, there should be appropriate reserves in each of the biotic provinces, with multiple reserves in areas of particular population concentrations.

Further consideration should be given to means of conserving ecosystems occurring wholely or partially in international waters. This will be a particular subject of discussion later in this meeting.

Since many of the areas proposed for conservation in the Pacific Islands are of world significance and their protection will ultimately be of world benefit (often to a greater degree than to the local population), it is appropriate to consider the establishment of an international park and reserve system in the Pacific region. Such a system could perhaps be organized under the Convention on Conservation in the South Pacific Region, and much of the necessary technical and financial support could be sought from the world community (international organizations, overseas aid agencies, and private groups). Reserves of outstanding conservation significance could be nominated by their governments for inclusion in this system, would be subject to certain standards of legislative protection, and would therefore receive management and enforcement assistance through the international reserve system.

At the world level, UNESCO is developing a program of Biosphere Reserves, areas designated by their governments for inclusion in a world network of base line areas for monitoring the state of the biosphere. It is expected that governments will organize appropriate research programmes in these areas. It would be appropriate to discuss potential biosphere reserve areas in the Pacific Islands during this Symposium.

TYPES OF CONSERVATION APPROACHES

There are many ways of achieving the conservation of a particular ecosystem, habitat or species. In the past, areas of land have usually been set aside in National Parks or reserves of various types, but this approach is not always suitable in the Pacific Islands, where land is scarce and must often be used for multiple purposes. It will therefore be useful if Symposium participants attempt to define other approaches to the conservation of ecosystems, more suited to Pacific cultures and conditions. In many instances, the type of reserve or conservation control should be adapted to the type of ecosystem or habitat, and should allow for some flexibility. Island ecosystems are often dynamic, with populations invading,

changing, or becoming extinct. It might be more useful to define the conservation of certain forest types, for instance, in terms of the precentage of a total area to be protected and the rate at which that protected area is allowed to shift within the region to permit forest reestablishment in abandoned areas. The simple leaving of small but frequent nuclei of a biome type may permit its regeneration in a development area and thus effectively achieve the conservation of the biome.

NATIONAL CONSERVATION PLANS

It is hoped that this Regional Ecosystems Survey will help the governments and territorial administrations of the South Pacific area to develop their own more detailed national conservation plans. The ecosystem lists can help in an initial inventory of natural areas. Conservationists sometimes become so concerned with the rare and unusual that they forget the common or typical natural systems that are often more important for the quality of life of the people, but both are important in conservation planning.

Areas with the best combinations of biomes or species of conservation interest can then be identified for priority conservation action along with sites or species where urgent measures are required. Boundaries can then be defined if a park or reserve is necessary or management guidelines if some other approach is envisaged. An educational programme for the local population is generally an essential part of any conservation programme; enforcement itself may be best carried out by local leaders who understand the need for conservation action. This is especially true in the Pacific Islands, where governments cannot often afford to staff a scattered, isolated network of parks and reserves.

The national conservation plan should become an integral part of the development planning process. Conservation and development should move forward together. The plan can help to identify areas of conflicting priorities where choices will have to be made, and can help to direct development along those lines most in harmony with the environmental resources and natural heritage of the region. Conservation areas can then be progressively established without blocking the essential development of the country. The form that that development takes will be the subject of another part of this Symposium.

The goal of conservation is the same as that of development: the highest possible standard of well being and quality of life for the peoples of the Pacific Islands (and indeed of the world), within the limits defined by the resources and natural systems of the planet.

IOME OCCURRENCE BY BIOTIC PROVINCE

Probable Absent

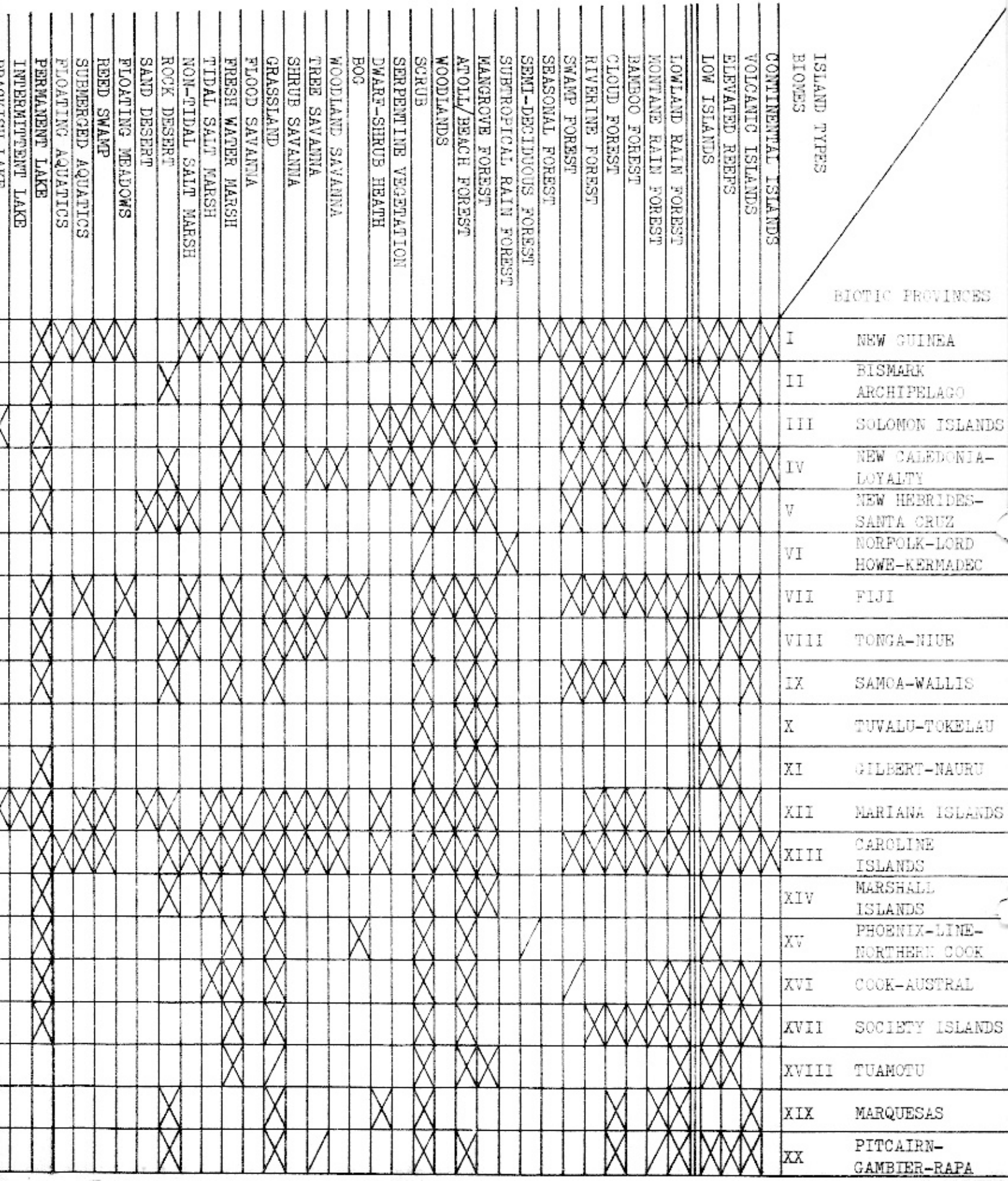
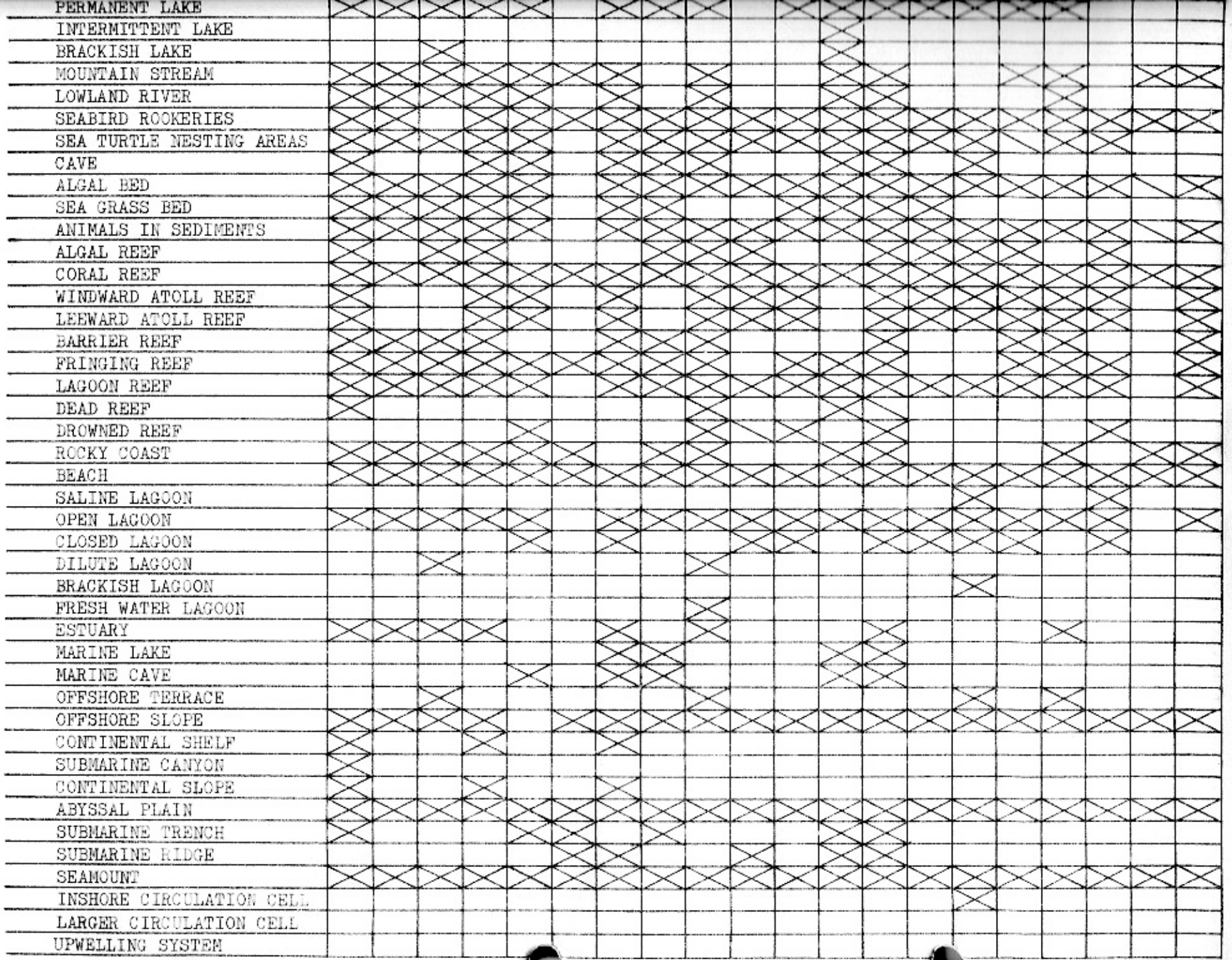


Fig. 6 MATRIX OF BIOME OCCURRENCE BY BIOTIC PROVINCE

Present Probable Absent

Fig. 6 MATRIX OF BIOME

☒ Present



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