PLENIPOTENTIARY MEETING TO CONCLUDE A CONVENTION ON CONSERVATION IN THE SOUTH PACIFIC
(Apia, Western Samoa 9 - 11 June 1976)

PROVISIONAL LIST OF PARTICIPANTS

A. PARTICIPANTS FROM SOUTH PACIFIC TERRITORIES AND COUNTRIES AND FROM PARTICIPATING GOVERNMENTS OF THE SOUTH PACIFIC COMMISSION

American Samoa
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Cook Islands
Iles Cook

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Mr Nikau Tangaroa
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Fiji
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	Mr Mark Goodwin Ministry of Local Government and Rural Development P.O. Box 65, BAIRIKI, TARAWA.
New Caledonia and Wallis & Futuna Nouvelle-Caledonie	M. Paul Rancurel Office de la Recherche Scientifique e Technique Outre-Mer Centre de Noumea, B.P. A5, NOUMEA.
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	Mr Allan Cook, New Zealand High Commission, APIA, WESTERN SAMOA.
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Tonga	Mr Sione Tongilava Superintendent, Ministry of Lands and Survey, NUKU'ALOFA.
Western Samoa Samoa Occidental	Hon. Ulualofaiga Talamaivao Masoe Niko Mr Iulai Toma Lealiifano J.T. Soon David Hull William F. Meredith George Meredith Hans Kruse R.B. McClymont Kilifoti Etouati

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C. INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES
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D. SOUTH PACIFIC COMMISSION
COMMISSION DU PACIFIQUE SUD

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Mr George Chan	Waste Digester Specialist
Mrs Margie Falanruw	SPC Consultant on Environmental Education
Mr S. Gorelov	Interpreter
Mr D. Shearer	Interpreter
Mlle F. Calvet	Translator
Mrs M. Church	Stenographer
Mme H. Claude	Stenographer

E. CONTRIBUTORS OF PAPERS UNABLE TO ATTEND THE SYMPOSIUM
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CONVENTION ON CONSERVATION IN THE SOUTH
PACIFIC REGION

Information Sheet

1. Venue	:	All the meetings will take place at Parliament Buildings, Mulinu'u.
2. Hours	:	The Plenipotentiary meeting opens at 9.00 a.m. on Wednesday morning 9th June, 1976. The meeting will determine its working timetable in its first Session.
3. Transport	:	Transport will be provided for all participants from the Hotel Tusitala to Parliament Buildings for all sessions. Enquiries to Mr. Tuipoloa Suisala who is a member of the Secretariat for the meetings.
4. Dress	:	For the opening of the plenipotentiary meeting we advice shirts and ties.
5. Social Functions	:	(i) The Minister of Justice, Police, Youth Sport and Culture, the Hon. Ulualofaiga Talamaivao Nesoe Niko is hosting a Cocktail party on Wednesday evening 9th June 1976, at Legislative Lounge Mulinu'u. All participants in the meeting are invited. (ii) On Friday night 11th June, 1976 there is a Fiafia night at the Hotel Tusitala where all participants in the meeting are welcome.
6. Outings	:	(i) On Saturday June 12, 1976 a visit to a traditional Samoan village (SIUMU) on the south coast of Upolu island has been organised. Enroute participants will have the opportunity to walk to Lake Lanuto'o. Tramping gear required for this part of the trip. You will be advised of Departure times. (ii) The following day, Sunday 13 June 1976 a picnic at the beach at Salamumu village has been planned. This should provide a relaxing time for all participants. You will be advised of departure times.
7. Tickets	:	Any participant who requires bookings or have any other travel requirements please contact Mrs Church, Tusitala Hotel.
8. Immigration	:	If there are any problems or enquiries about immigration arrangements please contact Elisapeta Matatumua, Prime Minister's Department.

(Draft 1) December 1974

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

Draft of Proposed Convention on Conservation in the South Pacific Region

THE CONTRACTING STATES,

RECALLING the Principles relating to the preservation and enhancement of the human environment set out in the Declaration adopted by the United Nations Conference on the Human Environment at Stockholm in June 1972, particularly Principles 2, 3, 4, 7 and 24;

CONVINCED of the urgency for action based on these Principles, especially in relation to the maintenance of the capacity of the earth to produce vital renewable resources, the safeguarding of representative samples of natural ecosystems, and the safeguarding of the heritage of wildlife and its habitat;

FULLY CONSCIOUS of the ever-growing importance of natural resources from an economic, nutritional, scientific, educational, cultural and aesthetic point of view;

CONSCIOUS of the dangers now threatening these irreplaceable assets;

DESIROUS of undertaking individual and joint action for the conservation, utilization and development of these assets through careful planning and management for the benefit of present and future generations;

HAVE AGREED as follows:

ARTICLE I

Definitions

For the purpose of this Convention, unless the context otherwise requires:

(a) "Protected area" means national park or national reserve;

Note 1 (b) "National park" means an area established for the protection and conservation of ecosystems not materially altered by human exploitation and occupation, containing animal and plant species, geomorphological sites and habitats of special scientific, educative and recreational interest or a natural landscape of great beauty, which is under the control of the highest competent governmental authority and open to visits by the public;

Note 2 (c) "National reserve" means an area under government control established for protection and conservation of natural resources, and includes strict nature reserve, managed nature reserve, wilderness reserve, fauna or flora reserve, game reserve bird sanctuary, geological or forest reserve, anthropological reserve, archaeological reserve and historical reserve, these being reserves affording various degrees of protection to the natural and cultural heritage according to the purposes for which they are established;

(d) "Migratory species" means a species of animal, including marine species, all or some specimens of which may at any season cross the boundaries of the territories of any of the Parties;

(e) "Party" means a State for which this Convention has entered into force.

ARTICLE II

Establishment of Protected Areas

Note 3 1. The Parties shall explore at once the possibility of establishing in their territories protected areas which together with existing protected areas will safeguard representative samples of the natural eco-systems occurring therein as well as superlative scenery, striking geological formations, and regions and objects of aesthetic interest or historic, cultural or scientific value. In all cases where such establishment is feasible, the creation thereof shall be begun as soon as possible after the date this Convention comes into force.

2. If any Party finds it impracticable to establish such protected areas at present, suitable areas shall be selected as early as possible to be given protection as soon as, in the opinion of the authorities concerned, this action can be taken.

Note 4 3. The Parties shall notify the body charged with the continuing bureau duties under this Convention of the establishment of any protected areas and of the legislation and the methods of administrative control adopted in connection therewith.

Item 3:

3.1 Working procedure for meeting.

The Chairman will make the following proposals for consideration of the Meeting:

(a) The Meeting shall deal in plenary session only with formal issues leaving all detailed discussion of the text of the proposed Convention to be dealt with in a Committee of the Whole Conference.

(b) The working document for the Meeting shall be the text of the proposed Convention prepared by IUCN and already circulated with explanatory notes.

(c) The discussion of the working document will be carried out by the Committee of the Whole assisted by a Drafting Panel. Agreement will be reached by consensus.

(d) The Drafting Panel will consist of one representative from each voting delegation. It will be serviced by the Secretariat. Its task will be to prepare revisions of the text of the working document in the light of Committee discussions. Such revisions will be examined and dealt with by the Committee.

(e) The finally agreed text of the Convention will be formally approved by the Meeting in plenary session.

(f) The Chairman of the Committee may permit non-voting delegates and observers from international bodies to participate in the discussion bearing in mind of course the time constraints of the Meeting.

(g) An informal time limit of 15 minutes for each statement in plenary and 5 minutes for each intervention in Committee will be proposed.

(h) If further rules are found to be necessary, these should be the Rules of Procedure of the South Pacific Commission (modified to the extent necessary).

3.2 Consideration and adoption of Chairman's proposal (including any modifications agreed upon by the Meeting).

Heads of voting delegations will be asked to inform Secretariat of the names of their representatives on the Drafting Panel.

4. Opening Statements:

Each delegation will be given the opportunity of making a general statement of its views on the subject matter of the proposed Convention and any general observations on the working document.

5. Explanation of draft Convention:

It is proposed that this item be taken as the first item of business of the Committee.

6. Motion to adjourn Meeting and to go into Committee of the whole.

Wednesday, 9th June, (afternoon):

Consideration of Working Document -

(a) Explanation of draft text of Convention

(b) Consideration of draft text of Convention, Article by Article.

It is proposed that consideration start with Article II leaving Preamble and Article I until later in the discussion.

Thursday, 10th June, (whole day):

Continuation of consideration in Committee of draft text of Convention.

It is hoped that discussion can be completed during the day.

Friday, 11th June, (morning):

Continuation (as required) of consideration in Committee of draft text of Convention.

If the discussion is completed during Thursday, 10th June, Friday morning will be used by Drafting Panel to finalise editing and checking that English and French texts accord with one another.

Friday, 11th June, (afternoon):

Item 7:

7.1 Meeting resumes in plenary session.

7.2 Adoption of final text of Convention.

7.3 Adoption of text of Final Act.

Item 8:

8. Formal signing of Final Act.

Item 9:

9.1 Closing speeches.

9.2 Formal closing of Meeting.

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PLENIPOTENTIARY MEETING TO CONCLUDE A CONVENTION ON CONSERVATION IN THE SOUTH PACIFIC APIA, WESTERN SAMOA, 9 - 11 JUNE 1976

Resume of purpose and procedure:

1. The Plenipotentiary Meeting has been convened by the Government of the Independent State of Western Samoa to provide an opportunity for the States entitled to be parties to the Agreement establishing the South Pacific Commission to consider the text of the proposed Convention.

2. The Meeting will discuss the text and modify it as required.

3. The Meeting will adopt a Final Act which is equivalent to initialling the finally agreed text of the Convention.

4. It is proposed that the Convention will be open for signature in Apia at a time to be decided by the Conference and that thereafter it will be open for signature at the appropriate office of the Depositary.

5. It is proposed that the Convention shall be subject to ratification. Signature of the Convention by a State merely indicates that the State intends to become a Party to the Convention. Further action will be required before the State becomes a Party to the Convention and is bound by its provisions. This further action will involve deposit of an instrument of ratification (or of accession) with the Depositary.

ANNOTATED AGENDA

Preamble:

The Meeting has been convened by the Government of the Independent State of Western Samoa. The Government has asked the International Union for Conservation of Nature and Natural Resources (IUCN) and the South Pacific Commission to collaborate with it in providing a Secretariat for the Meeting. The Government of Western Samoa has appointed Mr Iulai Toma, Secretary to Government, as Secretary-General to the Conference and Mr Frank Nicholls, Consultant to IUCN, as Assistant Secretary-General.

This annotated Agenda has been prepared to provide an amplification of the formal Provisional Agenda (already circulated) and generally to assist in providing a procedural background.

In accordance with custom in the region it is intended that decisions be reached by consensus without recourse to formal voting.

Wednesday, 9th June, (morning):

Item 1:

1.1 Minister for Justice and Cultural Affairs of Western Samoa, calls meeting to order.

1.2 The Minister makes opening address welcoming delegates and observers.

Item 2:

2.1 Nomination and election of Chairman.

2.2. Nomination and election of Vice-Chairman.

PLENIPOTENTIARY CONFERENCE TO CONCLUDE A CONVENTION
ON CONSERVATION IN THE SOUTH PACIFIC,
APIA, WESTERN SAMOA
9 - 11 JUNE, 1976

PROVISIONAL AGENDA:

1. Opening Address

2. Election of Chairman and Vice Chairman

3. Adoption of Working Procedures for Meeting

4. Appointment of Drafting Committee

5. Delegation Statements

6. Consideration of Draft Convention

7. Adoption of Text and Final Act

SERIAL NO. CNA/1

ARTICLE III

National Parks

Note 5 1. The boundaries of national parks shall not be altered, or any portion thereof be capable of alienation, except by the competent legislative authority. The resources of these protected areas shall not be subject to exploitation for commercial profit.

2. The hunting, killing, and capturing of specimens of the fauna and destruction or collection of specimens of the flora in national parks shall be prohibited except when carried out by or under the direction or control of the parks authorities or for duly authorised scientific investigations.

3. Provision shall be made for visitors to enter national parks, under appropriate conditions, for inspirational, educative, cultural and recreative purposes.

ARTICLE IV

National Reserves

Note 6 National reserves shall be maintained inviolate, as far as practicable, except for duly authorized scientific investigations or government inspection, or such uses as are consistent with the purposes for which the protected area was established.

ARTICLE V

Protection of Fauna and Flora

Note 7 1. The Parties shall, in addition to the protection given to indigenous fauna and flora in national parks and national reserves, protect such fauna and flora throughout their territories so as to safeguard them from unwise exploitation and other threats that may lead to their extinction.

2. Special attention shall be given to migratory species, these animals being regarded as a resource shared by more than one State.

Note 8 3. The species included in the Appendix to this Convention shall be protected as completely as possible as a matter of special urgency and importance. The hunting killing, capturing or taking of specimens of such species shall be allowed only with the permission of the appropriate governmental authority of the Party concerned. Such permission shall be granted only under special circumstances, in order to further scientific purposes or when essential for the administration of the area in which the animal or plant is found.

ARTICLE VI

Cooperation between Contracting States

Note 9 1. The Parties shall cooperate amongst themselves in promoting the objectives of this Convention.

2. The Parties shall conduct research relating to the conservation of nature and natural resources. They shall as appropriate coordinate such research with research carried out by other Parties. They shall exchange information on the results of such research and on the management of protected areas and of species referred to in this Convention.

3. The Parties shall take action to promote exchanges of personnel and shall cooperate in the training of personnel for the conservation of nature and natural resources.

4. The Parties shall work towards unification of objectives and standards relating to the conservation of nature and natural resources.

ARTICLE VII

Avoidance of Disturbing Activities

Note 10 Each Party shall take all necessary measures to prevent any disturbing activities that may affect the conservation of nature either in its own territory or the territory of another Party.

ARTICLE VIII

Measures to be taken by Parties

Note 11 Each Party shall take appropriate measures to enforce the provisions of this Convention.

ARTICLE IX

States not Party to the Convention

Note 12 Each Party shall take action as appropriate to promote compliance with the provisions of this Convention by nationals of States not party to this Convention.

ARTICLE X

Effect on other International Agreements

Note 13 The terms of this Convention shall in no way be interpreted as replacing international agreements previously entered into by one or more of the Parties.

ARTICLE XI

Further Consultations and Secretariat

Note 14 1. The Parties shall continue to consult with one another with the object of giving effect to the provisions of this Convention.

Note 15 2. .... shall be designated to undertake the continuing bureau duties under this Convention.

ARTICLE XII

Signature

Note 16 This Convention shall be open for signature at .... until .... by all States eligible for membership of the South Pacific Commission.

ARTICLE XIII

Ratification, Acceptance, Approval

Note 17 This Convention shall be subject to ratification, acceptance or approval. Instruments of ratification, acceptance or approval shall be deposited with .... which shall be the Depositary.

ARTICLE XIV

Accession

Note 18 This Convention shall be open indefinitely for accession by the States referred to in Article XII and by other States which are unanimously invited by the Parties to accede to it. Instruments of ratification shall be deposited with the Depositary.

ARTICLE XV

Entry into Force

Note 19 1. This Convention shall enter into force ninety days after the deposit of the fourth instrument of ratification, acceptance, approval or accession with the Depositary.

2. This Convention shall enter into force for a State which ratifies, accepts or approves it or accedes thereto after the date specified in paragraph 1 of this Article ninety days after the deposit by such State of its instrument of ratification, acceptance, approval or accession.

ARTICLE XVI

Denunciation

Any Party may denounce this Convention by written notification to the Depositary at any time after five years from the date of entry into force of this Convention. The denunciation shall take effect twelve months after the Depositary has received the notification.

ARTICLE XVII

Depositary

1. The original of this Convention in the English and French languages, each version being equally authentic, shall be

deposited with the Depositary, which shall transmit certified copies thereof to all States that have signed it or deposited instruments of accession to it.

2. The Depositary shall inform all signatory and acceding States of signatures, deposits of instruments of ratification, acceptance, approval or accession, entry into force of this Convention, amendments to the Annex thereof, and notifications of denunciation.

3. The Depositary shall transmit certified copies of this Convention to the Secretary-General of the United Nations for registration and publication in accordance with Article 102 of the Charter of the United Nations.

IN WITNESS WHEREOF the undersigned, being duly authorized by their Governments, have signed this Convention.

DONE at .... this .... day of .... One Thousand Nine Hundred and Seventy ....

EXPLANATORY NOTES ON DRAFT 1 (DECEMBER 1974) OF
PROPOSED CONVENTION ON CONSERVATION IN THE SOUTH PACIFIC REGION

Prepared by
International Union for Conservation of Nature and Natural Resources

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Introduction

The proposed Convention sets out measures for the conservation of nature and natural resources in the South Pacific, both at the national level and through cooperation between the States party to the Convention. The notes below relate to specific paragraphs of the draft Convention and are cross referenced through marginal annotation on that draft using the numbering set out below.

Much of the text is based on the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere (Washington, D.C., 1940) referred to here as, "Western Hemisphere Convention".

No area to which the Convention applies has been specified. The area could be defined as the area covered by the South Pacific Commission together with Australia and New Zealand.

Specific matters

Article I

1. The definition of "National park" when taken with Article III conforms wit the IUCN New Delhi (1969) definition.

2. The definition of "National reserve" has been made wider than that of the Western Hemisphere Convention, and more indefinite, by design. Alternatively, definitions of the various types of reserve could be included but this seems to introduce unnecessary detail.

Article II

3. This Article calls for the establishment of a network of protected areas a soon as possible.

4. This paragraph envisages circulation of information about protected areas; also Article XI.

Article III

5. See Note 1 above. This Article sets out the protection to be given to National parks.

Article IV

6. This Article sets out the protection to be given to National reserves.

Article V

7. This Article calls for protection of indigenous fauna and flora outside protected areas, with particular reference to migratory species and those listed in the Appendix.

8. This paragraph is concerned with species in danger of extinction. The Appendix will be drafted in due course.

Article VI

9. This Article calls for cooperation between the Parties and specified particular matters on which such cooperation is required.

Article VII

10. This Article calls for avoidance of activities that may disturb nature conservation.

Article VIII

11. This Article requires each Party to take action to implement the provisions of the Convention.

Article IX

12. This Article is linked with Article VII.

Article X

13. This Article may require further elaboration.

Article XI

14. This Article is concerned with future collaboration. More specific provisi for regular meetings of the Parties could be envisaged.

15. It may be appropriate to consider naming the South Pacific Commission to carry out these duties.

Article XII

16. This Article and those that follow may be elaborated but the pattern proposed follows earlier precedents.

The question of which States may adhere to the Convention needs examinatio This is linked with Article XIV.

Article XIII

17. A decision will need to be made on the Depositary. It might be a Contracting State or the South Pacific Commission.

Article XIV

18. Provision has been made for the accession of States not members of the South Pacific Commission.

Article XV

19. It is proposed that the Convention should come into force when four States have become party to it.

Morges, Switzerland
12 December 1974

DRAFT OF APPENDIX TO
DRAFT OF PROPOSED CONVENTION ON CONSERATION
IN THE SOUTH PACIFIC REGION

Proforma List of Species which shall be protected as completely as possible; (reference Article V para. 3)

Mammalia

Macropus parma	Parma wallaby
Onychogalea fraenata	Bridle nail-tailed wallaby
Onychogalea lunata	Crescent nail-tailed wallaby
Lagorchestes hirsutus	Western hare-wallaby
Lagostrophus fasciatus	Banded hare-wallaby
Petrogale xanthopus	Yellow-footed rock wallaby
Caloprymnus campestris	Desert rat-kangaroo
Bettongia tropica	Northern rat-kangaroo
Bettongia lesueur	Lesueur's rat-kangaroo
Wyulda squamicaudata	Scaly-tailed possum
Gymnobelideus leadbeateri	Leadbeater's possum
Lasiorhinus barnardi	Queensland hairy-nosed wombat
Chaeropus ecaudatus	Pig-footed bandicoot
Macrotis lagiotis	Rabbit bandicoot
Phascogale calura	Red-tailed phascogale
Antechinus apicalis	Dibbler
Planigale tenuirostris	Narrow-nosed planigale
Planigale subtilissima	Kimberley planigale
Sminthopsis longicaudata	Long-tailed sminthopsis
Antechinomys laniger	Eastern jerboa marsupial
Thylacine cynocephalus	Thylacine
Balaenoptera physalus	Fin whale
Balaenoptera musculus	Blue whale
Megaptera novaengliae	Humpback whale
Eubalaena glacialis	Black right whale
Dugong dugon	Dugong

Aves

Tuamotu Islands

Porzana atra	Henderson Rail
Prosobonia cancellatus	Tuamotu Sandpiper
Ducula aurorae (2)	Society Islands Pigeon
Gallicolumba erythroptera	Society Islands Ground Dove
Vini peruviana (3)	Tahiti Lorikeet
Vini stepheni	Henderson Lorikeet
Halcyon gambieri	Tuamotu Kingfisher

Society Islands

Ducula aurorae (2)	Society Islands Pigeon
Vini peruviana (3)	Tahiti Lorikeet
Pomarea nigra nigra	Tahiti Flycatcher
Acrocephalus caffer longirostris	Moorea Polynesian Warbler

Western Samoa

Didunculus strigirostris	Tooth-billed Pigeon

Marquesas Islands

Ducula galeata	Marquesas Pigeon
Ptilinopus mercierii	Red-moustached Fruit Dove
Gallicolumba rubescens	Marquesas Ground Dove
Vini ultramarina	Ultramarine Lorikeet
Halcyon godeffroyi	Marquesas Kingfisher
Pomarea mendozae nukuhivae	Northern Marquesas Flycatcher
Acrocephalus caffer aquilonis	Eiao Polynesian Warbler

Norfolk Island

Cyanoramphus novaezelandiae cookii	Norfolk Island Parakeet
Turdus poliocephalus poliocephalus	Grey-headed Blackbird
Zosterops albogularis	White-breasted Silvereye
Aplonis f. fuscus	Norfolk Island Starling
Petroica m. multicolor	Scarlet breasted Robin

New Hebrides

Aplonis santovestris	Santo Mountain Starling

Line Islands

Vini kuhli (2)	Scarlet-breasted Lorikeet
Acrocephalus acquinoctialis	Kokikokiko

Austral Islands

Ptilinopus huttoni	Rapa Island Fruit Dove
Vini kuhli (2)	Scarlet-breasted Lorikeet

Cook Islands

Vini peruviana (3)	Tahiti Lorikeet
Pomarea dimidiata	Rarotonga Flycatcher

Fiji

Bulweria macgillivrayi	MacGillivray's Petrel
Rallus poecilopterus	Barred-wing Rail
Prosopeia personata	Masked Parakeet
Trichocichla rufa	Long-legged Warbler
Erythrura kleinschmidti	Pink-billed Parrot Finch

Solomon Islands

Edithornis sylvestris	San Cristobal Mountain Rail

Papua New Guinea

Sericornis nigroviridis	Watut Leaf Warbler

Antipodes Islands

Coenocorypha aucklandica meinertzhageni	Antipodes Islands Snipe
Cyanoramphus unicolor	Antipodes Island Parakeet

Auckland Islands

Anas aucklandica aucklandica	Auckland Island Flightless Teal
Rallus pectrialis muelleri	Auckland Island Rail
Coenocorypha a. aucklandica	Auckland Island Snipe

Campbell Island

Anas aucklandica nesiotis	Campbell Island Flightless Teal

Chatham Island

Gallivallus australis hectori	Weka
Thinornis novaeseelandiae	New Zealand Shore Plover
Coenocorypha aucklandica pusilla	Chatham Island Snipe
Hemiphaga novaeseelandiae chathamensis	Chatham Island Pigeon
Cyanoramphus avriceps forbesi	Forbes' Parakeet
Petroica traversi	Chatham Island Robin
Prosthemadera novaeseelandiae chathamensis	Chatham Island Tui

Lord Howe Island

Tricholimnas sylvestris	Lord Howe Wood Rail

Loyalty Islands

Eunyomphicus cornutus uvaeensis	Loyalty Islands Parakeet

<u>New Caledonia</u>

Rhynochetos jubatus	Kagu
Drepanoptila holosericea	Cloven-feathered Dove
Ducula goliath	Giant Imperial Pigeon
Eunymphicus c. cornutus	Horned Parakeet

<u>Snares Island</u>

Coenocorypha aucklandica huegeli	Snares Island Snipe

<u>Stewart Islands</u>

Bowdleria punctata wilsoni	Codfish Islands Fernbird

May 1976

SOUTH PACIFIC COMMISSION

AND

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

SECOND REGIONAL SYMPOSIUM ON CONSERVATION OF NATURE

Apia, Western Samoa, 14 - 17 June 1976

Theme : Conservation and Ecodevelopment in the South Pacific

PROPOSED PROGRAMME

Monday 14 June

0900-1030	Opening remarks by Secretary General, SPC (or his delegate)
	" " " Director General, IUCN (or his delegate)
	Election of Chairman.
	Adoption of Agenda.
	Report from Intergovernmental Conference.
	Appointment of Resolutions Committee (3 people initially, to which chairmen of other committees will be added).
1030-1100	Coffee
1100-1230	Report of 'Regional Ecosystems Survey of the South Pacific Area' by Arthur L. Dahl, SPC.
	Discussion of report including country comments.
1400-1530	Continuing discussion of report.
1530-1600	Coffee.
1600-1700	Continuing discussion of report.
	Appointment of committees on research and conservation.

Tuesday 15 June

0900-1030	Brief summaries of papers on
1100-1230	'Ecodevelopment and Traditional Natural Resource Management in the South Pacific' by Robert Allen, IUCN.
1100-1230	'A Framework for Ecodevelopment in South Pacific Island Countries' by Jimoh Omo-Fadaka.
	'Traditional Conservation Practices for Modern Pacific Societies' by Suliana Siwatibau.
	Discussion of traditional practices and ecodevelopment.
	Appointment of Committee on Ecodevelopment.

Tuesday 15 June (contd)

1400-1530	'Critical Marine Habitats', by G. Carleton Ray.
	Discussion.

Wednesday 16 June

0900-1030 1100-1230	Brief presentations of :
	'The South Pacific Programme of IUCN' by Raymond Dasmann, IUCN.
	SPC Special Project on Conservation, by Arthur L. Dahl, SPC.
	UNESCO MAB Project 7.
	UNEP plans for the Pacific, by Kai Curry-Lindahl, UNEP.
	Discussion of the role of institutions and organisations (national, regional, international) in conservation and ecodevelopment in the South Pacific.
	Appointment of Committee on Role of Institutions and Organisations.
1400-1530	Legal measures for conservation : World parks, biosphere reserves, Law of the Sea conferences and their implications. Brief report: 'The Concept of World Parks and International Law' prepared by Cyril de Klemm, IUCN.
	Discussion.
	Appointment of Legal Committee.
1530-1700	Committee meetings.

Thursday 17 June

0900-1030	Committee meetings.
1100-1230	Reports of Committees.
1400-1530	Reports of Committees.
1600-1700	Adoption of Resolutions.
	Closing of Symposium.

1 June/juin 1976

SOUTH PACIFIC COMMISSION
COMMISSION DU PACIFIQUE SUD

AND/ET

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES
UNION INTERNATIONALE POUR LA CONSERVATION DE LA NATURE ET DE SES RESSOURCES

SECOND REGIONAL SYMPOSIUM OF CONSERVATION OF NATURE
(Apia, Western Samoa, 14 - 17 June 1976)
DEUXIEME COLLOQUE REGIONAL SUR LA PROTECTION DE LA NATURE
(Apia, Samoa-Occidental, 14 - 17 juin 1976)

CHECK LIST OF DOCUMENTS
LISTE RECAPITULATIVE DES DOCUMENTS

Working Papers

SPC-IUCN/2RSCN/WP.1 - Regional Ecosystems Survey of the South Pacific Area by Arthur Lyon Dahl.

Inventaire des écosystèmes de la région du Pacifique Sud par Arthur Lyon Dahl.

WP.2 - Ecodevelopment and Traditional Natural Resource Management in the South Pacific by Robert Allen, IUCN.

Ecodéveloppement et gestion traditionnelle des ressources naturelles dans le Pacifique Sud par Robert Allen, UICN.

WP.3 - A Framework for Ecodevelopment in South Pacific Island Countries by Jimoh Omo-Fadaka.

Schéma d'écodéveloppement pour les pays des îles du Pacifique Sud par Jimoh Omo-Fadaka.

WP.4 - Traditional Conservation Practices for Modern Pacific Societies by Mrs. S Siwatibau, Fiji.

Les sociétés océaniennes modernes et les pratiques traditionnelles de conservation par S. Siwatibau, Fidji.

WP.5 - Critical Marine Habitats by G. Carleton Ray, U.S.A.

(Ce document de travail ne sera pas traduit)

SPC-IUCN/2RSCN/WP.6 - Report on the Special Project on the Conservation of Nature - South Pacific Commission
by Arthur Lyon Dahl.

Projet spécial de la CPS sur la conservation de la nature
par Arthur Lyon Dahl.

WP.7 - The South Pacific Programme of IUCN
by Raymond F. Dasman, IUCN.

Programme de l'UICN pour le Pacifique Sud
par Raymond F. Dasman, UICN.

WP.8 - (Working Paper not yet received)
(Ce document de travail ne nous est pas encore parvenu)

WP.9 - The Concept of World Parks and International Law
by Cyril de Klemm, IUCN.

Le concept de parc mondial et le droit international
par Cyril de Klemm, UICN.

WP.10 - Ecodevelopment in a Pacific Island Context : I. The Environmental Impact Study
by Graham Baines, Fiji.
(Ce document de travail ne sera pas traduit)

WP.11 - Ecodevelopment in a Pacific Island Context : II. Priorities in Mangrove Ecosystem Research
by Graham Baines, Fiji.
(Ce document de travail ne sera pas traduit)

WP.12 - Ecodevelopment in a Pacific Island Context : III. The Administration of Mangrove Ecosystems
by Graham Baines, Fiji.

(Ce document de travail ne sera pas traduit)

Information Papers

- Declaration of the United Nations Conference on the Human Environment (Extract from the Report of the United Nations Conference on the Human Environment. Stockholm, 5-16 June 1972)

  Déclaration de la Conférence des Nations Unies sur l'environnement (Extrait du Rapport de la Conférence des Nations Unies sur l'environnement, Stockholm, 5-16 juin 1972)

- A Preliminary Classification of Coastal and Marine Environments
  by Carleton Ray (IUCN Occasional Paper No. 14, Morges, Switzerland, 1975)

Informal Papers

SPC-IUCN/2RSCN/Informal 1	-	Provisional Programme
Officieux 1	-	Programme Provisoire
Informal 2	-	Provisional List of Participants
Officieux 2	-	Liste provisoire des participants
Informal 3	-	Check List of Documents
Officieux 3	-	Liste récapitulative des documents

SPC-IUCN/2RSCN/WP 1.
13th May 1976.
ORIGINAL ENGLISH.

SOUTH PACIFIC COMMISSION

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INTERNATIONAL UNION FOR CONSERVATION OF NATURE

AND NATURAL RESOURCES

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REGIONAL ECOSYSTEMS SURVEY OF THE SOUTH PACIFIC AREA

Arthur Lyon Dahl

Regional Ecological Adviser
South Pacific Commission
Noumea, New Caledonia.

359/76

REGIONAL ECOSYSTEMS SURVEY OF THE SOUTHPACIFIC AREA

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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.

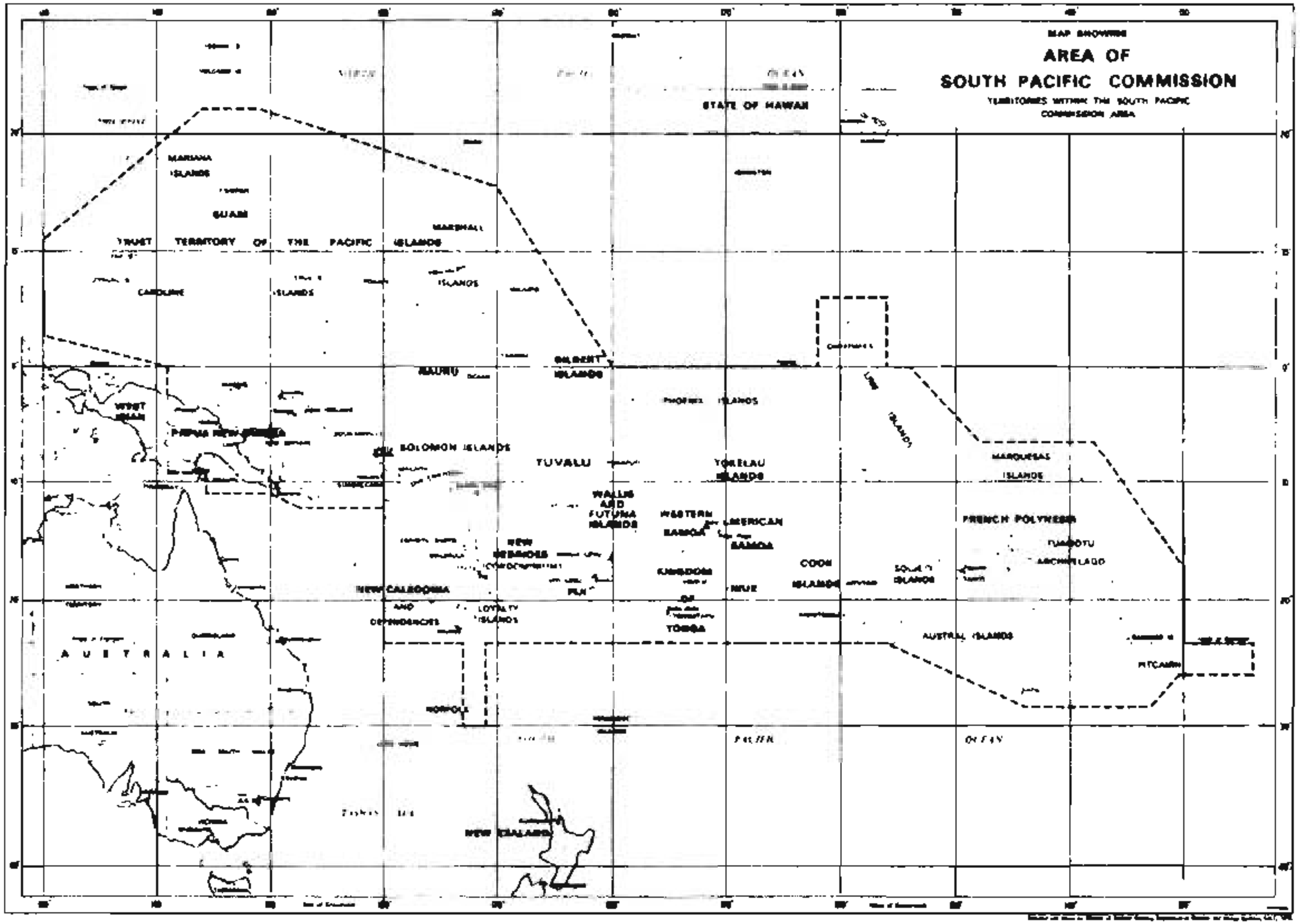

Fig. 1 AREA INCLUDED IN THE REGIONAL ECOSYSTEMS SURVEY

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 nedicines 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 (Dasman , 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.

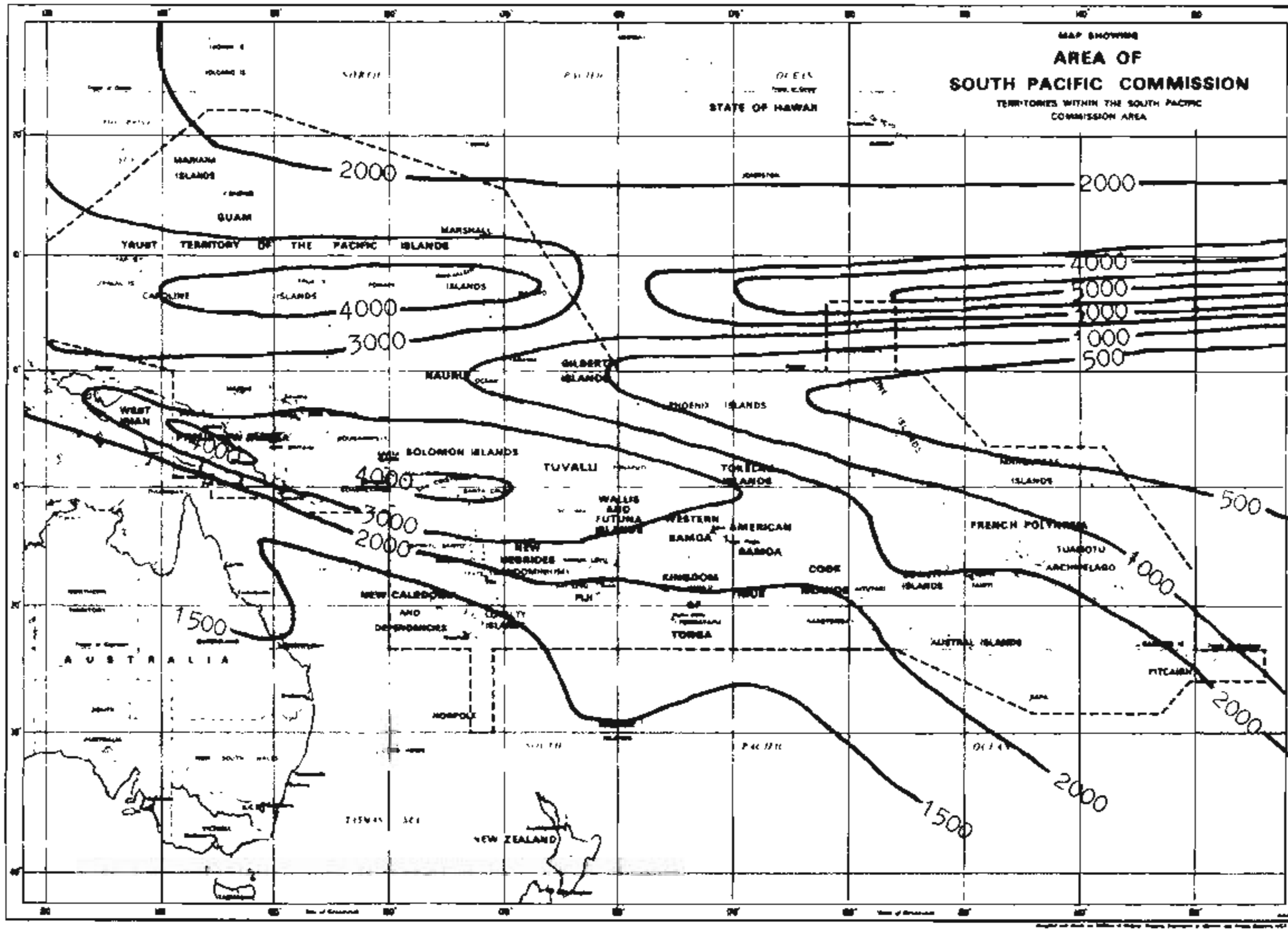

Fig. 2 AVERAGE ANNUAL RAINFALL
(after Sekiguchi, 1952, and Stoddart and Walsh, 1975)

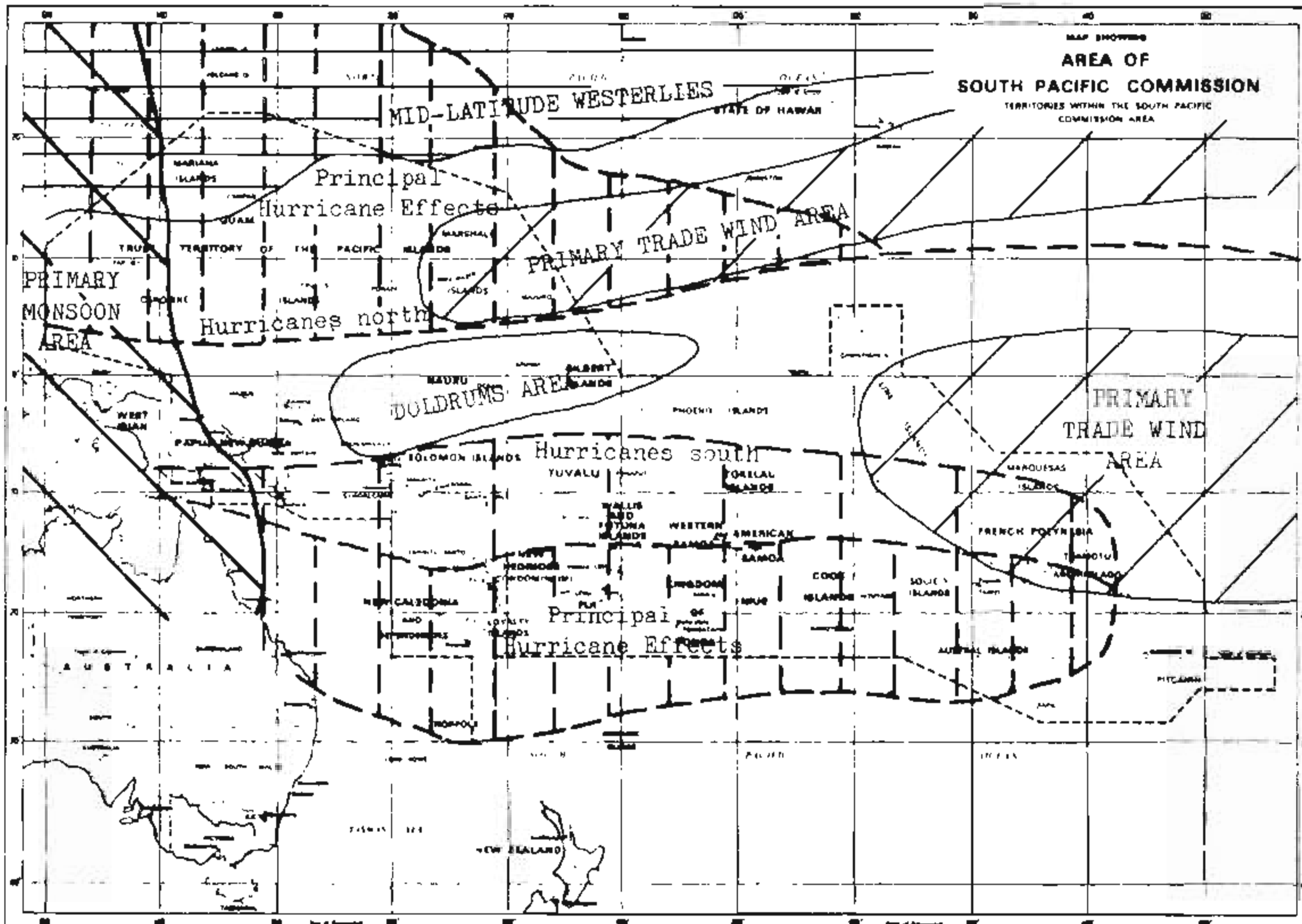

Fig. 3 CLIMATIC FACTORS

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

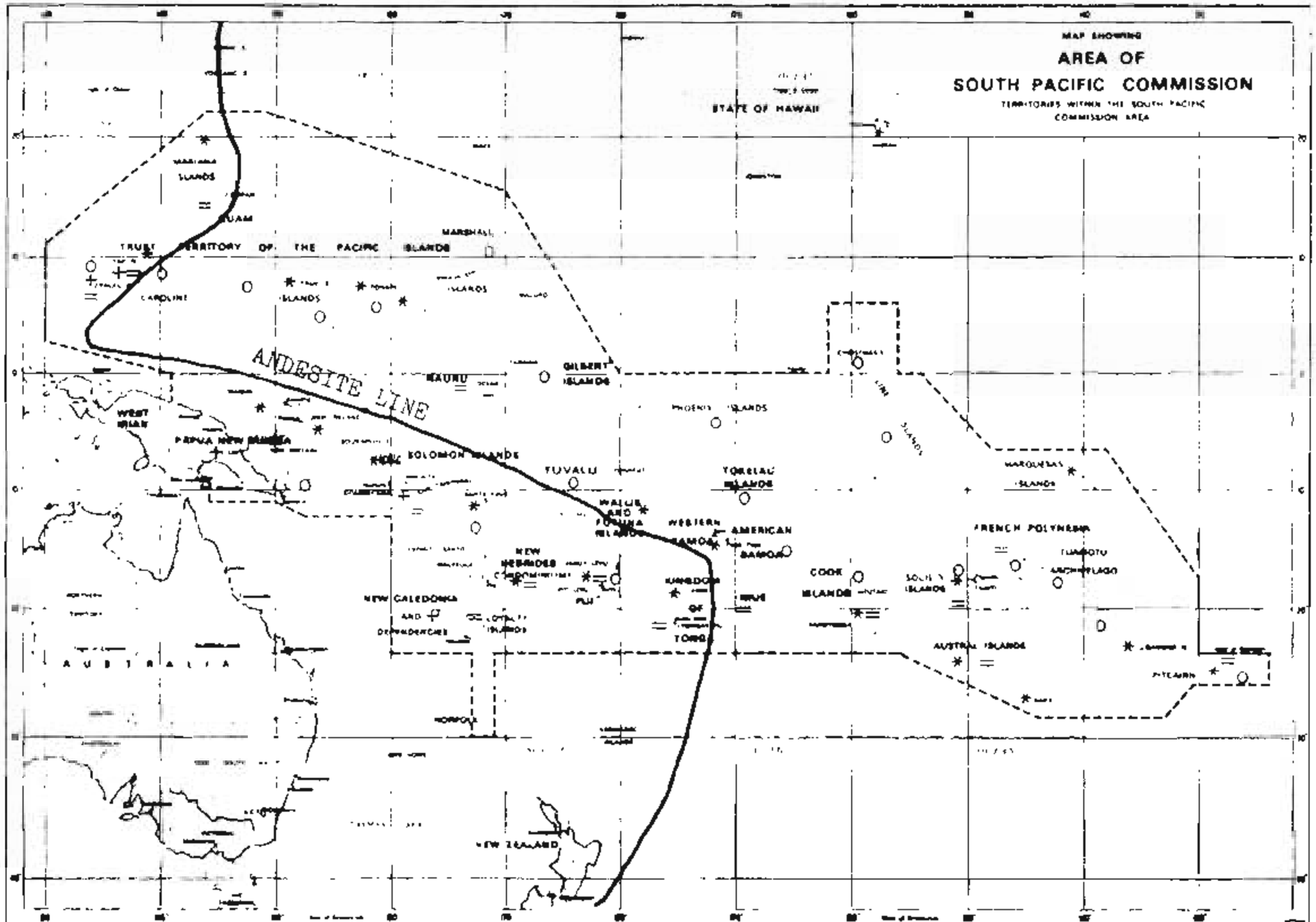

Fig. 4 DISTRIBUTION OF ISLAND TYPES

o 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

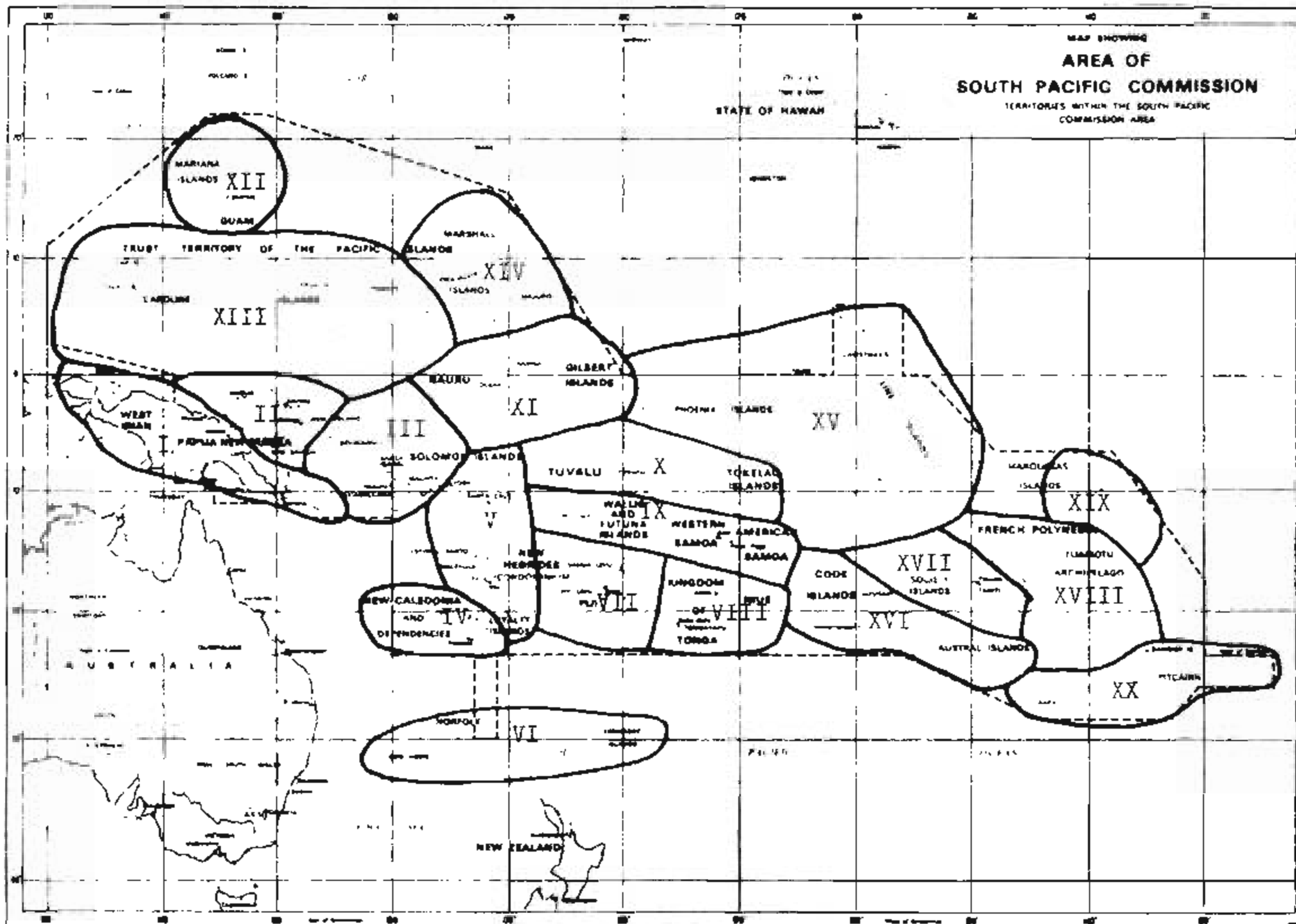

Fig. 5 BIOTIC PROVINCES

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	1.1.1.

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.

Lowland rain forest — 1.1.1.1.

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.

Montane/submontane rain forest — 1.1.1.2.

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.

Bamboo forest — 1.1.1.3.

Dominated by bamboo. Common in tropical mountains but may occur also in temperate and tropical lowlands.

Cloud forest — 1.1.1.4.

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.

Riverine forest — 1.1.1.5.

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).

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 — None.

Plant communities adapted to metalliferous serpentine soils. This substrate condition can also be used as a subdivision of other vegetation types.

DWARF SCRUB AND RELATED COMMUNITIES — 4.

Woody plants rarely exceeding 50cms in height (sometimes called heaths or heath-like formations).

Mainly evergreen — 4.1.

Dwarf-shrub heath — 4.1.1.

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.

Bog — 4.3

Often sedges are abundant. Sphagnum or other moss cover; Peat accumulation. Some woody shrubs may be present.

HERBACEOUS — 5.

Savanna — 5.1.

Tropical or sub-tropical grasslands or parklands with trees and shrubs covering not more than 30% of the ground.

Woodland savanna — 5.1.1.1.

Dominated by grasses with forest islands or patches or woodland.

Tree savanna — 5.1.1.2. and 5.1.2.1.

Grass cover with isolated trees dispersed regularly over the area.

Shrub savanna — 5.1.1.3. and 5.1.2.2.

Thickets or shrublands in an area dominated by grass.

Tropical grassland. — 5.1.1.4. and 5.1.2.3.

Grass with few or no woody plants.

Flood savanna — 5.1.1.5.

Grass periodically flooded with tree or scrub islands.

Wetlands — 5.5.

Fresh water marsh — 5.5.1.

Herbaceous formations on constantly or periodically flooded and waterlogged ground without or with few woody plants (*Carex*, *Juncus*, *Cyperus*, *Scirpus* are characteristic genera).

Salt marsh — 5.5.2.

Salt tolerant herbaceous or partly-woody formations in areas periodically or constantly flooded or waterlogged. Water saline or alkaline.

	IUCN Number.
Tidal salt marsh With marine environment subject to tidal flooding.	-
Non-tidal salt marshes and flats.	-
BARREN DESERT (Should also be applicable to recent volcanic deposits).	6.
Rock Desert Ground surface dominated by bare rocks or screes with occasionally plant cover in crevices, fissures etc.	6.1.
Sand desert Ground surface dominated by wind-blown sand, often forming dunes. Vegetation scarce or absent.	6.2.
FRESH WATER ENVIRONMENTS	
Aquatic vegetation	
Floating meadow Densely interwoven or matted forbs and/or mosses covering permanent fresh water. Woody plants may be present.	5.6.1.
Reed swamp Tall reeds rooting in soil at bottom of shallow lakes, ponds, or slow moving rivers.	5.6.2.
Submerged rooted aquatics Water areas dominated by rooted plants which are structurally supported by water and scarcely emergent.	5.6.3.
Floating aquatics Water areas dominated by non-rooted floating plants.	5.6.4.

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

Mixoeuhaline (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 for st N.W.PNG.	none
	5)Secondary lowland rainforest, Ficus, Vitex, Pipturus.	Variata
Montane rain forest	above 1,200m	
	1) submontane Araucaria/Agathis 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.	Variarte
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 :

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

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 <u>Castanopsis</u> forest, bamboo forest, submontane <u>Araucaria</u> forest with <u>A. cunninghamii</u> and <u>A. hunstteinii</u>. 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 Tawala 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, Podocapus, 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.

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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.	Talde 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) : Laky 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 - domin ted 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 sever l 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 sw mp forest.	none
Mangrove forest	1) Tall (Rhizophora, Bruguiera, Dolichandrone) 2) Low (Rhizophora.)	none
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/Calophylium/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.
Keith Treneman, Chief Forest Officer.
Ken Martin, Forest Officer.
R. James, Fisheries Officer.
Mike Hoyle, University of Papua New Guinea.

J.M. Diamond, "A proposed forest reserve system and conservation strategy for the Solomon Islands" (unpublished report).

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Whitmore, T.C. 1974.

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 C ledonia, 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, 5670 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, <u>Podocarpus</u>, 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.

<u>Proposed reserves.</u>	<u>Proposed classifiation</u>.
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 localized 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.

<u>References and sources.</u>

Visits to several parts of New Caledonia.

F. Goy, Director, Forest Department.
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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V. 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 Fatut ka	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.

Recommended 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 Discombe.
H. Bregulla.
J.M. Diamond, personal communication.
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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: <u>Syringodium iseotifolium</u> <u>Halodule uninervis</u> <u>Halodule pinifolia</u>	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 Kambara islanders).	none
Marine Cave	Presumably common in raised limestone areas Yaswas, Qaranitoa, Fulaga Is. Red prawn pool-cave on Vatulele Island and Red turtle pool-cave on Koro Is of special interest.	none
Offshore environments	No data available.	none

<u>Conservation interest</u>.

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 (? 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_)	Subject to predation by cats and mongoose.
White-browed rail (_Poliolimnas cinereus_)	
Sooty rail (_Porzana t. tabuensis_)	
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 (R·vilevu)	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 (*Neoveitchia 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 active.

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, Tajahi, 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 Tuanuku, '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 *Maniltou 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.
Hakauloa, 260 ha. 4km west of Nuku'alofa, Tonga. Reef habitats.
Muihopohoponga, 2 km. of caostline 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 starii - 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)
Lake Mautalano, Savai'i) Crater lake with montane and swamp forest.
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.

I 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 accumulatio 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 areum 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 caldera 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 dis-posal 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
Boerlagiodendron 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 oth r 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 est blished 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 Chal an-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 community 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 <u>Guamia</u> <u>marianae</u>, 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 <u>Leucaena</u> <u>insularum</u>, 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 <u>Megapodius</u> <u>laperouse</u> 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.

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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 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 <u>Thalassia</u>, <u>Enhalus</u>, <u>Ruppia</u>, <u>Halophila</u>.	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 man- 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. Falanruw, 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*, *Piscnia 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 *Messerschmid* 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, Caroline, 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 *Pomerea 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) Fenuaura (Scilly) Mopihaa (Mopelia)	sea bird rookeries and turtle nesting areas and a selection of atoll marine biomes.

<u>References and sources</u>.

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 (¼ 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.

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

X 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 Sources.

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.

Fig. 6 MATRIX OF BIOME OCCURRENCE BY BIOTIC PROVINCE

X Present / Probable ☐ Absent

ISLAND TYPES / BIOMES \ BIOTIC PROVINCES	I NEW GUINEA	II BISMARK ARCHIPELAGO	III SOLOMON ISLANDS	IV NEW CALEDONIA-LOYALTY	V NEW HEBRIDES-SANTA CRUZ	VI NORFOLK-LORD HOWE-KERMADEC	VII FIJI	VIII TONGA-NIUE	IX SAMOA-WALLIS	X TUVALU-TOKELAU	XI GILBERT-NAURU	XII MARIANA ISLANDS	XIII CAROLINE ISLANDS	XIV MARSHALL ISLANDS	XV PHOENIX-LINE-NORTHERN COOK	XVI COOK-AUSTRAL	XVII SOCIETY ISLANDS	XVIII TUAMOTU	XIX MARQUESAS	XX PITCAIRN-GAMBIER-RAPA
CONTINENTAL ISLANDS	X			X									X							
VOLCANIC ISLANDS	X	X	X	X			X	X	X			X	X			X	X		X	X
ELEVATED REEFS	X	X	X	X	X		X	X	X		X	X	X			X	X	X		X
LOW ISLANDS	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X
LOWLAND RAIN FOREST	X	X	X	X	X		X	X	X			X	X			X	X	X	X	X
MONTANE RAIN FOREST	X	X	X	X	X		X		/			X	X			X	X		X	/
BAMBOO FOREST	X	/	X	X	X		X					X	X				X			
CLOUD FOREST	X	X	X	X	X		X		X			X	X				X		X	X
RIVERINE FOREST	X	X	X	X	X		X		X			X	/				X			
SWAMP FOREST	X	X	X	X	X		X		X				X			/				
SEASONAL FOREST	X																			
SEMI-DECIDUOUS FOREST															/					
SUBTROPICAL RAIN FOREST						X														
MANGROVE FOREST	X	X	X	X	X		X	X	X	X	X	X	X	X				X		
ATOLL/BEACH FOREST	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X
WOODLANDS	X		X		/		X					X	X							
SCRUB	X	X	X	X	X	/	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SERPENTINE VEGETATION			X	X																
DWARF-SHRUB HEATH	X		X	X								X	X						X	
BOG							X								X					
WOODLAND SAVANNA				X			X					X	X							
TREE SAVANNA	X			X			X	X				X	X							/
SHRUB SAVANNA							X	X				X	X							
GRASSLAND	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	/	X	X
FLOOD SAVANNA	X											X	X							
FRESH WATER MARSH	X	X	X	X	X		X	X	X			X	X		X	X	X	X		
TIDAL SALT MARSH	X											X	X	X		X				
NON-TIDAL SALT MARSH	X				X		X	X				X	X							
ROCK DESERT		X		X	X			X	X			X	X	X					X	X
SAND DESERT					X							X								
FLOATING MEADOWS	X						X													
REED SWAMP	X							X				X	X							
SUBMERGED AQUATICS	X						X					X	X							
FLOATING AQUATICS	X																			
PERMANENT LAKE	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X			
INTERMITTENT LAKE												X								
BRACKISH LAKE			X									X								
MOUNTAIN STREAM	X	X	X	X	X	X	X		X			X	X			X	X		X	X
LOWLAND RIVER	X	X	X	X	X	X	X					X	X				X			
SEABIRD ROOKERIES	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SEA TURTLE NESTING AREAS	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	/		
CAVE	X			X	X		X	X	X		X	X	X	X	X					
ALGAL BED	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	/		X
SEA GRASS BED	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X			
ANIMALS IN SEDIMENTS	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	/	X
ALGAL REEF	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X
CORAL REEF	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	/	X
WINDWARD ATOLL REEF	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X
LEEWARD ATOLL REEF	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X		X
BARRIER REEF	X	X	X	X	X		X	X	X			X	X		X	X	X	X		X
FRINGING REEF	X	X	X	X	X	X	X	X	X	/	X	X	X	X	X	X	X	X		X
LAGOON REEF	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
DEAD REEF	X								X			X	X							
DROWNED REEF					X				X	X	X	X	X					X		
ROCKY COAST	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X
BEACH	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SALINE LAGOON															X			X		
OPEN LAGOON	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X
CLOSED LAGOON					X		X			X	X		X	X	X	X	X	X		
DILUTE LAGOON			X						X											
BRACKISH LAGOON															X					
FRESH WATER LAGOON									X											
ESTUARY	X	X	X	X			X						X				X			
MARINE LAKE							X	X				X	X							
MARINE CAVE					/		X	X				X	/							
OFFSHORE TERRACE			X						X						/		X			
OFFSHORE SLOPE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CONTINENTAL SHELF	X			X			X													
SUBMARINE CANYON	X																			
CONTINENTAL SLOPE	X			X			X													
ABYSSAL PLAIN	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SUBMARINE TRENCH	X				X	X		X				X	X							
SUBMARINE RIDGE						X	X			X		X	X							
SEAMOUNT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
INSHORE CIRCULATION CELL															X					
LARGER CIRCULATION CELL																				
UPWELLING SYSTEM																				

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ECODEVELOPMENT AND TRADITIONAL NATURAL RESOURCE MANAGEMENT IN THE SOUTH PACIFIC

by

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Ecodevelopment

Perhaps the only surprising feature of ecodevelopment is that its practice is so recent. Although the word itself was coined only four years ago (by Maurice Strong, first Executive Director of UNEP, the United Nations Environment Programme), the idea expressed by Mr Strong's definition of ecodevelopment was already well established: "ecologically sound development".

This definition is close to IUCN's current definition of conservation: "the wise use of natural resources". Unfortunately, both definitions are too broad to be of any but the most general use, and neither frees people from the prison of their mental models of what development or conservation consists. In practice, it is difficult to dislodge the conviction that conservation means preserving "natural" environments as they are, or that development means becoming like countries regarded as already developed, such as the United States, France, Australia or Japan.

The persistence of these mental models is understandable. It is unwise to strive for the impossible, and what is generally regarded as possible is restricted to that which exists already. The conservationist, contrasting the biological richness of the pristine tropical rain forest with the sterile mockery that too often replaces it when it is "developed", has difficulty conceiving of any change as desirable, except perhaps the installation of a fence and a guard. The developmentalist, contrasting the poverty of rural, technologically weak nations with the prosperity of urban, technologically rich ones, has difficulty conceiving of development as being anything but the process of changing from the former state to the latter.

The challenge for conservation is, as one report puts it, "to discover ways of disturbing [my emphasis] the natural tropical ecosystem for the benefit of man while not jeopardizing the richest source of biological information on the earth" (Farnworth and Golley, 1974). Similarly, the challenge for development is to find ways of improving the conditions of tropical peoples that do not ignore the enormous diversity of those peoples and of the environments of which they are part. The aims of conservation and development are, or should be, identical. Only their emphases, and the expertise they require (being complementary differ.

Hence the need for a new word, "ecodevelopment", and for a fuller, more detailed definition of it than was given when the word was coined. Ecodevelopment means development of the oikos, the house or locality, by making the fullest sustainable use of that locality's resources and of the knowledge, techniques, technologies and other adaptations of the people who live in that locality. This emphasis on locality - on local people and local resources - reflects the obvious though hitherto neglected fact that environments and their inhabitants differ substantially throughout the world, and that these differences present both problems and opportunities requiring special responses. Stated baldly, this notion appears to be almost a truism. Of course, environments and cultures differ. Yet, too often, development projects have foundered or provoked undesirable side-effects, because insufficient account has been taken of such problems as a shortage of trained manpower, a complex and fragile ecology, the majority of the population outside the market economy, or of such opportunities as the profound knowledge many local peoples have of local ecological conditions and of how best to profit from them.

The short definition of ecodevelopment as "development of the locality taking the fullest sustainable advantage of that locality's physical, biological and cultural resources" may be expanded into a statement of four key principles:

1. The solutions to the development problems of today should not become the development problems of tomorrow. Natural resources should be managed so that present generations can benefit from them without reducing the benefits due to future generations.

2. As far as possible, the consequences of proposed actions should be assessed. Much development aims at the achievement of one or two specific objectives (an increase in food supply, for example, or the exploitation of a mineral resource). Ecodevelopment requires an examination of all the physical, biological and cultural systems within the locality concerned.

3. The form and rate of development should be determined by the people most affected by it. Local people should be involved in the formulation of plans and in their implementation. The implications of proposed changes should be explained fully, without bias, and in terms of the local value-system. In certain cases, people will need help and training to judge these implications, since the proposed changes may create conditions of which they have no experience.

4. Development should use the knowledge, techniques and technologies of the local people. Many local cultures embody a rich store of experience of how to live reasonably well under conditions other cultures might find difficult or unpleasant. This experience should be built on. As a recent UNEP document suggests: "Although this does not mean that local 'traditional' technologies and organizational forms are necessarily superior or that modern technologies should be rejected, any changes which are proposed should harmonize with past adaptations to the environment" (UNEP, 1976). There is no hard and fast rule as to whether techniques and technologies should be small-scale or large-scale. They should be appropriate to the needs and resources of the locality.

These principles may be abbreviated into the slogan "adapt, then adopt", as opposed to "replace and transform". By following these principles, ecodevelopment is likely to have a number of advantages over conventional development: it can be more responsive to the perceived social and economic needs of the community; it can be more sensitive to ecological variation; it can be more economic; and, by starting from a position of consultation with the community (by asking its opinions of both problems and solutions), it can gain the cooperation of the community more easily. Thus, ecodevelopment is as applicable to "developed" localities as it is to developing ones.

Ecodevelopment planning is in its infancy, but is rapidly being applied, tested and refined. UNEP has three pilot ecodevelopment projects - one in Colombia and two in East Africa (UNEP, 1976). The National Centre for Science and Technology in Mexico has established in ecodevelopment centre, engaged in research and project planning, and the University of Paris awarded the first doctorate in ecodevelopment in 1975. Parallel to these activities IUCN has been engaged in the formulation of ecological guidelines for island development (McEachern and Towle, 1974) and for the development of the hymid tropics, especially those areas still under forest (IUCN, 1975a, 1975b; Poore, 1974, 1975, and in press). Because ecodevelopment is still in embryonic form, the following notes on the structure of an ecodevelopment plan should be taken not as definitive but as indicative.

An ecodevelopment plan may be divided into six stages, with a seventh running side-by-side. These stages are: (1) inventory; (2) evaluation; (3) retention; (4) modification; (5) introduction; (6) monitoring; (7) consultation.

(1) Inventory. An inventory is made of the locality's physical and biological resources (climate, soils, minerals, flora, fauna, etc.); of the local people's attitudes and practices - traditional, recent, and contemporary - concerning those resources; of the local people's economic, demographic and other cultural circumstances; of existing and potential agents of change; and of the social and economic relationships between the locality and the rest of the nation, region, or other political and economic groupings. The inventory should be as complete as is consistent with the intention that development eventually take place.

(2) Evaluation. The resources, circumstances, and so on, identified in the inventory are evaluated. In particular, the local people's attitudes and practices, techniques and technologies, concerning local resources are assessed for their capacity to meet the community's perceived needs, now and in the foreseeable future.

(3) Retention. A conscious attempt is made to retain those attitudes, techniques and technologies that are found to be productive, or otherwise to satisfy the requirements of the community.

(4) Modification. Some of these techniques and technologies may be amenable to modification, so that they can be made more productive or efficient without being destroyed or without causing disruptive side-effects. Alternatively, attitudes and practices that are presently satisfactory may be foreseen to be inadequate to cope with unavoidable changes, unless those attitudes and practices are modified. Conversely, attitudes and practices that have lapsed might be assessed as valuable and attempts made to revive them, generally in modified form. Care should be taken to assess the consequences of such modification or revival, as far as is possible.

(5) Introduction. Retention and modification of existing or recently lapsed attitudes, techniques and technologies may be inadequate to cope with demographic or economic changes, or with the altered aspirations of the community. Accordingly, new ones will have to be introduced. Care should be taken that introduced attitudes (via education and public awareness activities), techniques and technologies are

appropriate - that is, do not disrupt retained and modified cultural resources, or indeed physical and biological resources.

(6) Monitoring. Regular monitoring of the effects of development (of stages 3-5 above) is necessary, in order to compare actual results with predicted results, and through such comparison to improve the development process.

(7) Consultation. At each stage, the people should be fully consulted, as suggested in principles 3 and 4. The importance of public participation is increasingly being recognized by planners in developed countries, who nevetheless too often regard it as an embellishment to the planning process rather than an integral part of it. Since the local people are the immediate beneficiaries (or sufferers) of its development, they are entitled not only to express their views and to lend their expertise but also to have a deciding voice as to the nature and timing of any development that may be proposed.

Traditional natural resource management

Traditional methods of natural resource management are often worth retaining or reviving, either in their original or in modified forms. For example, field experiments with traditional cropping systems in various parts of the world have demonstrated that many of them bring high yields, conserve nutrients and moisture, and suppress pests. Intercropping of corn (maize) and rice, a common practice in small upland farms in Indonesia, reduces the incidence on corn of both corn borer and downy mildew (IRRI, 1974); in northern Nigeria, traditional mixed cropping systems achieve higher profits and lower risks for the farmers than introduced monocultures (Norman, 1974); and in tropical America, the incidence of Spodoptera (fall army worm) on corn and Diabrotica on beans is lower when corn and beans are grown together (as is the indigenous practice) than when they are grown separately (CIAT, 1974). Traditional cropping systems have the additional advantage that they are often nutritionally well-balanced and also provide their practitioners with the combinations of taste and texture they prefer.

The evaluation stage of an ecodevelopment plan is likely to reveal a number of methods of natural resource management that should be retained or revived. The review of some of the methods of the island peoples of the South Pacific that follows suggests this is so. This review concentrates on "low" islands (atolls and raised reefs) and on some of the smaller "high" islands, since they present problems and opportunities of a somewhat different nature from those of the larger "continental" islands.

Atolls, of which the Pacific contains three times more than all the other oceans put together, are one of the most difficult environments in the world. It is only a slight exaggeration to describe the atoll as a desert within a desert - a scrap of infertile soil marooned in a saltwater waste. Fortunately, the interface of these two deserts, the coral reef and associated waters, is one of the most productive environments in the world. Nevertheless, because of the problems posed by the small size, poor soil, lack of streams, and in many cases exposure to hurricanes and tidal waves, the atoll adaptation may be regarded as quite as striking a testimony to man's tenacity and ingenuity as the Arctic adaptation. The traditional food-producing methods of atoll dwellers require slight manipulation of this environment. Indeed, the inhabitants of atolls live almost as hunter-gatherers - hunting and gathering the produce of lagoon, reef and open sea, catching birds and collecting their eggs, and gathering the fruit of coconuts and pandanus. Although coconuts and pandanus are planted, that is virtually all the tending they receive, except at harvest. The principal, and most widespread, horticultural practice is the swamp (natural or artificial) cultivation of the aroid Cyrtosperma chamissonis supplemented to a greater or lesser extent by the cultivation of taro, arrowroot, breadfruit and banana. Cyrtosperma cultivation is elaborate and laborious: pits are dug at the centre of the island until the freshwater lens is reached; bottomless baskets are placed in these pits and filled with fallen leaves and vegetable waste; Cyrtosperma clones are then planted in the baskets of raw compost. These pits of wet organic matter strikingly reproduce the tropical swamp forest habitat of the wild relatives of Cyrtosperma (Barrau, 1965; Catala, 1957).

The atoll environment is so marginal to horticulture, and intensive cultivation so foreign to atoll dwellers, that substantial increases in yield and variety of crops grown seem unlikely. A more realistic requirement at present is to retain or revive traditional interest in such cultivation as is, or was, practised, but which has declined with the spread of the cash economy. Apart from copra (the price of which fluctuates sharply), handicrafts, mother-of-pearl and postage stamps, atoll peoples have only their labour to export - a practice which will continue to be necessary for some time but which can be socially disruptive. Atoll economies which do not remain primarily (although not exclusively) subsistence are likely to be extremely vulnerable, the more so the more remote they are from their markets.

Some of the effects of a changeover to the cash economy can be observed in the Tuamotus and the Gilberts. One of the most significant is a marked decline in nutritional standards. In Raroia (Tuamotus), canned beef, flour, rice and biscuits have replaced the traditional diet (except for fish, although even fishing has declined) (Danielsson, 1954). In the Gilberts (and particularly Tarawa), rice, flour and sugar consumption have increased, and rises in riboflavin deficiency and vitamin A deficiency in pre-school children have been observed, especially in the semi-urban area of Betio (Willmott, 1970). Consumption of toddy - the diluted sap of the coconut flower spathe, and the main source of vitamin C - has dropped.

Catala (1957), Miller (1953) and others have testified to the adequacy of the traditional diet of atoll dwellers. There are no nutritional grounds for dispensing with this diet. Furthermore, the purchasing power of atoll dwellers is so small, and is not likely to increase significantly, that one questions the wisdom of spending available money on satisfying needs that could be met with the non-cash resources of the islands (plant foods, fish, shellfish, turtles, birds and their eggs, and so on). The growth of semi-urban areas on atolls is unwise not only because it tends to generate standard low-income food-consumption patterns, but also because higher population densities create conditions that make traditional housing materials less appropriate than they are in villages. It is, of course, possible to build houses in non-indigenous materials, such as concrete, but along traditional lines, thereby retaining many of the comfortable features (such as good ventilation) of traditional housing. However, the import of materials is a drain on money which could otherwise be spent on improving subsistence, sanitation, water-supply and the recycling of nutrients. The integrated sanitation system described by Chan (1970) and Ono-Fadaka (this symposium) could do much to solve some of the problems facing atoll dwellers today, but of course requires money to make and maintain. Cash is also needed to see atoll populations through the not unusual emergencies caused by hurricanes and tidal waves.

Although the environments of high islands cause fewer problems than the atol environment, all island economies are likely to have a considerable subsistence component. The transition from an entirely subsistence economy to an entirely cash economy has proven more lengthy and arduous for most tropical countries than seems to have been anticipated by the development experts who advised them. Some of the reasons for this are that much of the impetus for change has come from the outside, many of the development schemes have assumed environmental and social conditions similar to those of the temperate, developed northern hemisphere, and often economic transformation has demanded a social transformation that many of the participants have judged - at least instinctively - undesirable. Developed economies offer many goods of great appeal to virtually all peoples. However, representatives of developed economies rarely if ever go out of their way to inform the people whose lands and labour they wish to use that these goods bring with them certain desadvantages. Indeed, these representatives are generally concerned only with extracting raw materials at the lowest possible cost and with selling manufactured goods for the highest possible return. Such a practice simply reflects the value systems of western market economies, and although it often provokes the condemnation of liberal commentators, it is perhaps best accepted as a fact of life. Such acceptance should bring with it on the part of the peoples of developing countries a certain caution over complete involvement with the cash economy.

The aim of governments is, generally speaking, to see that the basic needs (food, clothing, shelter) of their peoples are satisfied, and then that other social and psychological requirements, often unique to individual cultures, are met. This does not necessarily demand 100% conversion to the cash economy. Instead it is possible, and probably desirable, to aim for a mixed subsistence-cash economy, in which traditional subsistence practices are encouraged to continue, though perhaps with greater efficiency in order to provide farmers and fishers with a significantly, if modestly, greater return on their labour. The resulting surplus can then be sold to other members of the community whose work requires them to buy rather than grow their food. As much as possible of the economy's growth should be generated from within, since in this way it is easier to direct that growth and control its consequences than when the economy is dependent on the forces of the monolithic and fluctuating export market. Not even sophisticated developed economies have succeeded in overcoming the problem of adjusting the demands of agriculture to those of the rest of the economy when agriculture is regarded simply as a sector of the economy as a whole. Perhaps developing economies with a dominant food production sector will be able to avoid this problem, but this is likely only if they avoid the mistakes perpetrated by industrial countries. In any case, it is worth bearing in mind that history rarely repeats itself except in the most general way. Given that the historical circumstances of contemporary tropical countries are vastly different from those of 19th century Europe, it is improbable that they will develop along the same lines. It is all the more unlikely given the no less substantial geographical differences.

The majority of farmers in the South Pacific have small farms of only a few hectares. Soils vary considerably, being extremely poor on atolls and some raised reefs, such as Niue, and are fertile on volcanic high islands and on raised reefs with volcanic soils such as Tongatapu. Rainfall is variable, with some islands being extremely wet and others extremely dry, but on the whole it is seasonally abundant, and many islands receive either too much or too little. Power is limited but labour is readily available. The farmer needs an assured source of staple food, a regular supply of fresh meat or fish, vegatables and fruits, fuel for cooking, fibre for building materials and other uses, and a steady cash income to buy goods and services not available from his farm.

Tests of the different farming systems practised on South Pacific islands would no doubt reveal that they are extremely efficient. Nevertheless an increase in their efficiency, in order to satisfy the demands of growing populations as well as to fuel economic development, is probably feasible. For example, analogous tests in South East Asia and in West Africa have demonstrated that efficiencies can be increased not by introducing completely different cropping systems but by identifying those elements of the systems which could be improved and applying the appropriate improvement. Thus, Indonesian combinations of corn and rice have shown themselves not merely to have the pest-resistance advantages mentioned earlier in this paper but also to be more responsive to applications of nitrogen fertilizer. In this context, the recycling of nutrients recommended by Omo-Fadaka could possibly have a greater return than is suspected.

There are so many different systems of cultivation practised in the Pacific islands that there is no shortage of models for intensification of food production. Cultivation ranges from the semi-gathering of atoll cultures through extensive systems of slash-and-burn or shifting agriculture to intensive systems, often using irrigation, such as the linear contour, irrigable terraces of New Caledonia and the wet field terraces of Futuna (Spencer and Hale, 1971). Population increase will necessitate changes in agriculture, and probably the most practical strategy would be to intensify cultivation by adopting a variant of one of the more intensive techniques practised elsewhere in the region. Indeed, it is possible that such techniques have already been practised. For example, in the New Hebrides, archaeological research has identified terracing systems in areas where shifting agriculture now predominates. Archaeologists concluded that populations were once much greater than they are today, and that despite considerable increases in numbers in recent decades, they are still significantly lower than they were before being decimated by contact with Europeans. There are numerous signs of pressure on natural resources throughout the Pacific. This pressure ultimately will only be relieved by stabilizing populations. However, there is room for relieving this pressure by retaining or reviving traditional practices.

This is true not only for farming but also for the management of other natural resources, such as reefs, other fishing areas, and bird nesting and resting areas. Particularly on the smaller islands, birds and their eggs were a welcome change from the regular diet of fish and coconuts. Avian resources continue to be important, but with the erosion of traditional constraints on their use, the numbers of various bird species have declined. On Raroia, in the Tuamotu archipelago, the Polynesian sandpiper, little rail and fruit dove have been exterminated, and populations of booby and sooty tern are very low

(Danielsson, 1956). On the Tokelau Islands, traditional prohibitions have lapsed and any number of birds or eggs may be taken by any inhabitant on his own family holding. Tokelauans told Wodzicki and Laird that "Most of the birds, particularly sought for food, such as noddies, terns and pigeons, are steadily though not drastically declining" (Wodzicki and Laird, 1970). On Niue, Wodzicki has reported that populations of the Pacific pigeon and the purple-capped fruit dove are under severe pressure from hunting.

Clearly, it is desirable that while birds continue to be taken for food, a degree of control over consumption be exercised. The most appropriate form of control seems to be a version of that which was practised traditionally. On Raroia, the chiefs and priests were able to enforce restrictions and decide when bird catching might take place. The new elected chiefs and councillors do not have the same authority, apparently because, unlike leaders formerly, they are not religiously sanctioned. Similarly, in the Tokelau Islands, the council and the high priest placed a general tapu on visiting nesting and resting areas, and the tapu was raised periodically for a few days only. Wodzicki and Laird have recommended that "As in olden times, the control of the bird life - and also of some other natural resources - in the three islands [of Tokelau] should be entrusted to the Council of Elders (Fono Toeaina) of each atoll, who should decide the numbers of birds to be taken, and the time when it is permissible to hunt them". The fact that modern leaders or councils lack the sanction of religion is unlikely to be a problem. The principal constraints on their effectiveness on Raroia, Tokelau and other islands where controls have broken down, appear to be (a) the general collapse of traditional attitudes to resources; (b) the absence of any specific allocation of responsibility for controls over natural resource consumption to the leader or council; and (c) the fact that ownership of nesting and resting areas is not specifically vested in the whole community. This is borne out by two examples of the successful retention of traditional controls, even under modern conditions. In the case of Tokelau, bird collection from communal property, such as of frigates from Faleа islet on Fakaofo atoll, is still regulated by the Council of Elders. However, the most impressive example comes from Pukapuka in the northern Cooks, where traditional controls in only slightly modified form have continued to be effective even when applied to a cash crop such as copra.

The Pukapukans regard bird nesting and resting areas, the barrier reef and all fishing grounds on the reef, contiguous areas of sea, the lagoon, coconut groves, and taro and *Cyrtosperma* beds as reserve lands. Reserve lands are controlled by three "companies", which in effect are Pukapuka's three villages. The *ariki* (village leaders) are the executives of the companies, and they decree when reserves shall be opened and how much of the reserves' resources - coconuts, taro, crabs, sea birds or fish - shall be taken. All adults receive equal shares (and children equal part-shares), except for the *ariki* who are given an extra supply of coconuts in recognition of their position. To ensure that the constraints imposed by the *ariki* are not abused, the companies operate a system of guards, in which adult members of each village take turns at guard duty. The guards patrol the reserves throughout the day to keep away thieves, to protect the nuts, pandanus trees and other reserve flora, and to keep wandering pigs and chickens from damaging the taro and *Cyrtosperma* beds. This control system has proved capable of expansion as in the case of the island of Nassau, purchases by the Pukapukans to increase their resources, and now treated as a reserve. More significantly, perhaps, the system has proved adaptable to the exploitation of resources sold for cash, in particular copra. When a boat is expected, the *ariki* open the reserves for harvest, having inspected them to determine how much the harvest should be. An equal number of nuts is assigned to each villager for preparation, who receives an equal share of the profits. As Beckett (1964) observes, this communal control of natural resources has enabled Pukapukan land tenure to escape "the strains to which that of the southern Cook Islands has been subjected". If the system has changed since Beckett described it, then it is hard to imagine that it has changed for the better.

Where land, lagoon, reef and ocean are held in communal ownership, and where institutions exist that ensure resource exploitation is controlled, and where such institutions are guided by traditional concepts of restraint on consumption or by the ecological understanding of each resource's capacity for exploitation, there the local community has a good prospect of enjoying its resources as fully as is consistent with the need to sustain them. Undoubtedly, a priority for island communities is to retain such conditions if they still exist, and if they do not to introduce them. A similar statement may be made on patterns of consumption. If fishing has declined and has been replaced by the purchase of canned fish, it is possible to predict two dangers. The first is that scarce resources of money are being spent on items that are readily obtainable at no cost save that of time. The second is that fishing techniques that are relatively well adapted to the ecology of the reef zone will decline and be replaced by techniques that are not so well adapted. Techniques of angling, netting and spearing and so on that do not depart significantly from traditional methods have proved themselves to be conservative to the reef ecosystem and all the fish that depend on it. By contrast, there is a serious danger that mass exploitation techniques will either damage reefs or overfish stocks or both, and consequently oblige communities eventually to impose much more severe constraints on fishing and reef use than ever have been imposed in the past.

Examination of traditional systems of resource management in the South Pacific indicates that most of the region's peoples were effective conservationists. Indeed, in some cases, they even had officers who acted as ecological decision-makers. In the Lau Islands of Fiji, the _vaka vanua_ was custodian of forest produce and of crops. His duties were to watch his island's food supply, and as each major food crop (whether wild or cultivated) matured, to place a _tapu_ on it. When the crop custodian judged the crop to be ready for harvest, he lifted the _tapu_. He saw that the initial harvest was distributed correctly, with portions going to the chief and, in equal shares, to each of the clans. If the harvest was a good one, some of this initial take was set aside to be fermented and stored against time of scarcity. Once the initial distribution had been made, the people harvested the rest of the crop, as they required it, from their own lands (Thompson, 1949).

The vaka vanua ensured that his island's food resources were used to the fullest, preventing people from succumbing to the temptation of harvesting crops before they were ready, and therefore making sure that they received the maximum nutritional benefit available from those crops. By also ensuring an equitable distribution of the harvest, and storage of reserves in case of famine, he acted to optimize the use of his island's land resources. Unfortunately, the British did not understand this remarkable institution, and so did not incorporate it into the new administrative structure they created when they established indirect rule. As a result, the office of vaka vanua lost most of its authority and prestige, the numbers of forest and garden crops placed under tapu declined, parts of the crops were eaten before they were ready for harvest, and thus their nutritional contribution was reduced.

Each of the Lau Islands also enjoyed the services of a ndau ni nggoli, a master fisherman and authority on the island's fish lore and fishing techniques. The master fisherman's job was to act as a fisheries' ecologist, studying the habits of all the edible marine species, the state of the fishing grounds, the incidence of toxic plants that might render fish poisonous, and all other matters affecting fisheries. No large, organized fishing parties were formed without his permission, and he led all communal turtle hunts. The master fisherman thus protected the island's marine resources from over-exploitation, and, by taking advantage of his knowledge of the optimum conditions for fishing, ensured an optimum take.

Again, unfortunately, the British did not understand this institution, and the ndau ni nggoli has lost status. Nevertheless, Thompson (1949) reported 27 years ago that despite the absence of administration backing, the office of master fisherman had persisted, though with reduced influence. As a result of this reduced influence, Thompson's informants claim, fishing grounds had been disturbed, fewer organized fishing parties were formed, and kills were smaller than before. It would be interesting to know what the situation is today.

This symposium is therefore faced with the curious paradox of receiving ecological advice from individuals and institutions, most of which, being European or North American, belong to the peoples who were instrumental in persuading or obliging the peoples of the South Pacific to abandon offices and customs that were impeccably ecological!

Some conclusions and suggestions

It would be nice to pretend that it is only now that international science has assembled the ecological data necessary to prove that South Pacific peoples have, or had, the basic institutions necessary for them to make the best use of their natural resources. But, in fact, this was pointed out very clearly by Laura Thompson in her study of the Lau islanders. Indeed, she went further and distinctly stated the ecodevelopment concept that is only now becoming politically acceptable. It is worth quoting her in full: "The significant problem of community welfare emerges as a matter of using and adapting local beliefs, attitudes, habits and institutions, supplemented where necessary by appropriate new ones, to the end that human groups, through natural eco-cultural processes, may foster the development of a balanced, healthy total community - plants and animals, as well as human groups".

It has taken more than a quarter-century, during which many valuable institutions and customs have continued to decline, for development agencies (and, let it be admitted, conservation agencies as well) to begin to recognize the importance of Thompson's statement. The challenge facing the peoples of the South Pacific, and the development and conservation agencies assisting them, is to re-evaluate their traditional and contemporary institutions and philosophies from a position of confidence and pride. Clearly there are situations which are unprecedented and for which custom and tradition can provide no solution. Possibly the western world's inventory of techniques and technologies can provide appropriate solutions in those cases.

However, care should be taken lest the incorporation of such techniques and technologies disrupt further or destroy altogether those traditional ones which are more suitable for the special cultural requirements and ecological conditions of the South Pacific.

One of the most valuable steps that can be taken immediately is a public awareness campaign in each island to reinforce pride in traditional lifestyles, as well as to add the ecological and other scientific reasons for supporting traditional practices that until the impact of Europe and North American had no need of objective validation.

It can be seen that a virtue of ecodevelopment planning is that it obliges the planner to reconsider what was hitherto ignore and to restore what was hitherto dismissed. If this symposium can translate the extremely general precepts of this paper into a set of proposals for action, then the prospects of the peoples of the South Pacific making fullest sustainable use of their natural resources are good.

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A FRAMEWORK FOR ECODEVELOPMENT IN SOUTH PACIFIC ISLAND COUNTRIES

by

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SUMMARY

The coming of independence to new nations means besides self-government and management of their resources, responsibility for the total welfare of the population. When options are available, what is the wisest way to development ?

The problem confronting many of the South Pacific Island Countries is poverty. This poverty is characterized by unemployment, underemployment, illiteracy, malnutrition, disease, and bad housing.

How is this problem to be solved ? The urban way or the rural way to development ? The imitation of the patterns of development of the industrialized countries or the adoption of development patterns suited to indigenous traditional cultures and ecological conditions ?

The lessons of the First United Nations Development Decade (1961-1970) have shown quite clearly that given the pressure of time(constantly aggravated by the increase in population) the urban way to development is incapable of handling problems as complex and deep rooted as those faced by many of the countries.

What is required is not the urban way to development; that is from top to bottom (at macro-economic level) but the rural way to development; from bottom up (at micro-economic legel) which takes into account traditional, cultural, social and ecological aspects of the environments of the different countries. In other words, ecodevelopment.

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A FRAMEWORK FOR ECODEVELOPMENT IN SOUTH PACIFIC ISLAND COUNTRIES

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1. ECODEVELOPMENT - WHAT IT IS

Ecodevelopment can be described as development which takes cognizance of the ecological, environmental, economic, social and cultural realities of a country. It takes a holistic view of nature and development, and not a fragmented view. In essence, the basic intention is to ensure that:

(a) Socially, economically, environmentally and ecologically sound development for all the people takes place;

(b) The benefits from development reach the people as a whole.

Ecodevelopment is an entirely different type from the conventional urban pattern of development, but could draw on the experience of other countries while modifying these models in the light of the specific social and ecological conditions of a country. This is effect means that a country needs to develop on its own, to invest its traditional concepts with new meanings and not slavishly accept the standards of industrialized countries.

To achieve this type of development, emphasis should be placed on developing an economic system; appropriate technology; patterns of trade and political institutions which are best suited to a country's indigenous cultural and environmental requirements.

THE TECHNIQUES OF ECODEVELOPMENT

The following framework of action at grassroot level aimed specifically at the improvement of the people themselves could be useful. A nineteen-fold approach is suggested.

(a) Small-scale agriculture
(b) Self-help villages
(c) Small-scale rural and cottage industries
(d) Self-help technology
(e) Education for self-reliance
(f) Low-cost medicine (health and medical care)
(g) Nutrition
(h) Security
(i) Low-cost housing
(j) Commerce

(k) Low-cost transport and communication
(l) Politics
(m) Village development associations or corporations
(n) Water management
(o) Land management
(p) "Wastes" recycling
(q) Forest Management
(r) Fisheries
(s) Preservation of wildlife

(a) Small-Scale Agriculture - Land Reform

About 87-90 per cent of the population of the South Pacific Island Countries live in rural areas, in villages. In order to increase agricultural productivity to meet the needs of an expanding population, a complete restructuring of the rural societies through land reform is essential. Land reform could take several forms depending on the conditions in the different countries.

In many of the countries the family is an economic as well as a social unit. From the point of view of productivity, what any land reform should aim to achieve is to give each family a piece of land so that they can invest whatever funds they have for raising yields and improving their land, and to invest their labour for these purposes.

If men and women are to remain happily on the land, they must have farms of their own. Given population pressures, these are bound to be small, perhaps not more than an acre or two.

Intensification of the production of existing local crops should be undertaken to meet local needs. Emphasis should be on the growing of cereals, vegetables, legumes, tubers, to replace food imports such as rice, flour, sugar and condiments, potatoes, tomatoes, cabbages, carrots, cucumbers, peas - many of which can also be processed locally to produce a whole range of consumer goods not only for local consumption but for export as well.

Also emphasis should be on growing animal feedstuff such as corn, sorghum, soyabean and other legumes which are now being imported.

(b) Self-help villages

Many of the South Pacific Island Countries are multi-ethnic societies, with peoples of different cultures, languages, traditions, customs and religious beliefs in each of the countries. Ethnic loyalty is very strong and in order to avoid civil strife and inter-ethnic quarrels and fights, the different ethnic or national groups within each country should be allowed to develop separately so as to avoid fear of domination of one group by the other. Once this fear is removed the various ethnic or national groups could collaborate in matters of common interest - economic, social, cultural, political - which would lead to unity based on consent rather than force or coercion.

New forms of farming organizations which would overcome the powerlessness of the individual farmer and his family need to be created. The basic forms of organization through which the rural transformation should take place are individual villages or combination of villages.

The villages should be run on communal lines and all work in them done communally. Communalism is the basis of the traditions of the South Pacific Island Countries. This communal organization is not a matter of individuals desperately clinging together to eke out an existence. It is a social organization which has developed its own philosophical system of organization, and which does not relate its evolution to an urban centre. This communal structure affirms its particularity through forms of thought and religion arising directly from its own functioning.

This communal system is that of small-scale communities whose economic arrangements express a community ethos of democratic socialism. The people were bound together not only economically and politically, but religiously and socially by a system of collective activity and mutual help which extended from the family to the ethnic group as a whole. It was a give and take policy, with a sense of belonging and brotherhood serving as a cornerstone of their traditional "extended family" system.

In crisis or hardship, the individual could depend on the family or clan or community for help. The extended family system constituted social security which followed the natural pattern of personal relationships. In a broad sense, then, society looked after a man or his widow and orphans. Both "rich" and "poor" individuals were completely secure. Because he or she might lack wealth, a man or woman did not starve from want of food or lack of dignity; he or she could depend upon the communal wealth.

Social obligations were taught. The purpose of education was to prepare a child for participation in the life of the community, the ideal of which was correct relations with, and behaviour towards others. The communal organization and educational system reinforced the lesson that one's comportment towards others was what mattered most. The strength and number of social ties between members of the same family, clan or age group and between different families and clans meant that the community could be very easily mobilized for cooperative activity. The building of houses, fences, bridges, agriculture (cultivation, sowing and harvesting) and industry were usually group or communal activities. People knew that if a job had to be done, they must do it together. Families and family groups pulled together to provide what they needed; and what they needed, they created together.

Though this communal system has been affected by foreign domination in the past, its foundations are still intact. This communal way of life, which is a positive and beneficial aspect of the culture of the people of the South Pacific Island Countries, should be reactivated where it has been adversely affected, and maintained and strengthened where it still exists.

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The co-operative or self-help villages should be based, as far as possible and practicable, on the different ethnic or national groups. The villages should have as an overall aim the building of completely self-reliant, self-sufficient, self-regulating and self-financing, human-scale communities.

Communalisation of food production (land clearing, sowing, harvesting and threshing) should become the subsistence farmers' major activity.

The economic activities in the villages or set of villages should be highly diversified. Apart from subsistence farming, agricultural activities should be widened to include poultry, fishing, and the keeping of livestock.

What agricultural development through farming co-operatives and self-help villages should aim to achieve is the mobilization of the enormous latent potential of the rural population. In this way the hugh rural population could become an enormous source of capital accumulation instead of becoming an economic burden.

When not working on the land (for instance during the period between planting and harvesting) farmers could be engaged in rural public work projects, such as building roads or their own dams for irrigation system, with the help of agricultural instructors, agronomists, etc.,. This is the policy of "turning labour into capital" by seasonal "investment" in public works.

The villages could also build their own workshops and co-operative shops, grain mills, timber mills, etc.,.

Agricultural practice should be based on labour-intensive farming methods. Overall use of chemical fertilizers and spraying with all-purpose insecticides should be avoided as far as possible.

Planting and harvesting could be timed to avoid the times of insect infections and less chemicals used to kill insects which threaten crops.

Cash crops could also be grown communally. Credit and marketing lend themselves readily to the co-operative approach and members can learn the value of co-operative activity. And more particularly the ability to improve quality of production will become better understood.

All income from sale of cash crops earned by the villages should not be automatically distributed to members. Some of the surplus could be reinvested in development projects such as the building of grain stores, or acquiring new herds of cattle or building poultry houses.

All developments in the villages should as far as possible, be internally financed.

(c) Small -Scale Rural and Cottage Industries

This should be represented by agriculture and by widely-diffused small-scale industries which are more or less traditional and labour-intensive. Economic activities should be decentralized and statistical and planning machinery placed under local control. In this way rural labour could be mobilized for economic development. This economic decentralization should be aimed at stimulating development from below which would make possible the release of a spontaneous initiative of the people.

The main branches of industry in the villages should be those closely dependent on agriculture, such as the preparation of animal feedstuffs, the manufacture and repair of agricultural implements, brick making, etc.

Small and cottage industries for the preservation and processing of meat, fish, poultry and agricultural products and residues such as fats, carbohydrates, proteins, cellulose, pulp and leaf to replace many imported foods and goods should be set up.

Pigs, chickens, goats, cattle produce, meat, eggs, milk, could also produce materials for small industries.

1. Small-Scale industry for food processing such as the undermentioned could be undertaken:

- drying and salting
- smoking and pickling
- canning and freezing
- milling and bakery
- brewery and dairy
- wet and dry rending

for fruits, flour, bread, biscuits and candy, sauce, wine or vinegar, oil, butter, cheese; and animal feed and fertilizer from residues (bone, fat, glands, shells, vegetables and fruit peelings).

2. Cottage industries based on

- coconut
- textiles
- tanning

for sugar, syrup, alcohol, oil, soap, grease, candle and glue, brush, twine, rope and mat, jute, cotton, silk, leather.

The advantages that could be derived from establishing such industries near the farms are:

1. Decentralization of economic activities and reduction in overhead costs.
2. Less sophisticated buildings built with local materials.
3. Availability of land and labour on the spot.
4. Availability of raw materials and fuel on the spot with subsequent reduction in transport costs.
5. No housing, overcrowding or sanitary problems.
6. No displacement of workers or disruption of family life.

(d) Self-help Technology

The villagers will need technology to achieve their development goals. The aim should be to design and build simple and appropriate technologies and implements for use at village or community level. Such a technology should:

1. Be a type consistent with the maintenance of healthy self-reliant, self-supporting, self-regulating and self-financing human-scale society at village or community level.

2. Have the lowest impact on ecosystems and should enhance rather than disrupt the life of rural communities. It should be designed for a relatively "closed" economic community at village level.

3. Be cheap and available to everyone in the village rather than a privileged few.

4. Be suitable for application on a small scale. It should be designed in such a way as to provide villagers with the means of doing profitable and intrinsically significant work; of helping then to achieve independence from bosses so that they become their own employers or members of self-governing co-operative groups working for subsistence and local markets.

5. Be labour-intensive, to reverse the trend towards increasing unemployment.

6. Be capable of being reproduced locally, thereby encouraging indigenous industries; that is, it should be such that can be operated, reproduced and maintained by the people themselves.

There should be a new type of literature for the rural population - literature on ecologically-based low-impact technology for support of small-scale village communities. Such literature should contain information on low-cost building materials; low-cost dams; low-cost energy, e.g. wind, water, solar and other renewable energy uses; low-cost medicine; low-cost transport; labour-intensive methods; workshop technology and all those things which the village needs to be self-sufficient, self-reliant and largely self-governing.

Small operators, however numerous, are less likely to be harmful to the environment than large-scale ones. Although as a result of ignorance, small communities can sometimes be guilty of causing serious erosion, this is trifling compared with the devastation caused by large organizations that are sometimes motivated by greed, envy and lust for power. Moreover, it is obvious that people who are organized in small communities and units are more likely to take better care of their bit of land or other natural resources than large anonymous companies.

(e) Education for Self-reliance

The new self-help technology at village or community level will require literate farmers. Villagers should run their own adult education classes during the evenings after the day's work. The purpose of this mass literacy campaign is to enable villagers to employ what they have learnt in improving their economic, social and personal relations as citizens.

The villagers should also run their own primary, secondary and training schools and research stations, with government assistance if necessary.

This education for self-reliance is the very basis of whatever action-oriented programme will be carried out. The education given at village schools should be designed to enable pupils to continue to work in the rural areas, instead of drifting to the towns.

There should be "work and study" programmes of education which include both classroom and production activities, both complementing each other. The aim should be to combine education and production as mutually reinforcing aspects of the same process.

The schools should have their own farms where pupils can learn about water storage, agricultural techniques, preservation of food and grain, and the traditional crafts of villagers. The aim should be to introduce practical technologies in school curricula which schoolchildren can apply themselves.

(f) Low-Cost Medicine (Health and Medical Care)

To eradicate disease and improve public health, the villagers should build their own nurseries dispensaries and health centres, staffed with physicians, and by nurses trained in midwifery.

Villagers need to be trained in basic social and preventive medicine relevant to the conditions and diseases in their areas; and also trained in First Aid so that they can take care of their family health problems. Small clinics for services such as maternal and child health, family planning and health education, should be set up.

Priority should be given to the training of medical auxiliaries or "barefoot doctors". They should be trained to treat simple ailments and diseases and be efficient in First Aid treatments.

(g) Nutrition

All the requirements of a balanced diet (protein, fats, carbohydrates, minerals and vitamins) could be obtained from a combination of vegetables in their natural or sun-dried state, properly cooked so as not to destroy the natural flavour and nutritional value. In some cases, such as bean sprout, they are all present in a single vegetable.

Eating vegetables with the minimum amount of meat, poultry or fish as a main dish is healthy and can do away with serious problems of obesity and heart trouble in a situation where people eat too much meat and carbohydrates. It also is a means for conservation of energy resources.

Fresh fruits eaten raw and vegetables properly cooked but with some meat, poultry or fish added, together with the right amount of cereal or tuber and plenty of wholesome water and natural fruit juice is a healthy and balanced diet. Home economics should be taught, with emphasis on cooking tasty and attractive meals from the variety of cereals, legumes, tubers and vegetables in the countries.

Food should be preserved less with chemicals and more with sun, salt, spices, oil, and naturally fermented sources, and smoke from wood for drying; or smoking in order to prevent wastage or reduce the huge quantity of imported chemically processed foods that are not only expensive, but of doubtful nutritional value.

The coastal waters, rivers, lakes, valleys and forests of the South Pacific Island Countries, if managed properly, could provide the people with a renewable source of protein food.

(h) Security

The villages should also become the basic welfare groups organizing relief measures in times of calamity. Families in need, because of illness or other reasons beyond their control, should have recourse to the welfare fund of the "team" to which they belong.

(i) Low-Cost Housing

Villagers should be encouraged to build new low-cost houses suited to the cultural environments of their villages, utilizing locally available resources with the help of innovative architect-engineers. Where possible and practicable, houses should be built communally. By this means they cannot be sold when individuals leave the villages.

In the day-to-day life of its members, co-operative or self-help villages could integrate the totality of the elements which make up the life of the villagers: food, clothing, housing, education, medicine and security.

(j) Commerce

1. The emphasis on self-reliance and co-operative living should be such as to make each village or set of villages understand that they will have as little contact as possible with the world outside in terms of commodity exchange relations. This should be so in order to reorientate agricultural production in the villages away from "world" markets dominated by industrial technological systems.

Production in the villages should be turned towards (first) the still underdeveloped internal markets of the countries and (next) to other countries with which they can enter into barter agreements with guaranteed "prices". In other words, trade by barter.

The overall aim in commerce should be to build a national conglomeration of self-supporting, self-reliant and self financing communities.

2. Farmers' associations

Farmers should form Farmers' Associations. These Associations, which should be run on co-operative lines, should deal with all matters concerning their farms. They should be concerned specifically with:

a. Increasing production and improving quality of products; marketing; purchasing; supply; credit and extension work.

b. Providing assistance to farmers for improving their technical know-how and organizing them into joint or co-operative ventures.

c. Supervising farmers' activities and liaison with the relevant government departments.

d. Co-ordination of crop production with other Farmers' Associations in other villages to ensure the maximum yield and effective use of manpower on crops most suited to the conditions in each area and to local interests, but still within requirements of the national market in order to stabilize prices, besides bringing reasonable returns to the farmers. The Government in turn should consult with other countries producing similar crops, to prevent a glut in international markets.

e. Acquiring and using on behalf of its members any finance from Government.

(k) Low-Cost Transport and Communication

Low-cost and effective means of transport between villages and the country as a whole is essential.

Transport of farm produce to Farmers' Associations' Headquarters can be done by draught animals on tracks, or specially designed carts made from local materials and drawn by animals on dirt roads. Both systems, though slow, could transport a lot more than the bilum, and relieve villagers (men and women) of carrying heavy loads on their heads.

Mechanized tricycles and carts can be gradually introduced as the road system is improved, but the use of expensive trucks and tractors should wait until there are adequate maintenance facilities and spare parts.

Draught animals and small "machines" could also be used to increase agricultural production. It has been found for example that in the Philippines and Taiwan, one water-buffalo can plough and harrow one acre of land in less than one day; and that a man and a small "machine" which looks like a lawn-mower can level a rice field and also transplant rice seedlings over one acre in one day.

This simple and appropriate technology could be realistic in the South Pacific countries where people cannot afford big machinery from abroad that can replace people and cause widespread unemployment.

(l) Politics

As already stated, the emphasis on self-reliance should be such as to make each village or set of villages understand that apart from developing co-operative living, the will to do so must come from the villagers themselves. The spontaneous approach to development from below in which villagers make their own decisions, with little or no governmental or bureaucratic interference, whilst welcoming assistance from the government when needed, should be encouraged.

The importance of the political factor in development should assert itself strongly in this context. This places great emphasis on the importance of dedicated leadership.

The villagers need to provide educated people and trained village cadres, teaching and working with the villagers. What should be avoided is the wholesale importation of people from other villages or officials from outside the area or areas, even from District or Provincial Headquarters, instructing the villagers as to their tasks but taking no physically active part in it themselves.

Also the general principle should be established that the villages should be the democratic political control agencies. T They should have representatives at village councils who are democratically elected and who are subject to democratic control and dismissal.

Elected members to village councils who prove to be unsatisfactory in their work can be unseated at the Council's General Meetings. These meetings could be called as often as is required.

(m) Villages Development Associations or Corporations

The villages in the various districts in the country should be encouraged to set up Village Development Associations or Corporations to promote economic, social, cultural and political development and awareness at village or community level and to give opportunity to the village people to participate fully in improving the life style in the village in general.

Development should be based on the people as a whole, and not on the urban privileged. The only way the South Pacific Island Countries can rescue themselves from poverty is by radical changes of structure which have a popular base and popular support. Both the farmers in the countryside and workers in the towns should be allowed to re-enact their own life experience to its logical conclusion. This is vital.

Political change in these countries will remain of little long-term value unless it is cultural change as well. But cultural change becomes possible only when men and women fight out their own mental battles themselves. It cannot be done for them.

(n) Water Management

Water management should be on a small scale. Small stone and earth dams should be built at suitable spots in creeks to store enough water and give sufficient head to operate hydraulic rams. The rams could be made from odd lengths of piping to pump water throughout the day without any fuel cost.

The waterfalls from various dam overflows could produce hydro-electric power, using small water turbines to meet local energy requirements.

Small windmills made of bamboo, wood and some metal, could make use of free wind power to pump water from wells to generate electricity and to operate small machines.

At District, regional or even national level, the rivers and streams could be connected together by channels and artificial lakes to store and distribute water to every part of the country for development purposes and, in some cases, for transport as well.

This water network is very important for rural development which should not rely on rainfall alone. At the same time, adequate rainfall collecting and storage systems should be devised, particularly in those islands where surface water is limited.

(o) Land Management

Many of the South Pacific Island Countries have vast areas of fertile land that are being gradually destroyed either through monoculture and ecclusive use of chemical fertilizers or lack of proper irrigation and good land management.

Apart from the fact that chemical fertilizers and pesticides are costly, their indiscriminate use could destroy the fertility of the soil on which food production depends. It is very essential that the soil should not be depleted of certain types of plant food. Consequently rotation of crops is essential. If it is necessary to protect crops from insects, pests and diseases, it is advisable to plant different types of crops at the same time. This could assist in controlling pests and diseases for the obvious reason that different crops are subject to different diseases.

Herbs and spices could also be planted and used to keep pests away. Also an integrated control combining biological predators and low toxic chemicals could be used.

It is impossible to exterminate all pests and it is a waste of time and money attempting to do so.

Management of the land is very important. Sloping land should be terraced to stop wasteful erosion. The terracing could be done by using draught animals such as water buffaloes, and local materials such as stones and bamboo.

(p) "Wastes" Recycling

Farm "wastes" could be recycled in the natural life cycle in the soil with the help of existing organisms and solar energy. All "wastes" - human, animal and agricultural - could be isolated in digesters and treated anaerobically to kill the existing pathogens that could cause diseases. The digesters could be built of concrete and steel on large co-operative farms, or sun dried mud bricks, empty drums, stones, clay or big bamboo poles.

Anaerobic digestion of human, animal and agricultural "wastes" could produce bio-gas consisting of two-thirds methane and one-third carbon dioxide - exactly like natural gas - using intestinal bacteria of human and animal origin for the process.

The bio-gas could beused for cooking, lighting, refrigeration and other domestic and industrial purposes.

Also anaerobic digestion of all natural resources, man-made "wastes" and animal "wastes", could produce much needed fertilizer, animal feed and fuel for agriculture, fisheries, and simple cottage industry, The only external source of energy comes from the sun.

The tropical conditions of the South Pacific Island Countries are conducive to this process.

George Chan, a citizen of Mauritius, former Senior Lecturer in Public Health at the University of Papua New Guinea, and Environmental Protection Officer at the Papua New Guinea Office of Environment and Conservation, and at present Expert on Digesters for the South Pacific Commission in Noumea, New Caledonia, has built small integrated farming system units - using the principles enunciated above at the Environmental Health Demonstration Centre at Gordon; the Makana Vocational Training Centre at Bomana; the Co-operative Training College at Laloki and the Agarabi Vocational Centre at Kainantu; all in Papua New Guinea (Annex A).

In Papua New Guinea, animal husbandry is based on pigs which are important for many reasons, especially in the Highlands. They roam about causing extensive damage to gardens. For several years the Government tried to persuade villagers to enclose their pigs behind fences. For economic reasons, they refused to do so for it would have meant additional work feeding the pigs, without any extra benefits.

The breakthrough was made by George Chan, a man with tremendous talent and experience at working out solutions to problems at grassroot level. (a) Animal House (Pen): He built a rectangular fence with a roof (made of local materials) over it and a concrete floor to build an Animal House (a). The House or Pen had a plastic drain so that the pig "waste" is easily washed away daily into a Digester made of concrete. (B) Digester: The Digester (B) which is the principal part of the system, is a fermentation tank with plastic drain into which pig "waste" is introduced in the form of liquid slurry. The only way the digester can function properly is to discharge into it plenty of fresh water from a Water Tank (C) every day. The water from the tank washes the pig "waste" into the Digester. The scheme can only work if pig farming is done to provide the "waste" which is the raw material for the project. The functions of the Digester are:

1. Isolation of pig "waste" and odours to prevent them from causing nuisances or pollution.

2. Settling of organic matter that is decomposed by anaerobic fermentation, i.e. bacterial decay in the absence of oxygen.

3. Stabilization of the settled solids into Humus, which is a dark matter with little or no odour which can be used to improve the fertility of the soil.

4. Conversion of gases of decomposition into Methane (CH_4). The methane is produced by a careful process of anaerobic decomposition of the "waste".

The gas can be stored if a gas cover with water and oil seal is fitted to the Digester (D). Painting of the gas cover in black allows maximum solar energy to be absorbed and heat the anaerobic liquid inside to activate the digestion or fermentation. At the same time pathogenic organisms are destroyed.

Simple pipes are connected to the digester to bring the methane to where it is required. The gas can then be used for home heating, cooking, refrigeration, running a small engine or generator for electric lighting or for pumping water or other purpose.

For intermittent use of the gas, as in cooking or boiling water, it can be used directly. But for continuous use, as in refrigeration or lighting, it is better to use the gas to run an electric generator outside the house or building.

The farmer can therefore generate his own fuel for running tractors and farm equipment, home heating and cooking, crop drying, heating farm buildings and incubators, and powering an engine or generator to produce electricity. For many generations to come there will not be the slightest chance for rural communities to have electric supply. So it is not difficult to imagine what a big difference it will make to the standard of living of a family in a village or remote island with such a convenient source of fuel for domestic, cooking and other purposes.

To produce enough gas for cooking, lighting and refrigeration, there should be at least five pigs per person. So a 300-gallon Digester can cater for all the needs of a family of six with 30 pigs. If more gas is required for other purposes, such as small cottage industries, more pigs can be bred. Since most of the feed is provided by the animals themselves, this should not be difficult to do in the South Pacific Island Countries with their tropical climate.

(E) Settling Tank: Since it is intended to use the end products of this treatment system for other useful purposes, there is an extension to the Digester to retain the effluent for another 24 hours in a settling tank. More settling takes place, with further digestion by anaerobic bacteria and destruction of pathogene (bacteria, helminths, viruses). A better effluent is also obtained for subsequent purification by oxygen.

(F) Algae Pond: The water or effluent from the settling tank is discharged into a long shallow channel, formed in a V-shape with a depth not more than 3 feet to allow sunlight to penetrate down to the bottom, and lined with puddle clay. The functions of the Algae Pond are:

1. To produce algae - The algae are not part of the original "waste" but simple natural plants than can change carbon dioxide from the air or water into food in the presence of sunlight by a biochemical process known as photosynthesis.

   The algae, particularly the blue-green type, are a good source of protein and vitamins that can be fed to animals. As a result, the animals will grow and breed faster, thus increasing the meat supply. A shortage of animal feed is mostly responsible for the deficiency of protein in many of the "developing" countries, because the cost of feed can represent up to two-thirds of the production costs of feeding animals.

   With the bulk of the animal feed readily available at practically no cost in the Integrated Farming System, there should be more incentive for every family to raise more and more animals where land is available. Also with the free fertilizer they can grow a great variety of vegetables which are also lacking in their present diet.

2. To convert organic matter into inorganic compounds - minerals - that are suitable for use as fertilizer.

(G) Fish Ponds: The effluent from the Algae Pond then flows into a second pond (G), also V-shaped, in which fish could be introduced. The effluent from the algae pond contains nutrients that can be used in fish culture, particularly for tilapia and carps that grow and reproduce well. The fish is another source of minerals and protein. The fish could be eaten by human beings or could be fed to animals. They feed on a algae and protozoa. In any case, any enteric micro-organisms will long since have been killed by the digestion and oxidation process. In fact the use of effluent in fish culture is practised in such highly "developed" countries as the United States of America, Israel, South Africa, Japan and Germany.

Also if ducks are kept enclosed within the fish pond, they will not compete for food with the fish, but will eat what the fish do not want, thus helping to keep the pond clean. Between them they also keep mosquito larvae and weeds under control.

(H) Vegetable Garden: Finally, the water flows into a garden (H) and is rich enough in minerals to make possible the growing of several crops a year. The overflow from the fish pond contains the end products of the decomposition of the organic matter in the effluent, and these are minerals that are suitable for use as fertilizer. Without the use of chemicals, the purified effluent of the fish pond can make vegetable gardening a very profitable proposition. For example, as much as ten crops of vegetables per year have been obtained in some countries. The vegetables can provide the bulk of the animal feed required or can also be eaten by human beings.

Finally, the stabilized sludge or digested slurry at the bottom of the Digester is pumped out periodically and dried in a shallow bed in the ground to kill any pathogens present, before it is used as humus to improve the fertility of the soil. The digested slurry is a highly effective natural soil conditioner and fertilizer, containing a high percentage of nitrogen and also phosphorus, potassium and metallic salts essential to plant growth.

(I) Cottage or Small Industries and Food Processing: The availability of cheap and convenient sources of fuel can facilitate, directly or indirectly, the establishment of cottage and other small industries for the production of food, drinks and consumer goods (I). Food processing is also possible because of the availability of cheap and convenient sources of fuel for water heating, cooking and refrigeration. An abattoir for slaughtering and dressing pigs and poultry; a cold room for meat and fish conservation; a preserving plant for drying, salting and smoking surplus meat, fish and vegetables - all these can be run from the gas or electricity on the spot.

A bio-gas plant can be designed to suit almost any farmer's operation and needs. It saves him money for fuel and reduces his fertilizer bills.

For a small farm with about 30 pigs and the same number of chickens, a 300-gallon Digester will be adequate. It costs about US$300; the pig pen or chicken house, built with local materials; and the algae and fish ponds, built in the ground and lined with puddle clay, cost approximately US$200.

For bigger farms, Digester units of 1,000 gallons can be used. Each unit, prefabricated in fibreglass, together with its Settling Tanks, costs about US$600. So the initial outlay is not excessive and can be recovered within a year. The possibilities are enormous.

All this is quite simple, costs very little money (capital and running costs) and solves at village or community level problems of "waste" disposal, energy and food. It is a really simple method by which the components of an ecological cycle, all interrelated in a balanced symbiotic arrangement, produce the basic necessities of life; fuel (methane gas); feed (algae and fish); fertilizer (minerals from organic matter); food, and renewable raw materials. With proper management of "wastes" and renewable natural resources, the world can satisfy its food needs by agricultural systems that do not depend on a major import of either fossil energy or electrical energy derived from fossil fuel or nuclear sources.

The Integrated Farming System is a concept that holds much promise for people who want to return to the land and make use of water and solar energy as their main non-polluting source of power for this technologically simple and economically feasible way of either utilizing natural resources while improving them in both quality and quantity, or consuming some of the non-renewable ones in a restricted but efficient manner so as to benefit all mankind.

The Integrated Farming System concept will involve nothing less than changing the whole system of established agricultural practice, now carried out in large plantations and already proved to be a failure, to that of the individual farm based on the Integrated Farming concept, which can be feasible immediately and very economical at the same time. So far projects on small farms in Papua New Guinea, Taiwan, India, Philippines, China and some of the other "developing" countries have proved successful and convinced many people that the system does work. As a result, designs of larger units are being prepared by the governments of these countries.

Also a considerable amount of research and development work has been done in various parts of the world - - in Canada, the United States of America, etc. In many "developing" countries, especially in Asia, considerable progress has been made in the use of bio-gas not only for domestic purposes but also for industrial purposes (e.g. the source of energy for generators to produce electricity). It is foreseen that with proper development of an integrated bio-gas industry, the rural areas in most "developing" countries could become not only self-reliant but also self-sufficient in their requirements of energy for a variety of uses, including the needs of agricultural machinery and also for running small-scale industries.

In the light of the energy and fertilizer crises, there is a growing awareness of the need to develop an indigenous and inexpensive source of energy in the rural areas and also to make use of the residue as an efficient fertilizer. The governments of some "developing" countries have taken concrete steps for the promotion of the bio-gas industry on an extensive scale. There is a great need to examine the wealth of information and the experience in various countries on the development of the bio-gas industry, and promote technical assistance where it is required.

(q) Forest Management

Forests should be managed carefully in order to maintain a sustained growth and yield, and keep a proper balance of plant and animal species.

Forests are a reservoir of medicinal herbs and a variety of plant and animal foods, as well as timber.

Timber should be exploited either to build decent houses or make furniture for the people. Concessions for timber exploitation to foreign companies should be viewed with caution, and where they exist every effort should be made to ensure that adequate measures are taken to ensure continued productivity, e.g. reafforestation, especially the re-planting of native species.

(r) Fisheries

This is the most important area where conservation measures must be taken. In many of the South Pacific Island Countries, there is a large-scale destruction of coral reefs, pollution of lagoons, over-exploitation of shells and corals for commercial sale. These problems are made worse by the activities of foreign fishing fleets.

At the present rate of exploitation and pollution, some marine life could be extinct before the end of the century.

There is the need for careful control of exploitation to prevent extinction and assure sustained yields.

Marine life should be conserved through proper fishing methods without upsetting the ecology.

Aquatic life in rivers and lakes should be protected from industrial pollution.

Suitable but simple fishing craft, gear and techniques should be used to get food from the sea and coastal waters. There should be refrigeration facilities in the villages, to preserve the catch.

(s) Wildlife

Wild animals and plants are a free source of food, medicine and raw materials and should be preserved for the benefit and welfare of the people.

Exploitation of wildlife must be carefully controlled to prevent extermination of native species and to assure sustained yields.

II. INTEGRATED FARMING PROGRAMME FOR ECODEVELOPMENT

The following research projects for ecodevelopment are recommended for consideration:

A. Environmental Management

a. Research into Water and Land Management to construct water grids for

- small dams in streams
- canal system
- artificial lakes
- rainfall collecting with appropriate water systems

for aquaculture, hydro-electricity, irrigation, transport, recreation, water supply, drought and flood control.

b. Water Lifting for

- hydraulic ram
- windmill
- water wheels

for agriculture, livestock, industry and water supply.

c. Soil Conservation for

- terracing and other erosion control techniques
- maintaining fertility
- improving productivity

for agriculture, livestock, aquaculture and reforestation.

B. Integrated Livestock/Fish-Crop Farming

a. Research projects into the use of Livestock

- pigs and goats
- water buffalo and cattle
- chickens and ducks
- rabbits and hares

for meat, milk, eggs, wool, for ploughing and transport and manure.

b. Aquaculture: the development of lagoons and other water for higher yields of fish and shellfish; algae and protozoa, and aquatic plants for

- food
- feed
- minerals

c. Agriculture: the use of

- inter- and multiple-cropping
- rotation of crops
- natural fertilizers
- fruit tree planting for tubers, greens, cereals, legumes, fruits, fibres, nuts and vines, feed, raw materials and humus.

C. Integrated Farming System Units

Research into projects like those being pioneered by George Chan could be useful where it is possible and practicable to set them up in villages or communities.

D. a. Small-scale industry research projects

b. Cottage industry research projects

based on (c) (see "The Techniques of Ecodevelopment").

E. Low-Cost Housing Research Projects based on (i) (see "The Techniques of Ecdevelopment").

F. Low-Cost Medicine Research Projects based on (f) (see "The Techniques of Ecodevelopment").

G. Nutrition Research Projects based on (g) (see "The Techniques of Ecodevelopment").

H. "Wastes" Recycling Research Projects based on (p) (see "The Techniques of Ecodevelopment").

I. Small-Scale Technology Research Projects based on (d) (see "The Techniques of Ecodevelopment").

J. Training Related to A. to I.
There should be appropriate training of villagers to produce Extension Workers to plan, manage and implement projects A. to I. In addition, the training should be designed to produce Extension Workers with a multi-disciplinary approach to problems, and take a holistic view of things.
All training at agricultural schools and colleges, technical schools and vocational centres, should be geared to projects A. to 1., with students going back to work in their villages after training. Changes in curricula of technical and secondary schools should be made to make them more agro-technically oriented.

III. THE NATURE AND SCOPE OF RESOURCES NECESSARY FOR AN EFFECTIVE IMPLEMENTATION OF THE SCHEMES OF ECODEVELOPMENT

Many of the South Pacific Island Countries have abundant natural resources for relatively small populations. With rational use and management of these resources, the countries can be self-sufficient in many sectors of their economies, with minimum dependence on foreign aid and trade.

Water Resources

Many of the countries have rivers and streams running through most areas. With proper management they could provide adequate and safe water supply for the urban and rural populations for domestic use, agriculture and industry.

Forests

Again many of the countries have land masses covered with forest. For example, the land mass of Papua New Guinea is about 46 million hectares of which 40 million hectares is covered with forest.

Rich and luxuriant rain forests cover 75 per cent of the land mass and the forest potentially is of a high order. The forest areas are practically totally underdeveloped in the infrastructural sense. The Government of Papua New Guinea should locate, assess and regulate the availability of the natural forest resources so as to bring them within reach of development.

Forest resources in the South Pacific Island Countries should be used rationally to ensure supplies while utilizing them for the benefit of the people as a whole. The present policy of giving concessions to foreign companies to cut down forests and export timber is bound to be disastrous for the countries concerned in the long run. This should be stopped.

Economic development of forests should be care fully orchestrated through intelligent and efficient use of forest products. For example, through selective logging for particular use locally, decent houses could be built in hardwood square timber, planks, plywood panels, chipboard and shingles instead of the rickety houses made of inferior bush materials or importing fibro-cement boards and iron sheets.

Forest products could also be used for industries such as furniture, pulp, paper charcoal, plastics, fertilizers, etc., to replace imports. The coconut palm is one of the most important forest resources of the South Pacific Island Countries. The coconut from the palm has mostly been exported as copra. A wide variety of products can be made from coconut. At present, South Pacific Island Countries import most of these products from industrialized countries that often make them from the copra imported from South Pacific and other countries.

It is worth looking for better use of coconuts; such as for the manufacture of sugar. For instance Papua New Guinea imported 20,000 tons of sugar in 1973 and the price has almost doubled since then. Small-scale sugar industry can be created immediately in the coastal villages, thus giving employment to villagers.

It is possible, using small-scale equipment, to produce 300 kilograms of sugar from 30 coconut palms every day of the year. This is equivalent to 75 tons per family per year, on a five-day working-week basis.

The 20,000 tons of sugar that was imported in 1973 can be produced locally. Less than 300 families could be involved, using 9,000 coconut palm trees out of so many thousands in Papua New Guinea. The same is true of other South Pacific Island Countries.

The sugar can also be used in small village industries to produce candy, syrup, banana chips etc., without building big factories or importing complicated machinery. In the process, methylated spirits (fuel), wine and vinegar can be made at village level, instead of importing them.

Other products from forested lands include tea, cocoa, peanuts, rubber, which can be processed locally.

Land

Some of the South Pacific Island Countries have undeveloped areas of fertile land and big valleys. With proper management, they could produce most of the countries' food requirements without depending heavily on food imports. Big valleys, such as the Markham Valley in Papua New Guinea, are almost totally undeveloped. Some of the valleys could be developed for meat and poultry industries to replace imports of frozen and canned foods.

Steps should be taken to regain all land leased to foreign companies or foreign individuals and also large indigenous companies or landholders and redistributed to landless farmers or the legitimate indigenous owners. Further leasing of land to foreign companies or to large indigenous companies or landholders should be stopped.

Climate and Grassland

The climate of some of the South Pacific Island Countries suits improved pasture species. The grasses grow extremely well and withstand grazing. For instance, large areas of the Junai grassland stretching from the foothills of the Prince Alexander Mountains to the Sepik River in Papua New Guinea may be suitable for cattle farming or ranching. The possibility of cattle farming and ranching in the Sepik Plains should be investigated as the grasses in the Plains, especially those near the Sepik Highway, are suitable for the establishment of cattle projects.

Cattle could also be used to improve the diet of people in areas that are short of protein, and supply meat for traditional feasts and celebrations.

Fishing

Fishing resources are also potentially abundant in the South Pacific Island Countries; however, overexploitation, pollution and commercial exploitation by foreign fishing fleets has led to serious depletion in some areas.

Sun

South Pacific Island Countries lie wholly within the tropics and have plenty of sunshine which could produce solar energy for heating, cooling, electrical generation, refrigeration, desalinization and other purposes.

Besides being free and plentiful it is also pollution-free and has sterilizing and other beneficial effects on all forms of life.

Also most of the islands have strong and continuous winds suited to the production of electricity from relatively inexpensive wind generators.

IV. URBAN DEVELOPMENT: AN APPROPRIATE MIX BETWEEN CAPITAL-INTENSIVE TECHNOLOGY AND LABOUR-INTENSIVE TECHNOLOGY

The major means of production should be under public control and should be redirected to serve the needs of the people. Certain services may need to be provided at the national rather than provincial or village level. However, there should be no attempt at making things heavy and on a large scale. "Gigantomania", making everything huge and heavy, should be avoided. Emphasis should be on lightness of construction.

The third step should be the development of community industries. This can only be achieved by a decentralization of industrial and economic activities. If there is need for large-scale industry, this should not exclude small ones in the villages. Because of the need to provide employment for everyone, attempts should be made to strike a balance between large-scale technology at urban centres and the preservation of labour-intensive activities.

In the urban centres there may be a need for large-scale capital-intensive industry. But within the urban-based industry itself there should be a parallel development of small scale labour-intensive and large-scale capital-intensive industry. This economic development should be "dualistic" with on the one hand a modern large-scale capital-intensive sector in the urban centres and, on the other, a traditional labour-intensive sector.

The Chinese experience is relevant here. The development of this "dualistic" economy is what the Chinese call the policy of "Walking on two legs"; the technique of combining agricultural and industrial development, new and traditional techniques, small-scale labour-intensive local industry and large-scale capital-intensive modern industry within a developing economy. The aim being to build a diversified and balanced economy, a balance of industry and agriculture, of light industry and heavy industry, and the development within each region of a country of the energy basis on which industry must rest.

V. OBSERVATIONS

At the end of the Second World War, practically all the South Pacific Island Countries were under the direct rule of countries in Western Europe, the United States, or Japan. Today, only a few of the countries remain under such rule.

On attaining independence, practically all the countries were poor. This poverty was characterized by unemployment, under-employment, illiteracy, malnutrition, diseases, ill-health and bad housing. How was this problem to be solved ?

With a few exceptions, all the countries, on attaining independence have been following the assumptions handed down to them by their former metropolitan countries. The countries were told, and accepted that their poverty was caused by their poverty in the now famous theory of the "vicious circle of poverty" and that the circle should be broken. But how ? By adopting the Conventional Approach (i.e. the free enterprises Capitalist System) to economic development.

The assumptions implicit in this Approach can be briefly stated as follows:

1. Industrialization is the pre-requisite for development; and an all-out attempt should be made to industralize.

2. Development should be based on the urban areas.

3. Agriculture should be industrialized for mechanized through capital-intensive farming methods and the "Green Revolution ", with its monocultural approach to agriculture.

4. Economic Growth, that is the Gross National Product (GNP) should be the yardstick for measuring progress. By shunting more of the gains from Economic Growth towards the lower income brackets, the solution of economic development would be achieved.

5. Private foreign investments should be increased as well as the transfer of technology from industrialized countries.

6. Aid from the industrialized countries should be stepped up.

7. Exports should be stepped up.

8. The growth of population should be arrested.

9. Economic development requires political unity. Attempts should be made at all cost to unite or weld together all the various ethnic groups in the countries concerned to produce highly centralized, bureaucratic, authoritarian societies.

Throughout the last decade, the First United Nations Development Decade (1961-1970) the efforts of many of the countries have been to follow religiously the above prescriptions. On this scoring it might be thought that the battle against poverty has been largely won and that given the assumptions that governed the struggle to achieve independence in all these countries, the people were enjoying the progress and prosperity for which they had fought. Yet what is the reality today ? Why industrialization ? Because, so the conventional answer goes, it is the only means by which to combat poverty and unemployment. But does it really do this ?

The First United Nations Development Decade has come and gone. We are halfway through the Second United Nations Development Decade (1971-1980). A thorough examination of the facts suggests that very little development has taken place. Many of the countries continue not only to remain poor, but their condition is getting worse in relation to the former metropolitan countries. Poverty has reached such a scale that it is not only threatening the "quality of life", but life itself.

According to The Cocoyoc Declaration, adopted by the participants in the UNEP/UNCTAD Symposium on "Patterns of Resource Use, Environment and Development Strategies" in Cocoyoc, Mexico, October 8-12, 1974, "Thirty years have passed since the signing of the United Nations Charter launched the effort to establish a new international order. Today that order has reached a critical turning point. Its hopes of creating a better life for the whole human family have been largely frustrated. On the contrary, more people are hungry, sick, shelterless and illiterate today than when the United Nations was first set up."

And worse still, the gap between the rich and the poor in many of the countries themselves is also widening fast. So the Conventional Approach to economic development is making the rich richer and the poor poorer. By and large the development which has been achieved has been of a badly skewed kind and has resulted in an ever widening of the "vicious circle of poverty".

Industrialization - Urban Areas

The problems of poverty and unemployment, after years of industrialization are simply staggering.

During the last successive five-year plan of India, urban-based heavy industries were given priority and rapid industrialization was regarded as the symbol of development. And yet according to Mansur Hoda, "urban-based heavy industrialization has not proved to be the cure for the country's ills. Excessive concentration on raising GNP has not solved the problems of unemployment and poverty. On the contrary, there is ample evidence to suggest that it has succeeded in creating imbalances in the economy and acute strains in the society."

The failures of industrialization are invariably attributed to technical faults in the implementation of industrialization programmes rather than to the principle of industrialization itself. Thus Mansur Hoda considers that failure was due to industrial development policies not being matched by policies promoting the development of other sectors. "Our policies lacked a comprehensive approach to the problems of development", he said.

Mr. M.M. Mehta, an International Labour Office Regional Manpower Planning and Employment Adviser attached to the United Nations Asian Institute for Economic Development and Planning of the Economic Commission for Asia and the Far East (ECAFE), Bangkok, emphasizes the effects of mounting unemployment in most of the countries of Asia:

a. "In India, the total number of unemployed persons, estimated at 5 million in 1961 and 9-10 million in 1966, stood at 15-20 million in 1971, and that of under-employment around 30-45 million."

b. "In the formerly undivided Pakistan, the Fourth Five-Year Plan (1970-75) estimated the total number of unemployed or under-employed to amount to some 7.5 million or 17.7 per cent of the labour force in 1970."

c. "In the Philippines, the Fourth Four-Year Plan 1972-75) gauges the number of totally unemployed persons to be around 8.6 million; visibly under-employed 1.1 million and invisibly under-employed 1.4 million."

d. "In Indonesia, the Ninth National Convention of GASBIIDO estimated the number of totally unemployed persons to be 4.5 to 5 million (10-11 per cent of the labour force); and under-employment 14-15 million in 1970."

e. "In Sri Lanka (formerly Ceylon), the Five-Year Plan (1972-76) reports totally unemployed persons to number approximately 550,000, about 12 per cent of the total labour force in 1972."

f. "In Malaysia, the Second Plan (1971-75) estimated the number of unemployed to be around 275,000, about 7.3 per cent of the labour force."

According to Mehta, "the marginal men, the wretched strugglers for survival on the fringes of farm and city, may already number more than half a billion, by 1990 two billion". He asks, "Can we imagine any human order surviving with so gross a mass of misery piling up at its base?"

Theoretical Considerations

It is not surprising that industrialisation is failing so dismally to prevent poverty in the "developing" countries. There are many reasons why it cannot concievably succeed in doing so. Firstly, the rich countries of today were industrialized during a time which was far more favourable to this process than is the present one. In those days non-renewable resources were cheap and plentiful; today they are increasingly expensive and scarce. In those days the biosphere had yet to be devastated by industrial activity on the massive scale at which it is now being carried out. Today it is fast reaching the limits beyond which we can pollute and devastate it no further. In those days society was psychologically ripe for the introduction of the industrial way of life. People really believed in it.

Today disillusionment with the industrial way of life is spreading throughout the world, especially among the youth. More important still, industrialisation among the rich nations was a slow and gradual process, whereas in the "developing" countries today it is occurring far more abruptly. People, in fact, are being forced to abandon the simplest possible pre-industrial techniques in order to adopt the most sophisticated and capital-intensive technology within a matter of years. The industrial revolution in Britain caused the same problems which industrialization is creating today in many of the "developing" countries, but they were on a smaller scale and very much more gradual.

The main reason why one can predict that industrialization will not solve the problems of the "developing" countries is that it has not even solved those of the rich coountries, even though it occurred there, as we have seen, under the best possible conditions. Consider the United States of America. In spite of the fact that the country now has a standard of living some fifty times higher than that of Nigeria, it still has a serious unemployment problem and 25 million Americans are still officially classified as poor. If industrialization cannot suppress poverty in the United States of America, the richest country in the world, what grounds have we for believing that it can do so in the poor countries ? Britain is exactly in a similar position. About one and a half million people are now unemployed there.

The industrialization and large-scale capital-intensive technology can eradicate poverty is thus a pious hope. As Mansur Hoda points out, "Development does not only mean increased production of goods - but also the development of people - the stimulation of their innate abilities, giving them a feeling of self-determination and enthusiasm, self-respect and self-reliance. Unless people are involved in the process of development and are given a chance to do something worthwhile, to grasp new ideas, acquire new skills and develop a sense of their own worth, no society can move out of misery and poverty. Indeed, development is almost a meaningless word when a large percentage of the population can neither contribute to the nation's progress nor benefit from it."

Although technology is an important factor in development, it is by no means the decisive one; it is people, not technology, that are decisive.

The fight to alleviate poverty is not to be won by technology and economic power, but by human power and social organisation. Technology and economic power are wielded by the people. What needs to be achieved is a social system in which man lives in harmony with nature and not against it. Technology to suit such a system will of necessity emerge from the people themselves, at grassroot level. Such a technology will be subordinated to social and human needs, not the reverse, as is the case today.

The Conventional approach is, of course, one of the options open to "developing" countries. The lessons of the First United Nations Development Decade have shown quite clearly that, given the pressure of time (constantly aggravated by the increase in population) the Conventional approach is incapable of handling problems as complex and deep rooted as those faced by many of these countries. In fact, many of the problems confronting these countries have their roots in just this kind of development as a result of their colonial past.

Impact of Colonial Rule

For example, we might do well to remember that "poverty" was almost unknown in pre-colonial South Pacific countries. There was no over-population in the sense of the rate of increase of population growing faster than the rate of increase of food production. The system of land tenure provided each family with the land required to feed its members. Each family also regarded it as its sacred duty to look after its members incapable of looking after themselves.

There was no unemployment, under-employment, or malnutrition. The changes initiated by colonial rule gave rise to poverty. It must be pointed out, however, that the people who suffered most from specific nutritional deficiencies were those brought fully into the colonial economy - the urban workers. Those who managed in spite of colonial rule to maintain their traditional pattern of nutrition have superb physique, and are generally very healthy and resistant to diseases.

What are the main problems enegendered by many years of colonial control and exploitation? Economically, there are two.

The first is that community identity became the victim of the profit motive in the West. The destruction of localized community life is largely the product of the pursuit of profit; bigger industrialized units and increased specialization of labour spell bigger profits and these objectives were pursued quite regardless of their ill effects on community life. It is here that the contemporary problems of poverty associated with many of the countries in the South Pacific have their origin.

The second is that colonial rule concentrated economic power so overwhelmingly in the hands of a small group of countries the former metropolitan countries. According to The Cocoyoc Declaration, "Much of the world has not yet emerged from the historical consequences of almost five centuries of colonial control which concentrated economic power so overwhelmingly in the hands of a small group of nations. To this day at least three quarters of the world's income, investment, services and almost all of the world's research are in the hands of one quarter of its people ....The solution of these problems cannot be left to the automatic operation of market mechanisms. The traditional market makes resources available to those who can buy them rather than those who need them ....In the international system the powerful nations have secured the poor countries' raw materials at low prices, they have engrossed all the value added from processing the materials and they have sold the manufactures back, often at monopoly prices........Indeed the pre-emption by the rich of a disproportionate share of key resources conflicts directly with the longer term interests of the poor by impairing their ultimate access to resources necessary to their development and by increasing their cost.........The overall effect of such biased economic relationships can best be seen in the contrast in consumption. A North American or a European child, on average, consumes outrageously more than his Indian or African counterpart---a fact which makes it specious to attribute pressure on world resources entirely to the growth of Third World population.......... These unequal relationships contribute directly to environmental pressures."

A Redefinition of Development

1. The cause of poverty in the South Pacific Island Countries is not backwardness or lack of resources, but the decay of the rural structure. Most of the plans drawn up over the years have up till now, by-passed the rural areas; and between 87-90 per cent of the populations of the countries live in the rural areas, in villages. It is here that one finds onself in the midst of abject poverty.

2. The countries will have to recognize that for the foreseeable future the great mass of their populations will be subsistence farmers, and the importance of the agricultural base shouldbe recognized. It is only then that agricultural productivity can be brought to the level at which a sustained policy of industrialization is possible.

3. The problems confronting the South Pacific Island Countries cannot be solved by industrialization *per se*, and any attempt to superimpose a highly developed industrial system upon an already unstable economic and social condition will only worsen the problem of poverty.

The type of development the countries need is that which will produce enough food to feed their populations and which will absorb their labour. In this type of development, agriculture should be the leading link, *not* industry. In effect this means a pattern of high densities of population producing their own food; running small workshops and factories when they are not working on the land, and with very limited numbers of large-scale capital-intensive modern industrial centres.

Consequently development should be taken to the countryside in a planned systematic manner. This is where the majority of the people live.

4. Definitions of development which take economic growth as their hub are dangerously misleading. Expanding production of goods and services is a necessary condition of development but does not guarantee it.

Development is better defined ethically in terms of raising levels of sustenance, human dignity, and freedom or the alleviation of poverty, unemployment and inequality.

5. South Pacific countries are caught in a dilemma. On the one hand, they want all that is modern in technology for their development, which is totally understandable. On the other hand, they have limited capital resources (money), but unlimited manpower, largely unskilled, lying idle. The crux of the matter is how to strike a balance between the two and use the resources in the best manner that is profitable to the countries as a whole. In many of the countries, industry accounts for less than a quarter of the national product and employs less than one-fifth of the workers.

Although the countries want to industrialize, they lack the technical know-how. Thus an all-out attempt at industrialization at all costs should be ruled out at this stage. In other words, industrialization should proceed according to the temperament, attitudes and cultural backgrounds of the people and at their own pace. Industrialization cannot be grafted onto a country like a foreign body. It must grow within the country and at grassroot. level. The type of technology needed to achieve this type of industrialization will emerge from the people themselves at grassroot level within the context of readily available resources. The countries should make the best use of their resources - land and human effort. Emphasis should be placed on the use of <u>people</u> not <u>money</u>.

6. It will be difficult for South Pacific Island Countries to initiate the type of development that will solve their poverty problem when the industrial machine they have to contend with is mainly in the hands of foreign companies. It is unlikely that these companies can be persuaded to subject their purely economic consideration to indigenous needs. They are unlikely, for instance, to introduce labour-intensive small-scale technologies to provide <u>over-employment</u>. They seek above all to be internationally competitive, and if local conditions do not permit this, they will simply move off to greener pastures. Many are involved in activities which by their very nature can only be of short duration.

When there is no copper left in Papua New Guinea, nickel in New Caledonia or phosphate in Nauru, the companies will move elsewhere. In the meantime people will have left their original home areas to work in the mines, they will have been trained for work associated with mining and will have forgotten their traditional occupations. Indeed the economic colonialism that seems to be associated with industrialization may be as harmful as the political colonialism that has only just ended.

7. Aid programmes are unfortunately double-edge; they make the recipient countries ever more dependent on the donors. Self-reliance is a pre-requisite of economic stability, and in order to achieve it, dependence on foreign aid should be reduced rather than increased. The development of the spirit of self-reliance should be an important aspect of the economic policies of the countries. They should do things themselves, and should, as far as possible, do without foreign aid or assistance.

If aid or assistance is necessary at all, it should be related to the actual needs of the countries, and not the needs of the donor.

At any rate a good many undesirable things come into a country on the back of aid. Aid often creates a psychological dependence on getting still more aid. It saps initiative and enterprise; or again, it may foster as it has been doing in many of the South Pacific Island Countries - types of development wholly inappropriate to circumstances. Industrial plants are created instead of improving basic water supplies. Aspirations are created which can never be fulfilled. The Western or Eastern "expert" wants to bring his whole cultural baggage with him and this can include myths about what happens and what is possible in his own country.

Moreover, no-one in a position of power and prosperity can offer such aid as would threaten his own security. In a lot of ways aid has become a means of impoverishing and exploiting the recipient countries. The donor countries are getting richer and richer while the recipient countries are getting poorer and poorer. So all the aid is only helping the donor countries, and not the recipient countries. A notable exception is Sweden whose aid is actually related to the needs of poor countries.

The transformation of South Pacific countries should come from a common and spontaneous enthusiasm, and not a series of alien directives. The countries should strive to control their destinies within self-reliant societies. Furthermore self-reliance will encourage the use of the countries' most abundant resource ------ manpower - as a substitute for scarce capital resources. A policy of "turning labour into capital".

8. Development should not be conceived of as "catching up" with the industrialized countries in the conventional way by building gigantic steel mills, gigantic dams, etc. Many industrialized countries are now faced with almost complete breakdown as a result of these large projects. They are faced with serious social disruption leading to high incidence of mental diseases, suicide, and crime, especially in the cities and towns; alienation of the people from one another, social and psychological breakdown of their societies; drug addiction, and a sense of hopelessness arising from the destruction of the environment caused by these hugh projects.

At any rate the techniques of the conventional approach to economic development are foreign to the indigenous cultures and traditions of the peoples of the South Pacific Island Countries. For example, the principle of the centralized nation-state; capitalist economy, social institutions, capital-intensive or labour-saving technologies are all foreign importations which are difficult to reconcile with the tradition and cultures of these countries.

South Pacific Island Countries should not imitate the conventional pattern of development. They should adopt patterns of development suited to their environments. They should pioneer their own way --- the rural way as opposed to the conventional urban way ---of development which avoids the economic and social pitfalls of the conventional pattern of development.

Many people in the industrialized countries, especially the youth, are looking for a different life-style; simple and humane, completely different from the present atomistic and highly centralized society they have inherited. The South Pacific Island Countries should learn from the mistakes of the industrialized countries and try not to repeat them. If they try to imitate the development patterns of these countries, they will end up with the same problems, without having solved their own. The result could be disastrous.

For instance a large-scale scheme such as the Purari Hydro-Electric Scheme that is being presently considered by the Government of Papua New Guinea should not go ahead until all the relevant facts are known. What, for example, are likely to be the effects of the project on rural communities; the physical environment; the eco-system, etc ? Who is likely to benefit more from the project ? Papua New Guineans or the foreign companies and governments who will construct the dam, and possibly put up most of the money for its construction? Is there a viable alternative?

South Pacific Island Countries should not attempt to transform their societies through such huge industrial projects which would subordinate their rural populations to foreign monopoly capital and perhaps ultimately destroy the rural population). Alternatives to such huge projects should always be considered.

It is advisable that all proposed projects, large or small, be accompanied by an Environmental Impact Statement. What is needed is a set of strategies that will not only solve the countries' problems in the short and long term, but also lead toward a more stable, just and sustainable society in future. Any programme put forward should carry with it an environmental impact statement saying what its proposed activities are likely to do to the air, water and other natural resources upon which the peoples' survival depends; as well as how the activities might be expected to affect family and social community structures.

Before the South Pacific Island Countries can overcome their problem of poverty, they should realize that the conventional approach to development, with its analytical tools, systems of control and remedies are completely obosolete. Economics alone cannot solve their problems. For example, any attempt to weaken environmental and ecological controls as trade-offs for immediate profits may worsen their problems. It will be an attempt to mortgage or perhaps even bankrupt the future for the sake of the present.

No doubt the countries must on occasions make trade-offs between immediate economic gain and long term social and ecological health. But if they do, they should know in advance what these trade-offs are likely to entail. Only in this way can the countries avoid their past errors; their traditional failure to see how economics interconnect with other systems-social, cultural and ecological. Such an Environmental Impact Statement attached to all proposed major policies would help South Pacific Island Countries to avoid unnecessary side effects of development.

For instance it is the impact of tourism rather than of urbanized industrial development that is of particular consequence to most of the South Pacific Island Countries. Hawaii, for instance, is the epitome of the tourist paradise, with its blue skies, white sand, splendid scenery and a warm welcome from the islanders. Now this promise has been broken by greed and stupidity, so that air and water are befouled, flora and fauna endangered if not destroyed, and the welcome soured by an alien ethos of puritanism plus profit.

Hawaii, and especially the state capital of Honolulu, has serious pollution problems. "The loveliest fleet of islands that lies anchored in any ocean" as Mark Twain described them, is in trouble. Large segments of the islands' land and most of its trade has fallen under the controlling hands of the booming tourist industry. The life-style and the communal way of life of the indigenous islands is being destroyed; so is their economy. The new economics of the tourist industry makes retreat back into the old life-style almost impossible. The people are being forced into factories, industries, plantation fields and businesses, most of which are engaged in providing goods and services for tourists. The needs of tourism take priority over the needs of the people.

Land Speculation: Hawaii has become a whore in the market place and her businessmen her pimps. The indigenous peoples' ancestral land is being destroyed and sacrificed for the tourist industry, The smallness of these beautiful islands, combined with the rapidly increasing population and booming tourist industry, has put land at a premium. As a result, land speculation has gone wild.

In the last five years, sections of prime land have changed hands several times and gone up 100 per cent in market value with no improvements made. The average Hawaiin finds it financially impossible to buy land or own a home. He must lease property, usually on short terms, from one of the huge corporations catering mostly for tourism.

Recently many of these families have been evicted to make way for resort hotels, highways and high-cost housing construction. Mammoth construction projects to provide high-cost housing for the influx of tourists is changing the islands drastically. New high rise buildings transfigure this once breathtakingly beautiful horizon of verdant and brown mountains, lush green palms, and sparkling blue ocean into just another predominantly vertical big city sky-line. The whole life chain of Hawaii is endangered by this thoughtless technological rape.

The effect of all these is that the people are becoming landless, unemployment is rising because the tourist industry cannot provide employment for everyone; the crime rate is soaring and prostitution is rampant.

Water Pollution: Raw untreated sewage is pumped into the ocean daily, and the sea cannot hold much longer. The volume of raw sewage could increase in the next few years to the point where Honolulu, the capital city of Hawaii, might be forced to close its beaches. And now, much to the shock of tourists, incidents are being reported of toilet paper and human faeces washing up on Waikiki Beach.

This continual bombardment of sewage into the islands' waters has caused the growth of algae to skyrocket and, in turn, poses a serious threat to Hawaii's precious coral reef. Divers have already reported that vast expanses of coral off the honolulu shore have been taken over and killed by algae. Also all the streams are polluted at the lower levels and parents keep their children away from them. Large quantities of fish are beginning to die in Hawaiian streams. The situation is reaching alarming proportions.

Air Pollution: Air pollution is also reaching alarming proportions. The big jetliners which bring the trourists to the islands are major polluters, putting as much filth in the air with each of their approximately 250 take-offs and landings a day as 10,000 automobiles.

Birds and Wildlife: When Captain Cook landed in Hawaii there were 70 species of birds and two of mammals native to the islands. Today 24 of these species are extinct, 27 on the verge of extinction, and the mammals, the hoary bat, and the monk seal, are considered endangered. Hawaii has lost more of its native bird life than any other area in the world and 20 per cent of the United States list of jeopardized wildlife are Hawaiian species. Destruction of the natural environment is chiefly responsible for the slaughter. Yet filling, draining, cutting, covering and other drastic alterations of marshes, ponds and forests are allowed to continue to take their toll in the name of progress and profit. But even though many species of wildlife are lost for ever, the environment of Hawaii is "not yet at the point of no return", as one biologist put it. It can be saved if action is taken now, and a plan is drawn up according to ecological principles. Today's social and economic planning is not the answer, because an economic model represents only a small section of the environment: it takes into account only a fraction of the variables that an ecological planner would make use of.

Hawaii's present economic design (as with most of the world) provides maximum despoilation of the environment for the maximum benefit of a very few people. There are still too many in Hawaii who place what they consider their own immediate advantages above all else, too many anxious to sell what little remains of this primordial paradise.

Undoubtedly, many local people are up in arms over this trend. There is an urgent need to reverse the trend through an outright ban or tourism, or heavy tax on tourism to reduce the number of tourists, or placing a moratorium on construction of tourist

9. Development should not be conceived of in terms of marriage between computer technology and indigenous traditions. It is most sensible to conceive of it in terms of increasing capacity to innovate effectively on the basis of indigenous resources, which means thinking in terms of appropriate technology rather than up-to-date technology, and in terms of human organization as the principal factor determining whether a technology can be effectively employed.

10. The trading relationships between the South Pacific Island Countries and the former metropolitan countries are much the same as they were during the colonial era. The former continue to supply raw materials in return for manufactured goods. The prices of these commodities, however, are very artificial; products badly required to satisfy local needs are sold to the former metropolitan countries to buy manufactured goods which play very little part in relieving poverty. This pattern of trade is against the interests of South Pacific Island Countries, and the only alternative that the countries have is to develop trade among themselves and also lay great emphasis on self-reliance.

11. Attempts should not be made to achieve political unity at all costs or by force. Stable relationships between different regional, ethnic or communal groupings are the goal to which national leaders should give priority. Rulers should not suppress open politics on the grounds that development requires unity. If they do, the question should be asked: Development for whom? For the people within the country or for outside interests? The relatively free operation of political parties and other groups can provide checks against arbitrary and exploitative rule.

It can provide leaders with leverage to use against foreign interests who may be pressing demands on them. And leaders who are responsible to ethnic fears and loyalties as well as freely organized political groupings, can mobilize popular enthusiasm for the development effort, in a way which both stimulates the innovative capacities of the people and strengthens the bonds of loyalty and solidarity.

Consequently there should be no attempt to build mass societies out of the various ethnic groups in the countries. Political and economic decentralization should be the goal, in order to stimulate development from below which would make possible the release of a spontaneous initiative of the people in accordance with their different cultural traditions.

Traditional South Pacific Island Countries' societies were not geared to highly centralized political and economic systems. They were and still are plural societies, and decision-making was decentralized to a very large extent. Co-operation was in small things and the government of the people was only the government of their own family units, and their clans, or at most of their ethnic groups.

attempts should be made at decentralized decision-making, politically, economically, socially, culturally and religiously. The government should be from bottom up not top to bottom, leaving room for central government to grow as leaders and conditions change. Central government should be allowed to grow to the different levels o economic, political and social development of the various sections of the community. It is the various communities who are in the best position to draw up their own programmes according to their resources and needs. Moreover it would encourage the weaker communities to struggle to advance themselves and seek help from the central government if need be.

People's needs cannot be met by the fine tuning of experts and politicians located hundreds of miles from reality. This can only be handled by decentralized economic intervention, locally, regionally, and sectorally determined by democratic means, with the central government serving only to sort out glaring contradictions and to allocate certain resources.

Local government should not be as it is in many countries mainly an administrative instrument or expenditure committees of the central government. Local government should be an arena for resolving important clashes of community opinion. The most important thing about constitutional reform and political change is not to lead the people into a new system at breakneck speed. Although the system may be the ideal system, the question of how to move from here to there is very important. If people are led into an entirely new domain they may get lost and opportunists all careerists come onto the scene. It is much better to move to a system that one knows something about; to start from below; a system that can be understood and developed according to the temperament, attitudes and cultural background of the people. In the final analysis, it will simply be a modified or modernized embodiment of the communal philosophy which is traditional to the peoples of the South Pacific Island Countries.

I do not wish to give the impression that the pre-colonial era in the South Pacific Island Countries was an era of Golden Age. In retrospect one can pinpoint some aspects of the cultures of the various peoples which are obstacles to development. However, this communal way of life is beneficial to development and should be maintained.

VI. ECODEVELOPMENT: THE CASE OF PAPUA NEW GUINEA

Events in the South Pacific Island Countries have come at a time when it is necessary to examine the policy of the present government of Papua New Guinea.

What has impressed me about Papua New Guinea since Michael Somara came to power is his rejection of Western or Russian models of industrialization as the only solution to his country's problems; his insistence that priority should be given to the rural areas, that a large part of his country's industry should be located in the rural areas and that the people as a whole should be the major and immediate beneficiaries of the new wealth it creates and not merely beneficiaries in the next generation; and on de-urbanisation.

The Government in its policy booklet Strategies for Nationhood - Policies and Issues, December 1974, states that it has Eight Aims - "Papua New Guinea Eight Aims". The Eight Aims provide a point of reference for all government activities.

The themes of the aims are self-reliance, rural improvement, reduction of inequalities in the distribution of incomes and services and decentralization. The Government wants priority to be given to the development of the rural areas where 90 per cent of the population lives. This approach, it is felt, is most likely to solve the country's problems. In the booklet, Government policies to ensure the creation of a genuinely Papua New Guinean society with its own identity are summarized.

The booklet makes it quite clear "that economic growth has been replaced as the central aim of Papua New Guinea's development strategy by self-reliance, rural improvement and equality". The Prime Minister, Mr Michael Somare, points out in the Foreword to the booklet "It has been the custom in most countries to focus policies on the attainment of economic goals, for example a 5 per cent increase in G.N.P. or a growth target of 10 per cent per annum in investment. The hope implicit in this approach was that somehow the benefits from such growth would trickle down to the people. In fact in those nations pursuing those kinds of policies there has been little improvement in the quality of life of the people. Instead the lion's share of any new wealth generated in these countries is captured by the elite. This will not happen in Papua New Guinea ....Economic policies for large scale activity have not been given the central place which was normal in the past in Papua New Guinea and other developing countries."

Strategy for Change

1. Rural improvement. The Government recognizes that "most people in Papua New Guinea depend directly on agriculture for their livelihood. In the foreseeable future there will not be enough jobs outside agriculture to employ more than a fraction of those who need cash incomes and the Government is strongly committed to continuing support for agricultural development."

   The approaches envisaged are as follows: developing self-help villages based on the various clans or ethnic groups and communities; diversifying agriculture, developing community or village types of industries, that is small-scale artisan service and business activities and rural industries; education for self-reliance at village or community level; developing rural or community health centres; developing small-scale or appropriate technologies at village or community level.

2. National sovereignty and self-reliance: The Government wants the country to be politically and economically independent and its economy self-reliant. This means, according to the Government booklet, "citizen and government control of most enterprises; subordinating foreign investment to national sovereignty and self-reliance; ensuring government control of major natural resource-based enterprises; restraining economic development to the level and skills and resources available in Papua New Guinea; and rejecting any agreement which would create substantial dependence".

   The Government recognizes that the "Techniques of production and organisation will be required from overseas so that other aims san be achieved efficiently, but the way these are used must be modified to suit Papua New Guinean conditions".

   To this end, the document states that......" the development of a more self-reliant economy may require giving up some of the economic benefits that foreign investment can bring. To become self-reliant the pace of foreign activity may have to be slowed down."

3. Commerce: The Government recognizes that the trading relations between Papua New Guinea and the industrialized countries is not necessarily in the best interest of the country. More emphasis is to be placed on the development of the country's internal market and self-reliance rather than concentrating on external markets.

4. Equality and participation: All citizens are to be given an equal opportunity to participate in and benefit from the development of the country. There will be no attempt at building a mass society out of the various ethnic groups in the country.

   Equal opportunity will be given for each citizen to participate in all aspects of the life of the country; there will be substantial decentralization of political, economic, social and cultural activities; there will be equalisation of incomes among individuals and regions; and there will be equal distribution of Government services.

   There will be equality for women. There will be participation of all groups engaged in development. There will be participation by citizens in decision-making affecting their interests.

5. Papua New Guinea Ways: Development will take place primarily through the use of Papua New Guinean forms of social, political and economic organisation. The Government intends to undertake a fundamental reorientation of all major institutions towards Papua New Guinean forms of participation, consultation and consensus.

   Cultural, communal and ethnic diversity will be recognized as a strength, and there will be respect for traditional ways of life and culture. Villages are to be preserved and improved.

6. Integral human development - liberation and fulfilment

The booklet insists that moral criteria should be paramount in the development of the country and not profit. All activities of the st te will be directed towards the personal liberation and fulfilment of every citizen so that each man and woman will have the opportunity of improving himself or herself as a whole person and achieving integral human development.

. . . .

The family is regarded as the fundamental unit of society and will be protected and promoted.

The Government wants to increase its awareness of an solidarity with the people of other developing countries in order to establish a New International Economic Order.

These national goals and directive principles became part of the country's Constitution at Indpendence on September 16,1975.

The aim of the Government is to remould Papua New Guinean society in such a manner that the humanism of its traditional society reasserts itself in a modern technical community. Consequently, it is hoped that structural change in Papua New Guinea will reintroduce a new social synthesis in which modern technology is reconciled with human values; in which the advanced technical society is realized without the staggering social divisiveness and deep schisms of the conventional pattern of development.

And the way the Government hopes to do this is by the creation of economic and social communities where people live together and work together for the good of all as in its traditional society; and which are interlocked so that all the different ethnic groups and communities also work together in co-operation for the common good of the country.

I am well aware of the impossibility of Papua New Guinea's experiment being simply copied by other countries. The experiment is, of course, the product of specific historical and cultural circumstances. As Papua New Guinea continues to develop, the prospects for the future are not without uncertainties. But the experiment, designed to solve the country's problem of poverty, presents an interesting alternative for other South Pacific Island Countries to think about during the current Second United Nations Development Decade and after.

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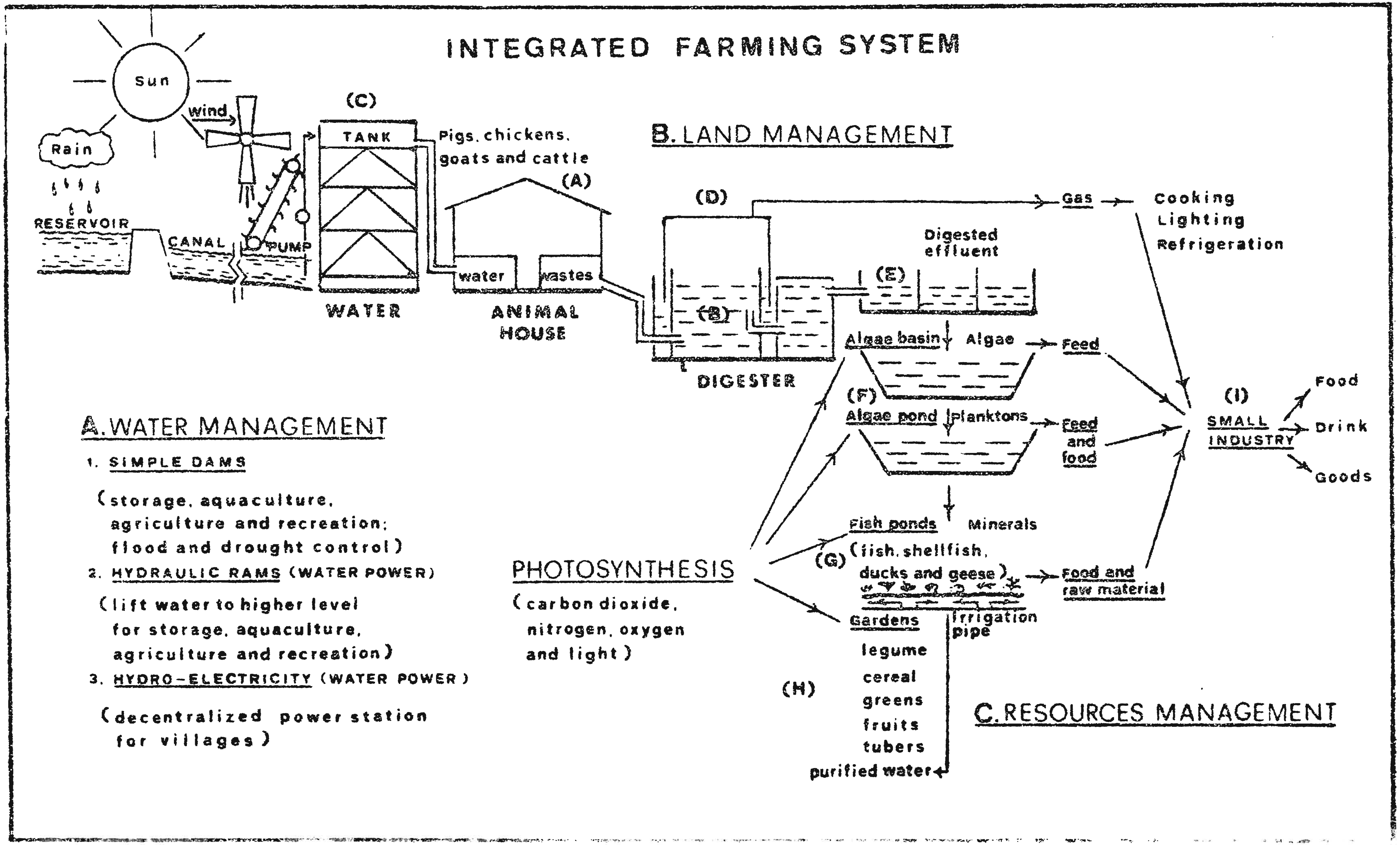
INTEGRATED FARMING SYSTEM
Sun
wind
Rain
RESERVOIR
CANAL
PUMP
(C)
TANK
WATER
Pigs, chickens, goats and cattle
(A)
water
wastes
ANIMAL HOUSE
B. LAND MANAGEMENT
(D)
(B)
DIGESTER
Gas
Cooking
Lighting
Refrigeration
Digested effluent
(E)
Algae basin
Algae
Feed
(F)
Algae pond
Planktons
Feed and food
(I)
SMALL INDUSTRY
Food
Drink
Goods
Fish ponds
Minerals
(fish, shellfish, ducks and geese)
(G)
Food and raw material
Gardens
Irrigation pipe
legume
cereal
greens
fruits
tubers
(H)
purified water
C. RESOURCES MANAGEMENT
PHOTOSYNTHESIS
(carbon dioxide, nitrogen, oxygen and light)
A. WATER MANAGEMENT
1. SIMPLE DAMS
(storage, aquaculture, agriculture and recreation; flood and drought control)
2. HYDRAULIC RAMS (WATER POWER)
(lift water to higher level for storage, aquaculture, agriculture and recreation)
3. HYDRO-ELECTRICITY (WATER POWER)
(decentralized power station for villages)

SPC-IUCN/2RSCN/WP. 4.

SOUTH PACIFIC COMMISSION

AND

INTERNATIONAL UNION FOR CONSERVATION OF NATURE

AND NATURAL RESOURCES

SECOND REGIONAL SYMPOSIUM ON CONSERVATION OF NATURE

Apia, Western Samoa, 14 - 17 June 1976

TRADITIONAL CONSERVATION PRACTICES FOR MODERN PACIFIC SOCIETIES

by

Mrs. S. Siwatibau.

Fiji

SPC-IUCN/2RSCN/WP 4.

TRADITIONAL CONSERVATION PRACTICES FOR MODERN PACIFIC SOCIETIES.

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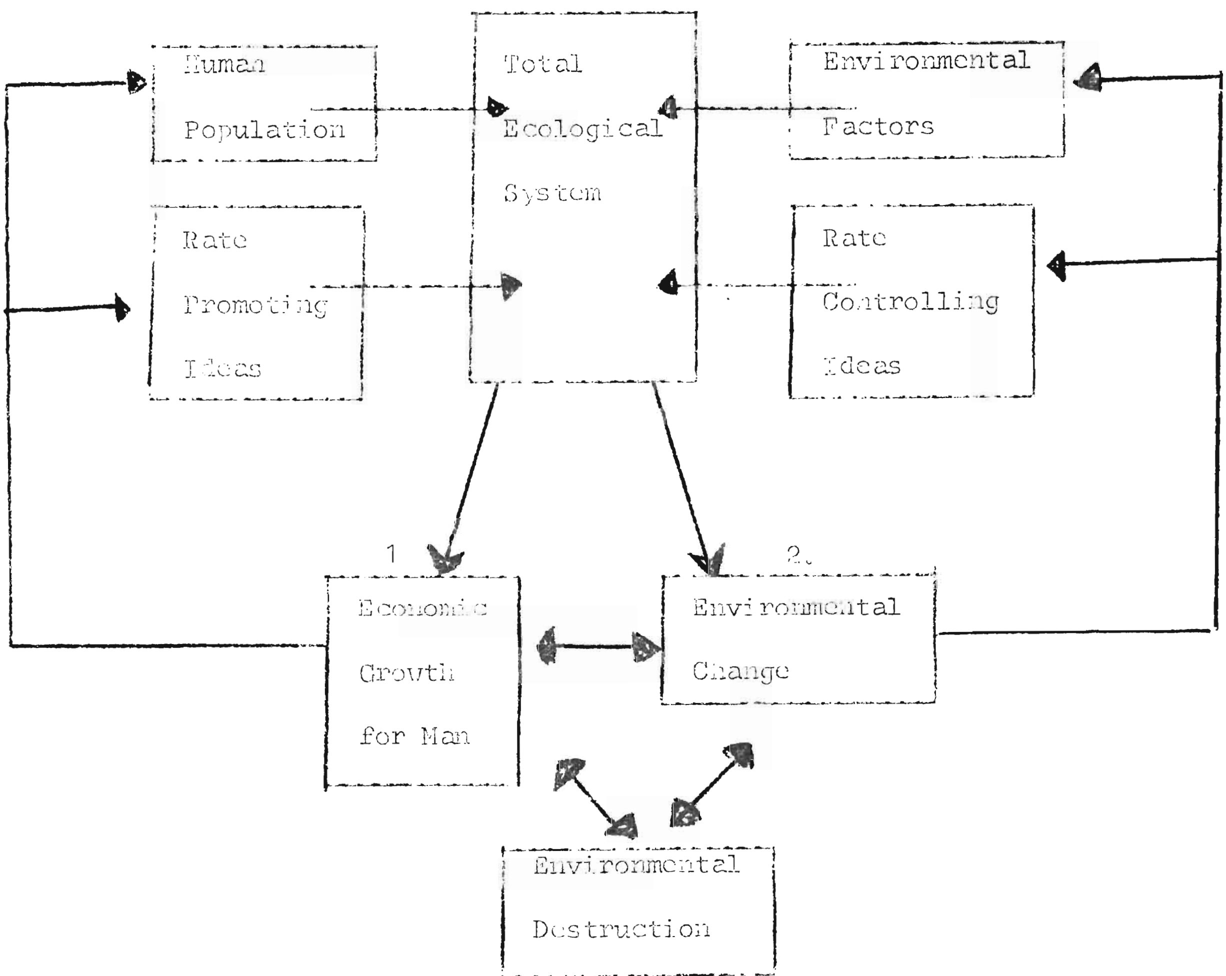
I propose to base our discussion on a simple input, output model of an ecosystem shown in Fig 1.



a) At Equilibrium: F_1 Man + F_2 Ideas = F_3 Environmental Factors
where F_1, F_2, F_3, are functions of pressure on the system.
Note that F_3 is equal but opposite to F_1 F_2.

b) Input Human Population includes Population and Man's actions - This input is rate - promoting in that an increase in it results in the acceleration of change and increase in output - particularly output 2.

c) Input Ideas included both ratepromoting and rate controlling ideas.
- Rate-promoting ideas include aspirations for
  - higher standard of living
  - Utilisation of natural resources
  - Environmental manipulations
- Rate-controlling ideas include
  - Controlled utilisation and development
  - Concept of Environmental Quality.

d) Input Environmental Factors are rate - controlling and are the contributions to the system of all the physical and biological units.
They include - Resistance to utilisation
- Recovery means (natural)
- Detrimental effects on Man.

The system is also a feed-back system where the output affects the input as shown in the figure.

For sound development, our aim should be to minimise output 3 - (i.e. Environmental destruction), while we optimise output 1 (i.e. Economic growth for Man.)

If we represent destruction of the environment as change in environmental balance - or Δ D and the various components of our model as

M = Human Population, P = Rate - Promoting Ideas, C = Rate-Controlling Ideas, E = Economic Growth,

then we may represent the relations between these as follows :

$$\Delta D \propto MP \quad , \Delta D \propto \frac{1}{C}$$

$$D = \frac{k_1 MP}{C} \quad \text{-----------------(1) To Minimise}$$

$$E \propto P \text{ and } E \propto \frac{1}{C} \text{ and } E \propto \frac{1}{M}$$

$$\therefore E \propto \frac{P}{MC}$$

$$\therefore E = \frac{k_2 P}{MC} \quad \text{-----------------(2) To Optimise.}$$

For the purposes of this paper we shall limit out discussion of conservation to 'environmental conservation'. This we shall define as the maintenance of equilibrium in a dynamic ecological system. This of course implies controlled change.

On hindsight we may state that man in the Pacific lived in equilibrium with his environment. There were, of course, exceptions which we shall deal with later. But in those societies where this appears to have been true, how was environmental conservation maintained ?

The concept of conservation was not consciously recognised in traditional society, but they did develop practices that ensured some measure of conservation. Traditional man utilised his resources to survive in a comparatively static social and economic system. He maintained this system through an efficient and comparatively painless education system.

Before the coming of the Europeans, most Pacific Islanders, except perhaps the sago palm gatherers of the New Guinea swamplands, had evolved from a hunting and gathering existence to one based on agriculture. For most, the sea played just as important a role as the land. Fishing was and remains an integral part of survival activities.

TRADITIONAL AGRICULTURE :

Let us first turn to their land resource utilisation practices.

From New Guinea in the west to the Marquesas in the east, agriculture was by subsistence, shifting cultivation. Important agricultural crops throughout were taro (*Colocasia indica*), yam (*Dioscorea spp.*), sweet potatoes (*Ipomoea batatas*) in Polynesia; *Cyrtosperma* in the islands between Polynesia and the Solomons; and Alocasia largely eastwards of New Hebrides. Tree crops also played an important role when environmental conditions permitted. Breadfruit (*Artocarpus altilis*), coconut (*Cocos nucifera*), sago (*Metroxylon spp.*), bananas (*Musa spp.*), are only some of the many cultivated tree species grown. There was, interestingly, an absence of grain and seed herbaceous crops. The important non-arborescent crops are all generally vegetatively propogated.

Except for irrigation practices in some areas such as New Guinea Highlands, New Caledonia, Futuna, Hawaii, manuring practices in New Guinea, Uvea and Rarotonga, complex terracing in New Caledonia, New Hebrides[1] and probably Fiji* agricultural practices were generally simple. Cleaning involved cutting the forest and burning what was felled. The cleared area, often with large tree and shrub stumps remaining, was then planted. Agricultural practices throughout the Pacific worked on the same basic ideas, such as for example - taro requires more water while yam requires better drainage. Agricultural practices varied in different islands only as much as they were adaptions to varying environments. They were all based on the same basic ideas.

* Remains of complex terracing systems are found in the Sigatoka Valley on Viti Levu.

Practices were such that there was little unnecessary disturbance of the soil surface after clearing. The practice of planting in individual, isolated holes or mounds, the arrangement of rubbish in transverse rows on a hillside, the restriction of extensive digging of large plots to the low lands, and the practice of mulching and of leaving tree and shrub stumps after initial cleaning, all contributed to better control of soil erosion.

The planting of tree crops is even less disturbing to the soil and to the native population. Tree crops, except for coconuts, were generally never planted in large single stands, but in mixed stands, often interspersed with native tree species. Tree cropping involved little initial clearing and even less consequent clearing. It is fair to assume that most of the inhabited islands originally supported forests. Tree cropping therefore simply emulated the structure of natural vegetation and as a consequence the physical environment was not as extensively altered as would otherwise be the case. A sufficient diversity of species of plant forms remained to continue to provide a diversity of habitats for associated fauna and flora. This ensured a store of predators for any introduced agricultural pests.

MAJOR FEATURES.

That traditional man lived in equilibrium with his environment was because of the following factors :-

1. His socio-economic system was a comparatively static one.

Although innovations must have occurred, and were adopted, so that society did progress - as for example from a nomadic gathering one to a settled agricultural one - it is doubtful that they were actively encouraged. However new introductions from without were often quickly adopted - as for example the use of iron fish hooks. Traditional man's demands were limited and he saw his needs within his reach. Subsistence agriculture with hunting and/or fishing sufficed. There was no strong urge to produce more than was necessary for survival except on occasions for feasting or for trade.

2. He was much more aware of his environment in a way relevant for his existence. Painlessly from infanthood, by watching, listening, and imitating, he learnt the components, changes and whims of his environment that were relevant for his survival. He learnt to regulate his life accordingly. The times for planting and for harvesting for example, were heralded by natural indicators. In Fiji our whole year was divided into seasons for clearing, planting, or harvesting, each season's commencement being indicated by the appearance of a reliable annual natural event such as the flowering of certain plants, the spawning of certain fishes or the changes in the phases of the moon.

For example the flowering of the reed (Miscanthus florindulus) heralded the harvesting season. Yams were harvested and stored in special garden storehouses (lololo). The appearance of new shoots on the stored yam tubers indicated it was time for land-preparation.

Garden sites were cleared and plots prepared. Natural occurrences associated with the different seasons were also observed and generally known. In the case of the flowering of the reed it was generally known that in that period there would be an increase in fly population and an increase in calcium oxalate crystals in the taro leaf (rourou). The latter was indicated by its itchy effect on the throats of those who eat rourou.

As well as those facts of the environment which were generally known, there were others which were understood only by specific members of society. For example, a society's carpenters knew the properties of the different timber species they had to use, better than did the other members of that society. Fishermen knew better the behaviour of fishes. They knew that during the duruka (Saccharum edulis) season, fish bite bait nearer the shore. Thus there was special knowledge of the environment associated with specific vocations.

Young boys accompanying their fathers through the bush would learn to identify useful and harmful plants, the foraging habits of wild pigs, or the favourite fruits of pigeons. Young girls out on the reef flats with older women learnt the habits and favourite haunts of fishes, crabs, sea shells, and began to differentiate the useful from the harmful.

3. He had an efficient education system that ensured not only awareness of the environment, but faithful continuation of survival activities necessary to maintain and conserve that society in that environment in perpetuity. Thus whatever conservation practices existed, were effectively handed on to subsequent generations.

4. He used his administration system to enforce certain conservation practices. This was done both formally and informally. Formally, traditional societies had a system of taboos maintained by a special person or persons in the society. The conditions, rules and regulations for taboo were carefully handed down through those special guardians; be they chiefs, priets, or family heads. They were strictly adhered to, often on pain of death.

In Fiji a large ceremonial gathering would be anticipated by certain taboos such as a ban of fishing in a particular area, gathering coconut from a specified stand, harvesting from special demarcated gardens. This ensured a build up of resources for the feasts. The Maohis of Tahiti deliberately reduced consumption for some period before the occurrence of a big feast. There was however, never a permanent taboo, in any area, specifically for conservation. Permanent taboos were for other reasons, such as the reservation of a haven for departed spirits, or an area for the tribal god or gods.

5. His system of shifting agriculture ensured the maintenance of an environmental equilibrium. While he chopped down a forest to establish a fresh garden in an area, he left a fallow to grow a new forest in another area.

6. Population remained small enough so that in terms of our model, inputs ('Human Population and R.P. Ideas') did not exert a pressure greater than input ('environmental factors') could counterbalance.

Thus in traditional South Pacific Societies, man lived in equilibrium with his environment, and the ecosystems maintained a balance of forces and a slow rate of change.

TODAY'S PACIFIC.

Returning to our model, the ecosystems will maintain equilibrium so long as the combined effects of Human Population and Rate Promoting ideas is counterbalanced by an equal force of environmental factors and Rate Controlling ideas. The four are constantly interacting forces, each being modified continually and creating a dynamic equilibrium on feed-back. Thus the rate of change in the total ecological system is dependent on the rate of modification in the four input areas, and the magnitude of the pressure of the four forces.

Maintenance of equilibrium of the ecological system did not prevail in all Pacific societies. In the Marquesas, Vinton[2] reported a decimation of the bird and sea-mammal populations, and a drastic reduction of the turtle and chiton populations shortly after man's arrival on the scene.

Here the bird and sea-mammal population could not adjust to man's exploitation. The turtle and chiton however did adjust and maintained a much reduced but constant population to present times. Man's actions here resulted in environmental change in as far as the system lost the effects of sea mammals and birds, but with time a new equilibrium point was reached, as shown by the stabilisation of the chiton and turtle populations.

Where the environment is affected to such an extent that man is affected adversely, either he has to change his ideas or practice some measure of population control. Many traditional societies followed the latter to varying degrees. In Tahiti, population control was practiced to the extend of infanticide to limit family numbers.[3] In Fiji, as in most other societies, population numbers were controlled to some extent by regulating spacing of children. A husband, for example, was not to sleep with his wife until the baby was weaned - usually at nine months but sometimes up to a year or more.

When, even with these measures, population pressure remained high, South Pacific peoples took to emigration to new lands. This was their most effective method of relieving population pressure on the environment.

With the impact of systems of economic development aided by sophisticated technology, today's Pacific societies can no longer remain static. Pressures from inputs 'Human Populations' and R.P. ideas, have increased rapidly, so that changes in the ecosystems have markedly accelerated.

How far the environment can stand these forces, and what conscious or planned modifications need to be made to the four input areas to maintain a balance, is, the concern of this conference. Whether we can learn from traditional practices, is the concern of this paper.

Among the countries of the SPC region are some with very high rates of population growth. Tonga and Samoa have over 3% annual growth rate, while Fiji's rate dropped to under 3% only after 1960. People's aspirations are high, so that there have been increased demands on resources in the attempt to achieve higher standards of living.

To modify input 'Human Populations', means effective measures of population control. Traditional societies did practice some form of population control.

To modify input 'R.P. ideas' will involve several approaches :-
In traditional societies, the education system was effective in inculcating not only an awareness of the environment, but also a respectful utilisation of it. The modern education system in the Pacific has so far failed to do this.

The formal administrative system was utilised to enforce some conservation practices. To-day's Pacific governments have not used this principle effectively. Traditional societies planned their land use to some extent. They did not mix settlement with crop gardens for example. One did not find a plot of taro within the village enclosure. They maximised agricultural output to some extent by planting crops in the most suitable areas. For example *Colocasia* and *Alocasia* were planted in low-lying areas where they grew best while yam was planted on gentle slopes where it grew best. Modern Pacific societies can also do the same on a larger scale. Coupled with GDP as the main aim of development plans must be some measure of GNP or environmental destruction resulting from the achievement of economic progress. Thus planning must take account of environmental factors. The encouragement of non-agricultural industries to relieve population pressure on the land is important. Better planned agricultural use of total available land so that it is used not only more intensively, but more effectively, is necessary. This may be done not only on a national basis, but also on a Pacific-wide basis. Where a country cannot produce something efficiently, it is better to import it from another more able to do so, thus the intensive use of fertilisers, pesticides, weedicides on marginal lands may be avoided in certain cases.

Whereas in traditional societies the population densities were such as to allow some measure of recovery by the environment, in modern societies it will not do so. Thus for example, where then a cleared area was left long enough to revert to secondary forest, now it may not be so. Active and directed attempts to aid environmental recovery are thus necessary. For our above example this would mean accelerating regeneration by planting forest species, exotic or native, in abandoned areas.

So far, ideas of environmental utilisation and manipulation have been formulated with little idea of the resultant changes in the ecological system and feedback effects. For man to control changes in environmental factors so the ecological system of which he is a part maintains an equilibrium, is an ideal difficult to achieve but worth striving for. For the achievement of this objective, it would be necessary to set up an extensive environmental monitoring system, coupled with the allocation of greater priority to environmental issues in planning and conducting economic development. There are constraints of course, the most important of which is cost. An environmental monitoring system for example, would be an expensive undertaking.

Whether or not the peoples of the Pacific will be prepared to pay the costs of maintaining a balanced ecosystem, will be a measure of the success of efforts such as we are putting into this conference.

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CRITICAL MARINE HABITATS

Definition, Description, Criteria and Guidelines
for Identification and Management

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FOREWORD

Many marine and marine-related ecosystems are now in serious jeopardy and action to protect and manage habitats of critical importance to the survival of marine species is urgently needed.

IUCN has asked Dr. G. Carleton Ray at The Johns Hopkins University, Baltimore, Maryland 21205, U.S.A., to undertake a study on the conservation of critical marine habitats which involves the identification and description of such areas and preparation of plans for their conservation. The work is being carried out under a grant from the World Wildlife Fund with additional support from UNESCO and the United Nations Environment Programme.

One of the objectives of the study is to provide criteria for the selection of areas to be set aside as marine parks or reserves and to prepare guidelines for their management. Dr. Ray has drawn extensively on material available to him from many quarters, particularly through his association with the Conservation of Ecosystems Program which was carried out until late 1974 as part of the U.S. contribution to the International Biological Programme (Darnell et al., 1974). The "National Workshop on Sanctuaries" (Lynch, Laird, and Smolen, Eds., 1974) provides a background on marine sanctuaries relative to important new U.S. legislation, the Coastal Zone Management Act of 1972 and the Marine Protection, Research and Sanctuaries Act of 1972, and this is also referred to in this study. However, the point of view expressed here is more general, in recognition of the fact that problems and solutions differ in various regions and areas.

Action has already been taken in various parts of the world for the establishment of marine parks and reserves. The recommendations of international meetings, including the First and Second World Conferences on National Parks (Adams, 1964; Elliott, 1974) have been important in leading to action. Nevertheless, there is only a small number of such reserves and, unfortunately, due to the nature of the coastal and marine environment, it is probable that few of them are self-sustaining. Therefore, a broad ecosystem-oriented point of view is presented here, particularly with regard to the value of parks and reserves in ecological research and in monitoring the impact of man.

The present paper has been prepared as a working document for those engaged in marine conservation in general or in the creation and management of marine parks and reserves in particular. It is a preliminary essay and is being circulated to attract critical comment with a view to its revision and expansion.

The paper is to be read in conjunction with IUCN Occasional Paper No. 14 "A Preliminary Classification of Coastal and Marine Environments" by G. Carleton Ray (Morges, 1975).

CONTENTS

PREFACE

Marine conservation has an ultimate goal to incorporate the knowledge derived from marine ecology into the fabric and practices of all societies so as to assure the maintenance of the health and productivity of marine ecosystems and the diversity of life within them. To work toward this goal, we must greatly amplify our efforts to identify habitats which are critical to the survival of marine species and biotic communities, and evolves methods for their conservation so as to exemplify how the broader aim may be reached.

The term "critical marine habitat" is here taken to mean those identifiable areas which are vital to the survival of a marine species, at some phase in its life cycle, or of a marine habitat, community or ecosystem, because of the ecological processes that occur within it. These may be extensive communities, such as mangrove-sea grass-coral reef systems, or small areas, such as rookeries for seals, or unique areas, such as lagoons which are important as whale breeding grounds, or even terrestrial areas, such as watersheds which nourish an estuary.

It is recognized that in the long run there is only one critical marine habitat, the sea itself. The "marine revolution" in which mankind is now involved, requires recognition that civilization as we know it, or an improved life style towards which we strive, is dependent upon the health, diversity and stability of marine systems. Terrestrial areas alone cannot provide sufficient food and other materials for the survival of mankind. Our objective must be no less than the comprehension and preservation of marine systems and the cessation of man's deleterious impacts upon them.

Such an objective is simple to state and has been stated in various forms many times in the past. The simple truth is that it is not being met — notwithstanding many meetings and conferences with their recommendations, and the clear warnings which marine ecology provides. The establishment of a few parks and reserves is a hopeful sign, but is also only a partial approach. There is no alternative to a massive, integrated effort of scientists, social scientists, lawyers, politicians, and public relations personnel in a regional, world-wide attack on the problem. Ecological science must take a lead since the primary need is to modify man's life style to the realities of ecosystems which he is far from understanding or controlling in the sea and coastal zone, but which he is presently destroying. The reverse approach — i.e. modifying the sea to man or what has been called the "engineering mentality" — clearly will not work in the light of our present knowledge or for the foreseeable future.

How man handles the coastal zone and the ocean commons is perhaps the most critical issue of la problematique (cf. the Club of Rome), since these areas are currently viewed as a placebo to the overuse of the land. Permanent solutions do not lie in drawing lines about what areas or species are to be exploited and what are not, nor do they lie in expansion of state's rights, nor in preservation of tradition. They lie in new directions, particularly in ecologically-oriented, regional applications of system theory, in readjustments of life styles, and in alterations of prejudicial lines of thought.

One such prejudice is that which exists between industrialized and non-industrialized nations or areas. The contrasts between them are real, but each is destructive in its own way to marine resources. Industrialized nations have already destroyed resources and have exploited much ocean space -- their own as well as others -- in their short-term interests. However, there is evidence that this trend is being reversed in some quarters. Conservation practice and theory have advanced and, most significantly, these nations have at least addressed the need to curb population and per capita consumption. Non-industrialized nations have destroyed more of their marine resources than would at first seem apparent. A few have taken some marine conservation action, such as the establishment of parks and reserves, but these often are gestures toward the development of tourism. Many have laws on the books for conservation of habitats and species, but these largely go unenforced due to short-term resource or economic needs. Most dangerous is the lack both of technology for marine conservation and of population planning. With the notable exception of a very few "ecosystem peoples", the non-industrialized nations may face a worse and even more immediate crisis than the industrialized ones, should present trends continue.

So far, man's approach to "critical habitats" has been largely to identify rare, threatened, or endangered areas or species and to make efforts to set them aside or protect them. Western man, mostly, has reacted emotionally to loss of aesthetic values or scientifically to loss of genetic resources while at the same time eating, breathing, buying, selling, and therefore destroying, what is common or taken for granted. The "protectionist" approach emphasizes a drawing of legal or geographic boundaries, which do not really exist ecologically, around what is considered, usually on a highly selective basis, exploitable and what is not. Such an approach may save the rare, threatened, or endangered, for a time at least, but only so long as ecological support systems and processes are also maintained. What such an approach cannot do is prevent the common from becoming rare or the clean from becoming dirty. Therefore, systems applications are required and this is especially true and difficult in the gigantic "sink" we call the sea, or the tortuous ecotone we call the coastal zone. In this coastal zone the majority of the world's people live, and the greatest diversity of life on earth exists; from it man extracts about half of the protein he consumes, as well as a large portion of his recreation.

Should present trends continue, that is, should population continue to grow, should per capita consumption continue to increase, should conservation continue to be piecemeal, and should man's activities have the effect of creating leaky, non-viable ecosystems, then there will soon remain but one endangered marine habitat -- the sea itself.

I suggest that we take the approach that this "long-range" danger may now be upon us even though we perfectly well know that the sea is far from dead, that abundance and good environmental health remain in many quarters and that restoration of many perturbed areas is clearly possible. Some areas need to be set aside as parks and reserves. But the overwhelming need is to meet the long-range goal stated above. The short-range objective of protection of certain critical habitats is the route towards this end.

How long is "long-range"? I would guess that if concerted and dynamic action does not proceed immediately, some now alive will live to see it.

G. Carleton Ray
Morges, December 1975.

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Mrs. Mary A. Mix, my secretary, has had to put up with my handwriting and many alterations in order to transfer the manuscript to legible form. I have also received help from many of the secretarial staff at IUCN, for which I am very grateful.

If the fishes, corals, mangroves, and waters of the sea had a voice - and who is to say they do not - I would also say thanks to them for life itself. And I do!

INTRODUCTION

Threats and Solutions

It is generally acknowledged, on the basis of both fact and intuition, that the seas are in jeopardy. Pollution abounds, overfishing is prevalent, coastal development remains excessive, and there continue to be losses in the productivity of many regions. Further we sense feedbacks which imply loss of stability in whole systems. There can be no doubt that the total impact of man's activities on the coasts and seas is impressive - and frightening in a world which still deludes itself that the seas are a panacea to our overuse of the land.

The literature is extensive on this subject. Hood, Ed., (1971) reviews the pervasive perturbations of man on the sea, and Clark (1974) summarizes problems of coastal ecosystem conservation. Edwards and Garrod, Eds., (1972) take an ecosystem-oriented approach to conservation which reveals many possible new approaches from fisheries management to radioecology in grappling with the many problems before us. Ketchum, Ed., (1972) points out that natural coastal systems may no longer exist, that "optimum human use" must be developed by means of models, and that a major effort must be devoted to this task. The U.S. National Academy of Sciences (1973) examined water quality criteria and found that major emphases needed shifting, for instance, from lethal to chronic effects and from diversity-stability indices to the determination of "most sensitive organisms" for monitoring purposes. Both of the latter studies made a strong case for the reserve concept, a concept largely devoted to both preservation and research and which has evolved far beyond early thoughts on marine conservation as implied by "parks". Lynch, Laird and Smolen, Eds., (1974) review the application of marine "sanctuaries" for purposes of mitigating impact, research, and monitoring.

Specific studies on the precise nature of man's impact, from geological to biological, abound. In a brilliant, concise paper, Inman and Brush (1973) cite impressive facts; for instance, "If everyone in the world decided to spend some time along the 440,000 km of world shoreline, each person would have less than 13 cm of shoreline". Although only 5% of the world's area is the productive continental shelf, about two-thirds of the world's population lives there. These same areas receive the bulk of man's impact in terms of waste discharge, thermal discharge, dredging, mining, poaching, and coastal destruction. Further, they point out that coastal waters have limited flushing capacity which contrasts strongly with the mentality which states: "the solution to pollution is dilution".

Turning to estuaries, which rank as among the most productive areas on earth as well as among the most threatened, Darnell (1967) reviews the many perturbations which occur there and also states: "The dreadful problem that we face is that there does not now exist in scientific literature sufficient information to guide ecologists in predicting the detailed effects of major environmental modifications...".
A sample scenario of the sorts of problems encountered begins with a study of Likens and Bormann (1974) which showed approximately a 1500-fold difference in sediment yield between a clearcut forest converted to farm and pastureland, and a stream running through mature forest. The differences between that same stream and a construction site in Baltimore was about 20,000-fold! This represents vast differences in the inputs of nutrients and pollutants between these three site types as well. Loftus, Subba Rao, and Seliger (1972) studied responses of phytoplankton to alterations in the physical and chemical parameters of Chesapeake Bay and found that relative species compositions changed

drastically. The conclusion raised by these two studies is: whereas we cannot predict the exact impact of clearing and construction on estuarine systems, we can say that we are drastically affecting the life support systems of essential resources to man through ecologically non-conforming development. Is such development, or the experiment which could prove the final result, worth the risk?

Two further scenarios are worth mentioning. The first concerns one of the most aesthetically and scientifically valued, and highly productive biomes of all - that of coral reefs. Johannes (1972) lists the many serious perturbations of man on coral reefs; the total effect is staggering. They include a variety of activities from souvenir collecting to siltation and pollution, the latter of which reduce the clarity of water and have a serious effect on coral. We are aware, for instance, of the symbiosis between corals and included a algal "zooxanthellae" and of the cleansing rates of corals, both of which mean that silty, dark water, as is caused by some forms of pollution and dredging, is inimical to reefs (Goreau, 1964; Lang, 1974). Even when coral reefs are included in parks, their protection is not assured. For instance, Voss (1973) has reported the "death" of patch reefs of the John Pennekamp Coral Reef State Park in Florida because of outside, as yet unidentified, influences. Strong possibilities are pollution and dredge-and-fill activities.

The last scenario is a reminder that the perils of pollution continue unabated in many areas. Here, the literature is huge, but among the most astonishing cases, to my knowledge, concerns damage to a whale which merely swam through the "boues rouges" (red muds) emanating from an industrial site in Italy, Pichod-Viale (1974) reports that the whale died because of deep skin corrosion and heavy metal impregnation through the damaged skin. Though this is an extreme case, it calls our attention dramatically to the pollution problem, and also to the fact that waters in many parts of the world are closed not only to the extraction of human food, but even to human contact.

These are but samples of the problem of perturbation by man. It is clear that the valuable resources of the sea will not survive without deliberate managerial intervention on their behalf. However, it appears unfortunate that to date national and international agencies have been only partially able to cope with problems of perturbation. So long as civilization's pattern of growth is sustained, the road to ecocatastrophe and the collapse of many cultures as we know them is assured. Nevertheless, whereas it is clear that our uses of coastal and marine systems must be altered so as to preserve their productivity, it remains to be seen how extensively ecological concepts will be incorporated into actual practice. It has been said that if history teaches us anything it is that man does not learn from history! Civilizations from Mesopotamian to Mayan have collapsed due to environmental abuse and there is no assurance that any present civilization is immune. For example we no doubt recognize problems, but it is astonishing how readily we reach for the quick technological "fix". Forbes Magazine (January, 1975) carried an article describing an underwater bulldozer, developed in Japan, 47 tons in weight and costing about $70,000, which some coastal city mayors see as a solution to their beach erosion and restoration problems! There is little doubt that there is insufficient appreciation of the value of solid ecological solutions (some of them free) for the already very widespread damage suffered by marine systems, nor that environmental damage threatens the support base of man himself at a time when his population is still explosively expanding and his *per capita* consumption is increasing.

Inevitably, protection of coastal and marine systems will interlock with the Law of the Sea. I have spoken of man's dependency upon the sea as the "marine revolution", in analogy with the previous, and still continuing, agricultural and industrial revolutions (Ray, 1970). The point was made that traditional legal systems for the sea are not in accord with what we know of marine systems and although that paper is out of date, one still finds only a modicum of ecosystem thought in the LOS discussions. There is still an over-riding concern for "yields" and "products" and a weakness in the formulation of long-term objectives. And there is very little planning which identifies systems as the proper units for management. These matters were examined at a recent Workshop on the Conservation of Wild Living Resources (Anon, 1975) which stressed the failure of international management of ocean fisheries. World catches have increased, but the rate has slowed despite an increase in effort and some marine resource populations have not proved able to withstand fishing pressure. The Workshop redefined some principles of the 1958 Geneva Convention by the addition of several emergent ecological principles. Most significantly, it defined resources as parts of their ecosystems and called for conservation of ecosystem and population stability. Peculiarly, neither the Workshop nor LOS discussions seem to have considered in much detail the relationships between coastal and open ocean jurisdictions and management, nor the role of critical marine habitat identification and protection.

Clearly, systems cannot be divided on the bases of legalistic proclamations about territorial limits any more than they can be separated by what is a "product" and what is not. The first is a largely economic spatial decision, the second a value judgement, and both are ecologically unsound. A current example concerns the role of the Waddensee. The value of this area as a nursery ground for international fisheries is well known biologically. Living resources, that is renewable ones, are clearly of greater value than non-renewable ones, as there is no theoretical limit on the time during which they may be exploited. Yet the decision by some coastal states which have jurisdiction over the Waddensee, or which influence it by pollution, is reverse - its value is seen as more important as real estate, as a dump, or for extraction of various non-renewable resources. What responsibilities do coastal states bear for stewardship of this critical habitat which clearly influences an entire ecosystem beyond their jurisdiction? What is the ecological unit, how can it be legally described and how can it be managed? One hopes that the UN Conference on LOS will come to terms with such questions.

Law of the Sea discussions and sub-discussions go on, seemingly ad infinitum (and often ad nauseam), but in the meanwhile, part of the answer to marine conservation is national and regional efforts to set aside parks and reserves. Genetic and ecological systems are valuable national and international resources which are theoretically perpetually renewable, but which are fragile. When they are gone, they are gone with finality. Mankind must protect samples of each major and minor type of habitat and community in order that ecosystems themselves will be made known and protected. In the history of conservation, early efforts towards the establishment of reserves dealt largely with species protection, mostly those that were endangered or of interest to sportsmen or commerce. Associated with this was the protection of areas of scenic or historic value; still, the intent was to preserve what was conceived "endangered" and the objectives were not truly ecologic. How could they have been? The science of ecology did not truly exist at that time. Later, habitat protection came to be entrained in these objectives, but it has been all too recently that we have realized that in very few cases indeed are "protected" habitats large enough to preserve the elements necessary for their continuity or the species they contain. A reason for this is that the natural communities which we seek to protect are not stable in time or space nor are they independent of their ecosystems. Migratory species, as many fish and marine mammals, are only protected in part by reserves set up for them. Further, the limited size of reserves implies that there will be loss of species and genetic diversity and control over the fate of the reserve is not possible within the reserve itself. What we will be left with in the end are a series of fragile, simplified habitats in an otherwise altered land or seascape, that is, "islands" which are highly unstable and which can hardly be called "natural" at all. These statements rest on the theoretical work of MacArthur and Wilson (1967) and upon such analyses as those of Diamond (1975) and Terborgh (1974). These have important implications in conservation.

Thus, very recently and largely through the rise of ecosystem science, we have come to know that what is really vital is the preservation of processes - evolutionary, genetic, and ecological. This is something we do not sufficiently understand, but it is not altogether intuitive. For example, we know of nutritional processes involved in the detritus food chain which makes mandatory the preservation of coastal productivity (Darnell, 1967; Odum and Heald, 1972). We know of nutrient "short circuits" in the sea whereby organisms moving through ocean boundaries transfer nutrients in ways that current structure cannot explain (Walsh, 1972). We also have begun to understand the important role of predators. In large fresh water systems the crocodilians have been shown by Fittkau (1973) to be important in nutrient cycling and pooling, and the loss of these predators may result in a decline in local fisheries. How extensively this may apply to marine systems is not known, but analogously, Estes and Palmisano (1974) have indicated the importance of sea otters, *Enhydra*, in maintaining the complexity and productivity of their inshore habitat through their dietary habits, alterations in herbivore populations, and resultant changes in aquatic vegetation. These results are exactly opposite to the widespread feeling that getting rid of predators will leave more for man's harvest or has little ecosystem effect! They also serve to remind the oceanographic community of the importance of predators in maintaining oceanic ecosystem stability, a feature which has been regrettably too little considered in their overwhelming emphasis on primary productivity. The role of large predators in nutrient transfer, nutrient pooling, and the maintenance of prey diversity ("predator effect") has been established for terrestrial systems and there is increasing evidence that this applies for aquatic systems too. Paine (1966, 1969) has identified "keystone" species as those which have a major environmental effect. The identification of such species is of profound importance.

All components of ecosystems, large and small, play a part in the maintenance of ecosystem structure. Woodwell (1974) warns about the consequences of loss of this structure. He issues a clear warning about the exploitation of the "assimilative capacity" of living systems, a bit of jargon that has come to be a standard of dangerous compromise; indeed "assimilative capacity" is a bit like "no significant effect" in that neither may exist for many of man's perturbations. Woodwell further states: "Clearly 'stability' at the level of the biosphere is of advantage to man" and he cites a lawyer's maxim in a plea for an international "no release" policy for pollutants: *Sic utere tuo ut alienum non laedas* or "use your own property so as not injure another's".

In a related sense, Holdren and Ehrlich (1974) call to our attention the "natural services" of natural systems: food production, conversion of wastes, control of the majority of pests and diseases, and storage of genetic information. No technology of man, now or in the foreseeable future, can perform these services to the extent necessary for our present civilization's continued support on this planet. They also point to a vastly important fact of life, that man emphasizes the productivity of systems, whereas nature emphasizes stability. No more pertinent example can be found for the man-nature conflict. Thus, ecosystem evolution progresses towards no net community productivity because mature natural systems recycle nutrients efficiently. Man's "systems", such as farms, are simplified and recycling is minimal. Further, we cannot depend on the oceans to solve the conflict. Holdren and Ehrlich point out that its vast bulk is deceiving; 99% of oceanic productivity takes place under 10% of its area and half of that is in the 0.1% where coastal upwellings predominate. According to late FAO figures, we are already harvesting over half of the potential protein of the sea; at the same time, we are destroying the sea's production potential. What the result has been on stability is not known, but clearly there is conflict with natural processes and services.

I have previously attempted to emphasize the ecosystem approach to marine parks and reserves (Ray, 1972 and 1974). Ray and Norris (1972) have emphasized the "regional management" approach to marine resource management. This means that we must place our efforts on two levels, the first of which involves systems concepts and the second of which involves implementation; put another way, we must evolve a strategy for marine habitat protection and, flowing from this, a technique for procedure. We must employ multidisciplinary efforts and effective information transfer so that our efforts will not be isolated. And we must do these things rapidly.

These are complex issues, but we must not await the accumulation of complete knowledge - an impossibility, anyway - before taking significant action. Wallis (1971) was among the first to review the marine parks of the world. He laments that "past conservation action has stopped, to a great extent, at the edge of the sea; resources beyond were 'out of sight, out of mind'". As far as parks were concerned, he was absolutely correct. Bjorklund (1974) gives the most recent review of marine parks and we see that even now these protected areas are pitifully few. Even more notable, there are few nations which have taken the ecosystem approach to marine conservation and none which have truly implemented it. That is, the park/reserve/sancturay concept ranks high, but what has not been considered in nearly enough detail is how their establishment will make enough of an impact on man's perturbations so that present trends may be reversed or at least intelligently monitored. This clearly involves considering the long-range biological health of protected areas, their relationships to the marine and terrestrial ecosystems on which they are dependent, and their utilization for research and monitoring. Utilization for recreation, as implied by "parks", is certainly important, but remains subsidiary to these broader ecological objectives.

Other aspects of this problem are that "parks" and "reserves" are set aside by boundaries which are almost always ecologically "leaky" and the very action of "setting aside" raises conflicts with those who often would benefit most from marine conservation. Most notably, sport and commercial fishermen need more, not less, conservation action in order that the natural productivity on which they depend may be preserved. However, fishermen often stand against reserves in fear of losing "rights". Similarly, hotel and property owners fear losing property value. Strangest of all, some who purport to appreciate the beauties of the sea (shell and coral collectors, for example) do not wish favourite areas to be put off bounds, but continue to exact a stupendous toll from the sea. Therefore, park and reserve establishment is seen by many to be in competition with their interests, when actually it is precisely the opposite.

Another aspect concerns the setting aside of "research natural areas". Many short-sightedly object to the removal of areas from full utilization by the present generation. On the other hand, Moir (1972) points out that to some, conservation requires development; they object to large areas being devoted to narrow scientific and educational purposes. Is not knowledge of how systems work at the heart of the matter? That is to say that even though we overcome obstacles, our vistory may be Pyrrhic. It is not sufficiently appreciated that such action will result in only limited ecosystem-process preservation. The most vital use of such areas may lie in the monitoring of man's actions, in research, and in the use of these efforts to mitigate those actions through modification of them. Research and monitoring in natural areas must determine which of man's actions are compatible, which prohibited, and which to be modified. The standard must clearly be ecological, not socio-economic, and these determinations must be made on a site-specific basis (McCormick, 1975).

There is a great difference between developed and lesser developed nations in their approach to these issues. The former tend to be "preservationist" and the latter seek "development". But with regard to monitoring of man's actions, their needs converge. The Man and the Biosphere Project 8 on "Conservation of Natural Areas and the Genetic Material They Contain" clearly recognizes this and has made an effort to define "biosphere reserves" (UNESCO, 1974) which we find to be the closest present approximation between reserve purpose, ecological reality and the desire of many nations to monitor and control development. But it must also be emphasized that these reserves do not replace the older "park" and "reserve" definitions; rather they augment the park concept.

> "The concept of biosphere reserves involves a broad philosophy of conservation. The great changes in the world in the last decades have made it clear that a new dimension in conservation action is required, to provide both for the perpetuation of the earth's living resources in all their variety, and for the proper study and understanding of the change affecting them - for the future use and enjoyment of mankind. The international network of biosphere reserves is intended to provide this new dimension by the maintenance of ecological processes on an appropriate scale. The concept of biosphere reserves may be viewed as an approach to maintaining the integrity of biological support systems for man and nature throughout the whole biosphere. As such, it involves conservation, restoration, and the acquisition of knowledge for improving man's stewardship of both the domesticated and wild countryside". (Emphasis supplied).

I have underlined what I believe to be the most salient thoughts which, if understood on an ecosystem level, describe the magnitude of the task before us. Indeed, the emphasis on processes and stewardship is no small matter. No longer can the "setting aside" of marine areas for their amenities alone, as "parks" imply, be our isolated purpose, for the ecological health of such encompassed areas cannot be guaranteed by this means alone. We must also learn to think in terms of the health of the system within which reserves are located. No longer may we delude ourselves by calling part establishment "ecosystem protection". Further, the surveys we undertake for the establishment of marine parks and reserves must incorporate a new level of sophistication far beyond the level of platitudinous recommendation.

It is widely recognized that a classification scheme for biotic provinces and habitats is a necessary first strategic step to guide an inclusive selection of reserves. It should also serve to build redundancy into the reserve system to circumvent lose from natural catastrophes or the inadvertent activities of man. It is not possible to define marine biogeography in detail at present, but it is possible to erect a pragmatic scheme. Therefore a tentative classification has been provided in the form of a companion paper to this one (Ray, 1975). This is, necessarily, a brief summary and is to be taken as a possible point of departure only. Dasmann (1972, 1973a) and the IUCN (1974) have suggested classifications for terrestrial biotic provinces, emphasizing vegetation. It would be facile to say that a vegetational classification of marine biotic provinces is impossible, yet there are some habitats for which it is essential, namely sea grass beds where the nature of nutrient recycling closely approximates the terrestrial condition and where vegetational characteristics predominate. Unfortunately, no comprehensive vegetational or floristic classification for the sea exists. Presently, water mass characteristics, in combination with benthic structure and zoogeography, dominate marine classification schemes, placing a level of complexity and dynamism on them with which those who deal with terrestrial systems are not usually familiar.

A second sort of classification is that for protected areas, and it crosses both technique and strategy. That of Dasmann (1973b) poses some difficulties when applied to aquatic systems as there is probably no such thing as a "strict nature reserve" anywhere in the sea. Downstream effects and the mobility of the living and non-living constituents of the hydrosphere mean that only a very loose definition of this term in coastal or marine environments is possible. Nevertheless, we do not propose to argue such points in detail here. Dasmann's terms are quite sufficient for present purposes, though this paper attempts to redefine and simplify them explicitly or implicitly.

Ecodevelopment

The Lamb misus'd breeds Public strife
And yet forgives the Butcher's Knife

Auguries of Innocence

William Blake

But who are those that see no such dichotomy, who depend upon, love, worship, cajole, fear, use, or misuse their environment directly, and who have neither "public" nor "butchers"? Conservation is an activity required because of the impact of industrialized, "biosphere man", whereas "ecosystem man" had no need of it. These terms are used by Dasmann (1975a) to highlight the difference between "all of the members of indigenous traditional cultures and some who have seceded from, or have been pushed out of, technological society" and "those who are tied in with the global technological civilization". Dasmann draws on the term "future primitive" of Gorsline and House (1974) for a new direction in both life styles and conservation: "This does not mean the rejection of the best of modern technology, but it does mean the avoidance of the worst. It does mean using the tools and energy that are still available to create something permanent, to create a way of life that can be sustained. In such a way of life, nature conservation would necessarily be taken for granted, since people will recognize that their future depends on the health and diversity of the natural world." Dasmann (1975b) enlarges on this issue, calling attention to the need to push responsibility and authority back to a more local level, reminiscent of Schumacher's (1975) marvellous title: "Small is Beautiful. Economics as if people mattered".

Recently, I have queried: "How can tradition, utilization, and conservation be made compatible in the sea?" (Ray, 1975), also pointing out the many conflicting traditional uses of the sea and the rapidity with which new traditions become incorporated into culture's fabric. What is not traditional is an ecological basis for human behaviour. It would be a great error to equate traditional, subsistence cultures or ecosystem peoples as "right" and industrialized peoples as "wrong". The above definition of Dasmann avoids doing so.

Yupiktak Bista (1974), a publication of an Alaskan Eskimo corporation, asks the fundamental question: "Does one way of life have to die so another can live?" It reminds us: "When the balance or circle of life as it has been called is broken, birds and fish and animals begin disappearing from the land. When they are gone, so are the people who depended on them...Poverty has only recently been introduced to native communities. Up until a hundred years ago people were living a finely balanced economic relationship with the land." This is a moving statement, but does it still represent a useful position for traditional culture and if so which ones and to what extent? Surely there are places where "cultural impact statements" need to be made as much as "environmental" ones, in the face of "development"!

There is a mandate that conservation, no less than exploitation, recognize traditional and substence rights. This not only cultivates good will but is part of the fabric of simple justice. Nevertheless, "traditional" activities do not long remain compatible with either their own origins nor with the dynamics of ecosystems. They are subject to external influences and changing technology in exceedingly subtle ways which often escape the attention even of social anthropologists. They also change through the increase in populations of peoples recognized as "traditional" or "aboriginal" or "subsistence-oriented".

How will it be possible to reconcile these problems? Perhaps "eco-development" is an answer. The Government of Papua New Guinea has tentatively defined a set of guidelines, quoted here from IUCN (1975):

"1. All our people have the right to a safe, healthy, productive and culturally satisfying environment which permits a life of dignity and well-being.

2. We are the trustees of the environment for future generations and our approach to development must reflect this.

3. Pollution of land, air and water in quantities which cause the degradation of the environment must be controlled.

4. Habitat and wildlife management must receive consideration in planning our development.

5. Protection and enhancement of the environment requires education directed toward living with our environment."

These guidelines recognize the people's rights to be involved in decisions about acceptable patterns of development. They recognize cultural and environmental values together and the danger in sacrificing these for short-term economic gains. They are close to the concept of the "future primitive", i.e., the achievement of a world-wide ecologically and culturally sustainable way of life. The true meaning of "ecology" is brought back for "ecodevelopment" unites man and nature.

It is particularly important to develop means by which marine conservation may be integrated into patterns of ecodevelopment, building from local knowledge and customs, and taking into account traditional uses of the sea. Such an approach would link conservation with increasing the economic welfare of people in ways that are ecologically sustainable and can therefore be enduring. This will not be accomplished by the same means everywhere. There is no more a social common denominator than an economic one for describing "value". As McCormick (1975) points out: "A written document organizes and presents alternatives, but the same policy cannot always be applied effectively everywhere. Local accommodation to specific needs and problems is the best means of safeguarding the critical habitats to be protected." This does not imply a dilution in effort, but rather the gaining of strength from parallels between culture, ecosystem, and the aspirations of people. Ecodevelopment needs to be explored as a means to that end. The nature of parks and reserves will be dramatically different in various parts of the world as a result.

Man is forced, pending much greater ecological know-how, still to place as his highest priority the protection of ecosystems and to interfere with them as little as possible. He is far from control by means of knowledgeable manipulation. Therefore he cannot place socio-economic values before ecological ones. Yet, to imply a sharp line be drawn between the two would be a great mistake. Unfortunately, conservation is yet in its infancy in uniting the two.

The Nature of Marine Ecosystems

Before we proceed, it is useful to consider the nature of the seas in general and the transitional/dynamic nature of the coastal zone. Three considerations are paramount. First, no-one owns most of the sea and this vast area of *res nullius* or *res communis*, whichever the approach to resources, impinges in important ways upon areas of national jurisdiction. Second, our knowledge of marine environments lags far behind that for terrestrial environments. Third, ecosystems are the largest *functional units* of the natural world, characterized by recycling of materials and properties of homeostasis.

The following salient points on the nature of marine and coastal systems are adapted from Ray and Norris (1972), Cronin, *ed.*, (1974), and Darnell (*in litt.*):

1. *Size and Mobility*. The scale of marine systems confounds thinking based on terrestrial models. The largest ecosystems by far are marine and we cannot aspire to include them, *in toto*, in parks and reserves. Certain exceptions to this statement exist, of course, but this is a general pattern with which we must cope. Whereas large-scale mobility or migration of major ecosystem biomass is more the exception terrestrially, it is the rule at sea. Whole fractions of ecosystems move great distances, limited only by behavioural and physiological tolerances, or by the sessile or sedentary habit of some species.

2. *Predominance of Water Current Among Evironmental Factors*. Of all the factors of the aquatic environment, water current is probably most important in the lives of marine organisms, and an understanding of water currents is basic to aquatic system management. Currents provide transport for many marine organisms and their development stages. They transport chemical nutrients and particulate food. They bring in oxygen and remove wastes. Their force determines, in large measure, which species may exist in an area. Currents also determine the quantity of freshwater and saltwater which enter an estuary and the overall circulation patterns may determine the temperature of a protected body of water. They also trigger events. Management of a coastal or marine area rests on maintaining the normal current patterns as well as their seasonal volumes and regularities. Management must also be based on an understanding of currents in order to control upstream events which might reduce the quality of the water bathing in area.

3. *Ecotones and Transition Zone*. The shore and coastal zone do not separate land and sea, but unite them. Neither geologically nor biologically can the coastal zone be defined as a complete ecosystem; it is the interface between two systems and, characteristic of such ecotones or transition zoens, is immensely productive as a result. For this reason, marine reserves should not end on the shoreline, but should incorporate adjacent land areas, either within their boundaries or in their management plan.

4. *Boundaries*. The sea is not a continuum, though the boundaries can be subtle. The sea's texture varies with eddies, circulation cells, currents, upwelling, salinity, and temperature, and any of these may form boundaries in addition to physiographic boundaries by which terrestrial environments are largely separated.

5. Dimensionality and the Living Hydrosphere. Life exists on land as a thin surface skin surrounded by an atmosphere which is uninhabited on a permanent basis; thus, terrestrial systems are largely two-dimensional. The sea is a "bouillabaisse" of organisms, nutrients, degradation products, inorganic chemicals, and pollutants. This "living" quality of the hydrosphere, in contrast with the "abiotic" atmosphere, adds a third dimension of large scale to marine systems.

6. Physiological Continuity. Most aquatic animals are not "sealed off" by virtue of a relatively impervious skin, as land animals largely are. Most aquatic organisms are in physiologic continuity with water and are generally very susceptible to foreign substances, pollutants, or nutrients, which enter their bodies with facility, then quickly are incorporated into the trophic structure. Exceptions, of course, are the air-breathing "re-entrants", i.e. the aquatic reptiles, birds, and mammals.

7. Inverted Pyramid of Biomass. Terrestrially, the greatest biomass is found in primary producers; much is locked into the "bottleneck of ecosystems", cellulose, which is slowly degraded and recycled. Aquatic systems, with the notable exception of algal beds, sea grass beds, and some reefs which are dominated by algae, do not have the greatest biomass at the lowest trophic level. Rather, phytoplankton productivity compensates for the lack of biomass so that production on an annual basis is very great, but the amount of plant material present at any one time is usually far less in weight per unit volume of habitat than that of the consumer levels.

8. The "Sink", "Downstream Effect", and "Short-Circuits". Ultimately, rainfall and land drainage carry terrestrial and atmospheric nutrients, pollutants, and silt to the sea. Thus, the sea has been called a "sink". Forests, estuaries, and marshes are natural "filters" which retard the process of passage of products, either harmful or beneficial, to the sea. The "downstream effect", as the name implies, refers to the mobility of silt, pollutants, nutrients, and organisms over great distances and to the effects in their wake. Organisms and their food chains move through oceanic features both laterally and vertically, often against currents, and provide "short-circuits" (Walsh, 1972) to nutrient and pollutant transfer, the magnitude of which we have only begun to suspect. These are among the features which make the protection of marine environments so very difficult.

9. Eutrophy. Oxygen supply is taken for granted in terrestrial environments, but it can be critical in the sea. Eutrophy refers to the over-enrichment of a body of water so that it becomes so productive that the biological oxygen demand may reach levels beyond the oxygen supply, thus depleting this vital substance and causing anoxic conditions. Large-scale die-offs of oxygen-dependent organisms may result. Particularly vulnerable are estuaries, lagoons, and the relatively stagnant bottom waters of fjords, enclosed seas, and oceanic trenches. The danger to trenches may be a surprise to some, but the suspicien grows among marine scientists that the life of trenches is presently endangered by the degree of dumping that occurs in some of them. Should organic wastes be dumped there in sufficient quantity, those poorly circulated waters could become anoxic and much of their characteristic biota would perish.

10. Dynamism. Spatial and seasonal alterations of inshore features reflect some of the most dynamic of all natural processes, exceeded only by earthquakes, floods, violent storms, and vulcanism. Shorelines, dunes, banks, and shoals move to change the faces, even the boundaries, of whole marine systems. Dredging, bulkheading, channelization, damming of rivers, and other attempts to contain or alter natural geomorphological processes are usually doomed to failure and are creating great problems (Inman and Brush, 1973). It is difficult to establish reserve boundaries which encompass such natural alterations as the movement of inlets, banks, and beaches. It is also sometimes forgotten that natural geomorphological change creates new habitats critical to the existence of certain organisms; for instance, certain shore-birds depend on new or recently storm-scoured sand beaches. Such "sterile" beaches are not solely the habitat of the beach buggy!

Summation

Perhaps the point is now clear that the strategy for environmental conservation falls within the realm of ecosystem science, that it is an immensely difficult ecological-social problem, that the descriptive phase may begin systematically with the aid of a classification scheme, and that techniques of description and implementation should flow from this base. A lengthy discussion of conceptual approaches to marine ecosystem preservation is not appropriate here; some thoughts on the nature of marine systems have been expressed and hopefully will suffice. The bulk of this paper is more related to establishing an approach than to theory; some aspects of this are difficult enough in themselves. For instance, for required detail, we will have eventually to employ workshops to elucidate such questions as: "What jurisdictional methods shall we employ to resolve conflicts between recreation, fishing, conservation, and mineral exploitation adjacent to or within marine reserves?" "What traditional values are ecosystem-compatible and which are not?" "What are the interfaces between land-oriented and marine-oriented conservation practices?" "How do geomorphological processes affect jurisdictions involved in marine habitat conservation?" "What are the indicator species which we wish to employ in the monitoring of reserves?" "What is the nature and extent of the buffer zone in protecting the core reserve?" "How will the many national and international agencies responsible for (or interested in) marine conservation coordinate their diverse (or conflicting) efforts?" These are among the many emerging matters which are dependent upon a sophisticated comprehension of marine systems. Most are already receiving some attention in various quarters, but integration of interests is not yet sufficiently strong.

In conclusion, there are two concurrent considerations. First, we must work towards the identification of "critical" areas and the "buffer" zones upon which the integrity of the critical areas depends. The selection and description of critical areas must be done in such a way that many national and regional efforts are compatible and comparative. The selection of what is "critical" must be according to a set of agreed criteria. Some specific reserve function or set of functions for selected areas must be identified from the start. Second, we must work to evolve a context for operation, based upon a classification scheme and a format for information gathering for marine and estuarine habitats. These two aspects should evolve together, not necessarily sequentially, and guidelines for conservation management will evolve directly from the level of our understanding on all levels, ecological to social.

The rationale is: given we do not understand ecological processes well enough to be able to predict the effects of man's perturbations; given our desire to protect the integrity of nature; given that marine and estuarine systems are too large to protect by means of reserves in their entirety; given that the existence of a diversity of biotic provinces, habitats, species, and cultures of man is probably reflective of ecosystem processes in all their complexity; therefore, let us set about assuring that diversity in all its aspects is represented in protected areas for the principal reason of understanding those processes and formulating procedures for man's actions which will neither jeopardize them nor - in the long run - man himself. As a corollary, we must see our efforts not merely directed towards the protection of pristine remnants of man or nature, but also towards the restoration of habitats within already devastated, despoiled, or perturbed areas (New York Bight, Florida's coast, the Baltic and Mediterranean Seas, the seas about industrialized Japan, some reefs of East Africa, Hawaii, etc.). We must allow that man will soon have within his grasp the improvement of many areas as, for instance, is indicated by our stated desire to develop mariculture and to maintain the productivity of wetlands.

There are clearly ecological, life-style and philosophical matters to be considered in our endeavours. Not all people or places are the same, nor should they be. The study of history, archaeology, and plaeontology give us a sense of the past and the fact of evolutionary change. The science of ecosystem ecology, with man as an integral part of nature, can aid in the development of the ethic that the only "reserve" is the Earth itself. The preservation of bits and pieces, as "parks" or "biosphere reserves", is an essential interim measure which will be necessary so long as man cannot police himself and remains ignorant of - or ignores - natural processes. Ecosystem science, in our view, is thus essential, both in the reduction of ignorance and the evolution of ethical values.

BACKGROUND ON DEFINITIONS AND PRINCIPLES

Terminology

Definitions are important, but must be interpreted with flexibility. It is not useful to quarrel over semantics though it is obvious that terms have quite different meanings according to language and local customs. The vital matters are that habitats be preserved, that the purpose of protected areas be well-defined, and that they be managed according to ecological knowledge and a set of enforceable and realistic guidelines, not that names merely be applied to areas for which there is no real management or stated purpose.

Nomenclature falls into two categories, title and function. By "title" is meant simply what we call the area. Function is considered below. Dasmann (1973a) considers aspects of both for terrestrial protected areas, but it is my belief that we can make a simpler effort here. Belying this is the summary given by Bjorklund (1974) in which 52 marine reserve names are now in use! Nevertheless, a few examples may suffice to clarify. Blumberg (1974) describes "santuaries" in the Commonwealth of Massachusetts; these actually describe administrative zones for control or prevention of activities on the sea bed, such as construction, removal of sand or gravel, incineration, dumping, and the discharge of coolant water. Thus, such a "sanctuary" is hardly complete, but serves critical control purposes. The U.S. Department of the Interior (1973 a, b, c) takes a broad view in defining an "ecological range" as encompassing entire or nearly entire biotic units or ecosytems substantially unaltered by the actions of man and "areas of ecological concern" as those which "contain resources that are part of the total ecosystem; and which if compromised, could endanger resources within the proposal". Clark (1974) identifies "vital areas", "areas of environmental concern", and "areas of normal concern" which he notes are analogous to the "preservation", "conservation", and "development" zones established by the State of Florida (see also Johnson, 1974). Last, "research natural areas" describes both title and function and is a name extensively used in the U.S. It is even incorporated into the Federal Committee for Research Natural Areas which is currently attempting to identify such places where study can be made of gene pools and the structure and function of natural communities to provide baseline data for long-term monitoring of environmental quality.

In short, names are important, but they should not cloud the major issues of ecosystem preservation through the establishment of a series of reserves. For purposes of this paper, four terms (titles) are paramount:

1. Reserve. An inclusive term for any area which is set aside for special purposes and for which management guidelines are established. Most of Dasmann's (1973b) terms apply. Thus, a marine "reserve" may incorporate only the single purpose of a moratorium against such exploitation for a region within which few other restrictions exist or of setting aside an area to protect breeding grounds for which there has been no previous protection. Other reserves prescribe against certain deleterious extractive use, for example oil, gas, sand, or gravel. Still other reserves may emphasize scientific research (i.e., research natural areas) or sporting activities. "Strict" nature reserves may forbid all trespass except under permit (Antarctica's Specially Protected Areas). "Sanctuary" is a kind of strict reserve, but with widely varying application (cf. Lynch, Laird, and Smolen, 1974).

2. Park. A kind of reserve in which recreation and/or public education are emphasized.

3. Core. The park or reserve itself which incorporates the "critical marine habitat". In many cases, more than one "habitat" is included. In others, historical or archaeological sites comprise the central feature.

4. Buffer. An area adjacent to or surrounding the core and upon which the core depends, or vice versa, in the ecosystem sense; i.e., an "area of ecological concern" as it is sometimes called. This is the hardest term to define. What is "critical" may not be known. Once a core area is acquired, it may prove not to be the critical one or, in the case of geomorphological change, it may move. The difficulty lies in the identification and prediction of natural processes.

Reserve Function

Protected areas or those managed along sound ecological principles serve a number of highly relevant purposes. First, they tell of natural processes and serve as areas in which to measure man's perturbations. Jenkins and Bedford (1973) emphasize the importance of environmental baseline data. As Moir (1972) puts it: "A greatly augmented, purposeful, national and global natural area system can provide an invaluable biological basis for measuring man's impact, and his future security, on this planet". Ecosystem research, especially that which is process-oriented, is central to this task and reserves must be set up in some of the most productive and desirable places, in terms of value for exploitation, so that we may do research towards the development of predictive capability. Second, reserves serve to protect species and habitats which are endangered by man and which embody unique processes and/or genetic materials. Obvious candidate species are large vertebrates such as birds, marine mammals, turtles, and crocodilians. Obvious candidate areas are productive estuaries, mangroves and coral reefs. There are several other functions, but what parks and reserves cannot do is survive intact outside the context of the ecosystems of which they are only a part. Thus, buffer areas must be established to include the support systems which usually derive largely from outside the core areas.

The preceding relates to the identification of natural ecological units, such as habitats or communities or ecosystems. There is another rather different, but no less important, use relating to education, the preservation of cultural values or of traditional use, and the continued appreciation of nature's amenities by mankind in general. The two might be contrasted by saying that the former is ecological, the latter cultural, but a false dichotomy between man and nature must not be erected. Eco-preservation and eco-development enmesh the two inseparably.

We must now relate terminology (which is less important) with function (which is all-important). The former simply describes a three-dimensional space. The latter describes our philosophy and use with regard to that space. Surely, the two are difficult to separate, or inevitably semantics suggest both; the point is not to let semantics interfere with our intent. To that end, I offer a condensation of functional definitions which have been widely used heretofore:

1. Habitat preservation. These areas are primarily for protection, and management of essential or specialized area components of

marine systems. The management emphasis is on preservation so that representation of the diversity of habitats in the coastal zone and adjacent waters shall be maintained. Preservation of endangered species and habitats must, by definition, involve unique areas either because man has eliminated a component of the area (the endangered species) or because similar areas no longer exist. Long term research is essential for the continuation of these species or habitats, including natural population studies, reproductive biology and recruitment rates, energy flow and nutrient recycling, carrying capacity, husbandry and pathology, impact of perturbation and the extent of the buffer zone, and alternate areas for propagation of endangered species. However, studies should be on a "not-to-interfere" basis, so are primarily observational with a minimum of sampling. A notable exception to the latter point is: what to do about preservation of subclimax conditions? This will require careful management, especially in small reserves where limits of space interfere with creation of new habitat.

2. Species preservation or conservation of genetic resources. In order to maintain species populations there must be a diversity of areas for protection of migratory pathways, spawning grounds, nursery grounds, and feeding areas. In some cases this involves the preservation of existing conditions, in others the re-establishment of former inhabitants. In all cases, research will be mandatory for the clarification of environmental correlates with the particular species' presence or abundance. In other words, why is the species there, with what does it compete, and why are there as many (or as few) as there are? The same statement with regard to subclimax stages applies here as above.

3. Research. These areas are for scientific research, monitoring, and to establish ecological baselines against which to compare and predict the effect of man's activities. Most important, they are necessary to develop an understanding of natural processes, without which neither reserves nor man himself can survive. Two basic subdivisions are possible: (a) "natural history" in which observation and a minimum of manipulation are involved. This, contrary to some opinion, may involve extremely sophisticated methodology, such as remote sensing and telemetry. The emphasis is observational which is the only type of research to be permitted within a strict natural area; (b) "manipulative" in which some disturbance is essential in order to comprehend ecological processes. A particularly important example requiring manipulation involves successional stages, emphasized above. Cronin, ed., (1974) considers research in greater detail. Randall (1969) emphasizes the importance of natural area preservation near marine laboratories: "More than one marine station has all but lost its raison d'etre because of pollution, shore alteration by dredging or filling, or by excessive collecting of marine organisms in the vicinity".

4. Recreation education and aesthetics. Such areas protect scenic beauty and/or complement and enhance areas for enjoyment and education of the public. Education and training should be on at least three levels: public education, training and education of park specialists and environmental managers, and higher education and research. There are several types of educational and recreational activities from those having a close relationship with sport to those which appeal to the artist -- or both. The latter is a highly personal matter and no strict definitions are possible, or

should even be attempted. However, an essence to be emphasized is that interpretation may take many levels. An imaginative and creative interpretative programme is one of the key elements or potentials in marine parks. Films, displays etc., will be important to inform possibly unfamiliar groups about the marine environment.

5. Special or cultural purposes. Unique areas may be necessary to protect geologic or oceanographic features, for instance the Phosphorescent Bay in Puerto Rico, a habitat type which is rare elsewhere, and even degraded there. They may also protect a cultural heritage. The latter point is important. Auburn (1974) states that: "Over extensive areas of coastal seas, skin divers have already looted and destroyed a considerable number of ancient wrecks in shallow waters". Protection of such sites is a difficult, often controversial, matter. "Wreck-hunters" have been a dominant feature in the scuba-world and, whereas many discoveries of value have been made, many sites have also been destroyed by those of selfish or greedy motivation.

6. Multiple use. Cronin, ed., (1974) examines this term from a largely ecological standpoint. All that is really intended is an expression that several purposes may be carried out continuously or contiguously in a reserve. This requires careful management, but is not to be taken to mean a dilution of one value to the advantage of another, such as has occurred in some forest reserves which also purportedly have broad scientific and wildlife value, but in which the latter are clearly secondary. A current example of multiple use in the sea is the oil and gas industry's acceptance of "sanctuary", but only insofar as the industry is not excluded (Hay, 1974).

Now we have two sets of terms, area descriptive and area functional. A combination is necessary for full description: i.e., "a reserve for multiple use", "a park for education", "a core area for the preservation of a coral reef", "a buffer zone for research, education, and for natural successional change", etc. In any case, the two sorts of titles should be clearly defined.

In conclusion, I cannot emphasize too strongly the need for incorporation of research and education within all reserves. The threat of man's activities to natural ecosystem health and stability pose critical problems for civilization's survival. Systems of national and international marine and estuarine ecological reserves, embodying genetic and ecological diversity, should be subject to investigations on the scientific basis of preservation. Reserves should be "reservoirs of biological species, physical phenomena, naturally functioning communities, and existing habitats" (Lynch, Laird, and Smolen, Eds., 1974). Not only must rare and endangered species and habitats be studied under a variety of conditions so as to evolve procedures for their continuity, but the structure and function of natural ecosystems must be studied, as opposed to those stressed by man's activities. From such study will emerge baseline data for long-range monitoring and a cadre of trained personnel to do the work. By means of educational programs, a better-informed public may prove able to make better and less costly environmental decisions.

Thus, the function of reserves is primarily preservation, but also incorporates education, recreation, and especially the potential for research in its fabric.

Management Principles

The following suggest a basic philosophical and practical approach to critical habitat management and are a condensation of much of what has already been stated.

1. Ecocentrism. Strong arguments for socio-economic (i.e., homocentric) decisions on land use persist. There should be no man versus nature dichotomy in resource decisions. On the other hand, socio-economic issues should be secondary to ecocentric ones in the decision-making process. The nature of ecosystems is our paramount concern, not to be diluted by overriding concern for monetary value, non-conforming social custom, or "needs" and "desires" which may result in deleterious environmental impact. The education of social scientists, lawyers, businessmen, engineers, politicians, and economists in the essences of ecosystem dynamics is a goal worthy of pursuit.

2. Conforming use and controlled growth. When numbers of peoples are small, use may be less important to control. However, the concentration of populations on the coastal zone requires careful control of man's actions there. Also, although no human populations actually live permanently on or under the sea, traditional and encodified Law of the Sea has promoted laissez-faire attitudes and common property uses there, most of which have not led to ecologically conforming use, in the sense that the objectives of man and ecosystem processes conflict. This implies controlled growth which may mean positive growth, negative growth, or no growth, depending on the area in question. Reserves serve important functions in the control of growth as well as in preservation, and one of their greatest values lies in the monitoring of growth as it affects ecological processes so that the biological support systems of the sea for man and other organisms will not be allowed to collapse as a result of man's perturbations.

3. Zonation, research and monitoring. The aim should not be only the identification and setting aside of critical areas; it is the zonation of the coastal zone and contiguous seas in the recognition of ecosystem structure and function, and of man's conforming use that is essential. Research and monitoring will lead to principles by which zonation can be applied. It will also lead to a flexible approach as is indicated by geological, cultural, or other alterations; i.e., zones will change in accordance with their use and ecologic health.

4. "Assimilative capacity" of receiving waters. This is a term of convenience used in the "engineering" of the environment. Surely, natural substances are assimilated, but the analogy should not be drawn that foreign substances and pollutants have a threshold concentration below which there is no "significant" effect on the ecosystem. It is probable that this concept is a myth, that we have simply not learned to recognize insidious, chronic effects. Odum (1970) mentions some of these with respect to estuaries. A "no release" goal for pollutants is to be highly recommended, even though difficult to achieve.

5. Site specificity. It is difficult to generalize management to cover all cases, from areas where maintenance of water quality is paramount for the maintenance of productivity, to areas where parks are established for tourism or where sanctuaries are established for species preservation. It is also difficult to extrapolate between the preservation of small representative or unique

habitats and the large, systems-oriented Biosphere Reserves proposed by MAB and it is difficult to establish guidelines for the management of biologically similar areas which are subject to quite different political systems. Reserves should usually be set aside in perpetuity, but it is also desirable to establish reserves of a short-term nature where, for example, restoration and later use are contemplated. Reserves may be exclusive of any use by man or merely be areas wherein certain administrative guidelines are employed, for example, the prohibition of shell and coral collecting in Kenya's marine reserves. So it is essential that the function of the reserves be made absolutely clear and that management proceed accordingly within both general principles and site-specific requirements.

6. Stewardship. Beaches move according to coastal currents and the impact of storms, and mangrove and marshes are highly transitory interfaces. In both cases, changes occur within human lifetimes such that serious jurisdictional and legal problems arise when the protected areas themselves move and undergo successional changes. How does one protect such dynamic processes in a world which seeks to stabilize habitats and boundaries? Purchase may prove so difficult and costly that perhaps it is useful to consider not the geographic boundaries involved in "ownership" or precise jurisdictional delegation, as reserves imply, but to turn our attention to "stewardship". This involves a highly imaginative approach to "reserves" and the solution of jurisdictional conflicts in unique new ways. The Coastal Zone Workshop (Ketchum, ed., 1973) identified some of these in the following categories:

(a) Alternative means for regulation of coastal development besides the taking of private property (easements and the like).

(b) Improvement of statutes and administrative regulation.

(c) Increased access of all to administrative and judicial proceedings.

(d) Establishment of local review boards for review of decisions.

(e) Establishment within the judiciary of an Environmental Court with broad jurisdiction.

7. Public disclosure. This is, in most circumstances, to be highly recommended in all cases involving coastal development. However, some areas are so isolated, with difficult accessibility, as to qualify as "natural reserves" without protective measures being taken. Advertisement of their existence can, in some cases, precipitate exploitation, and care must be taken in disclosure of some of the best areas, especially reefs, in advance of their protection and specification of enforcement procedures.

8. Regional agreements. For a majority of marine and coastal areas, downstream effects involve the necessity for regional, international approaches to conservation. Such should be incorporated from the start, particularly with regard to pollution control and resource exploitation, but in areas where this is presently impossible, it remains an eventual goal.

9. Cultural and traditional values. This exceedingly difficult matter has been discussed above under Ecodevelopment (p. 16). The incorporation of such values into habitat preservation in a changing world involves the most careful, detailed, and sensitive consideration which must, however, be interpreted so as to avoid ecological compromise.

ECOLOGICAL APPROACH TO PLANNING

Marine and coastal conservation must proceed from a knowledge of marine ecosystems and their interfaces with the land. Such knowledge must derive from studies of processes under the controlled conditions possible mostly in reserves established for the purpose. There is simply no substitute, either in conservation or "enlightened" exploitation, for the comprehension of ecosystem processes if man wishes to maintain the productivity and integrity of the seas while he uses them. Thus, marine reserves should, wherever possible, incorporate research as a major objective. In addition, "planners" must incorporate a broader ecological base into their work.

Strategy

We cannot await detailed study before taking strong and definitive action! Therefore, the following suggests a series of practical steps, not necessarily to be taken in the precise order given, for the initiation of coastal and marine conservation, emphasizing biosphere reserves, on national and international levels. Steps 1-5 should be taken quickly. Step 6 is long-term.

1. Survey. The Classification Scheme (Ray, 1975) may be used as a background on the basis that habitat survey is reflective of ecosystem processes. The initial survey thus should include a summary of habitats and community structure within the survey area. It also should include a catalogue of perturbations so that it may serve to prioritize conservation action. This survey is to be a relatively brief collection of existing and/or easily acquired information. It should be as comprehensive of whole coastal systems as possible and should attempt to identify natural units irrespective of political or legal boundaries. It should also identify people and logistics essential to the following steps.

2. Selection. Critical areas inclusive of all habitat types may now be designated according to agreed criteria (see below). Priorities must be worked out, designating the most critical areas, i.e. those which are not negotiable in ecological terms. Also to be included are cultural and educational criteria, as their application will identify areas possibly not "critical" in the ecological sense, but also worthy of protection.

3. Description. Selected critical areas should be described in a computer-compatible form (see Area Description below). Area purposes should be identified, at least preliminarily.

4. Management Recommendations. The above steps should result in a concise and implementable report delineating both critical habitats and recommendations for coastal system conservation and management. The Guidelines below may serve as an outline of subjects to be covered. A zonation scheme for use of the coastal and marine environment should be included.

5. Implementation. Authorities must put a coastal and marine conservation plan into action, either by executive action or enabling legislation. Both approaches usually are required as, for instance, executive action for the immediate protection of certain most critical areas or to cause cessation of harmful practices, followed by more detailed, programmatic national legislation.

6. Detailed Research and Management Refinement. An implementation programme will lead to the necessity to evolve detailed site specific guidelines and a research and monitoring programme. Research must be dedicated to the mitigation of man's perturbations, to restoration, and to the development and management of parks and reserves. Such a study must not omit socio-economic issues, but the major thrust still must be ecocentric. Thus, the investigation of the scientific basis for natural area and ecosystem preservation must include man, but it must not tread in fear of socio-economic and traditional policies and practices which clearly pose threats. The practical side of this question concerns the high priority effort towards the discovery of the legal and financial means by which preservation may be achieved. Research and management should be carried out so that feed-backs are generated leading to: (a) the formulation of new management policy based on the latest research results, and (b) the posing of new questions to the research community. The long-term nature of research and management, directed towards social adjustments, is to be emphasized!

Criteria for Selection

The Classification Scheme (Ray, 1975) should be used as a primary reference for the development of a system of reserves which shall be inclusive of habitat types and reflective of ecosystem processes. Included in this effort, we ask: "How inclusive of habitat types are existing reserves; what are existing management practices; how effective is present protection; and what among those habitats not already protected are suitable for preservation?". This leads immediately to the need for detailed criteria for further selection and for determination of reserve function.

Criteria may be used in at least two ways. First, they may be used to judge the quality or applicability of areas to fit the requirements and functions of reserves and, second, they may be used to determine priorities for the most suitable sites within a series of candidates. In either case, we should be careful not to pick only the single most qualified or few top candidates for at least two reasons. Foremost, we must incorporate considerable redundancy in a reserve system and, secondly, no two areas are precisely alike. The latter point involves a distinction between what is "representative" and what is "unique".

The various criteria should not be applied with equal priority to all candidate areas for the simple reason that area characteristics and functions will be quite different. It should also be obvious that the priorities will shift according to the purposes for which a reserve is to be used. A good deal of judgement in their aplication is necessary. The following is a list of criteria mostly derived from several sources (cf. Cronin, ed., 1974; UNESCO, 1974; James Dobbin, pers. comm.). The criteria are here arranged in three sets. Significant in its absence is a set of criteria pertaining to ecosystem man and eco-development, a set which possibly could be drawn from the three sets presented.

A. Set 1 - Ecological criteria

1. Criticalness. The degree to which important life stages or entire life histories of species are dependent on an area is an important criterion. Obvious cases are areas where rare or endangered species are present. Others include the feeding, resting, or breeding areas essential to marine reptiles,

birds, or mammals. Examples are: Laguna Ojo de Liebre (Scammon's Lagoon), Mexico, for calving of Gray whales, *Eschrictius robustus*; Round Island, Alaska, as summer habitat of walrus, *Odobenus rosmarus*; the many essential feeding areas for shore birds and Sirenia; the many nursery areas used by fishes. In emphasizing these critical areas, we must not forget those of a different sort, i.e., those which are critical in terms of production or other processes. Thus, sea grass beds and mangrove swamps are critical areas for detritus production and for nutrient conversion to other production such as fisheries and coral reefs. That is, not only must the endangered, rare, aesthetically important species be considered but we must also give increased attention to species of trophic significance, areas where processes are best exemplified, and upstream and downstream areas.

2. Representativeness and/or uniqueness. These two terms can be the extremes of a spectrum. A "unique" area is one that is rare, whereas areas which are representative fit well into the classification scheme, i.e., they are typical of biome or habitat types as they may exemplify processes, transition zones, ecotones, or subclimax situations of either undisturbed nature, or of interactions between man and nature such that some comparability between example areas is evident. On the other hand, unique areas (as the Puerto Rico Trench) can also be representative (oceanic trenches). In either case, unique areas, i.e., rare habitat or process examples, naturally rank high in priority as they are "one-of-a-kind". However, exemplary areas, i.e., the "best" sample areas among many representatives, rank equally high. In either case, extrapolation of the nature of ecosystem properties and processes to other areas should be attempted.

3. Diversity. This criterion often influences the size of the area to be preserved. It means the inclusion of several habitat types, successional stages, and biotic associations, such as lagoons, estuaries, various benthic types, associated river drainages, etc., within a single reserve. Whereas diversity shall have high priority, its lack should not mitigate against inclusion as certain areas are by their nature (mangroves, sea grass flats, etc.) not as diverse as others.

4. Naturalness. This is related to the degree of perturbation by man and, again, loss of naturalness should not mitigate against inclusion so long as some degree of restoration is possible. Care should be taken to include subclimax and transition zones and other areas which undergo natural change subsequent to natural disasters or perturbation. Care must be taken that "naturalness" does not exclude man's use. Semi-"natural" systems which have become stable under long established use practices may be included. Naturalness should not come to mean "degraded", however.

5. Natural Unit: Size and buffer zone compatibility. Areas to be preserved should be sufficiently large or buffered to allow natural dynamic change, biological or physical; that is, in so far as possible, "natural units" should have high priority. In case a buffer area is involved to incorporate this objective, its use and properties must be compatible with the core reserve area. In effect, size or extent shall be such than an effective conservation unit, biologically speaking, is created; i.e., what has been called the viability, defensibility, or integrity of the reserve may be maintained. In the case of marine and estuarine

systems, this inevitably involves the difficult problem of mitigating upstream effects, whether generated from land, river, or sea. Hence buffer zone compatibility ranks especially high in these environments.

6. Inclusiveness. The lack of a habitat type in a reserve system is a strong argument for finding one or more to include. In some cases, undisturbed habitat types will not be available for protection or such sites will no longer be extant. Potential sites for restoration should be sought so that the reserve system shall be inclusive of all present or potential habitat types.

B. Set 2 - Cultural, Recreational, and Educational Criteria

1. Diversity and abundance. These relate to qualities of the species and/or habitats within the area. Values are interchangeable; for example, the great diversity of life of a coral reef ranks as a prime criterion, but the abundance of few species of schooling fishes in channels, estuaries, or swamps may rank just as high in other areas. When both abundance and diversity occur together, the area will have a very high priority from the point of view of the public.

2. Physiography and topography. Just as for terrestrial areas, these are important criteria. The scope and grandeur of a scenic area especially in coastal or reef locations, contribute greatly to its value to the public. Scope and grandeur should, however, not be confused with size. Small areas have a grandeur of their own. This is obviously a matter involved with personal taste.

3. Uniqueness and rarity. The public is much attracted to one-of-a-kind locations and high priority should be attached to them.

4. Climate, weather and oceanographic conditions. Especially in marine areas, access is greatly influenced by these factors. Some areas, in fact, are rendered of relatively low use to the public because of difficult tidal or current conditions, low water visibility, frequent storms, high sea state, and low water or air temperatures. However, these features all fall into the category of "amenities". Such difficulties should not necessarily mitigate against inclusion, but they do often involve certain stringent safety regulations being imposed.

5. Cultural value. Sites of obvious aesthetic, historical, archaeological, anthropological, traditional, subsistence, or folklore value rank very high. These range in size from small areas wherein a shipwreck is protected, to a village or city now covered by the sea, to very large areas where traditional and/or subsistence activities of a whole people are currently carried out.

6. Scientific value. There are scientific values which bear little present relationship to pragmatism, but which are among the most important of all human values, as they relate to man's essential being. Asking "what good is science?" is like asking "what good is art?". Areas of scientific value, in terms of basic research, should rank very high, from the obvious cases of the Galapagos Islands and Aldabra, with their surrounding waters, to research or other localities of more local interest.

C. Set 3 - Pragmatic criteria

1. Value for research or monitoring. Reserves are an important source for study related to direct human use and high priority should be given to scientists' use now and in the future. This will depend on at least three factors; high scientific interest, past history of scientific research, and proximity to a user group of scientists which will monitor the area, use it for education, and transfer the information gained to the community at large as well as to management agencies. Lack of present use by scientists should not mitigate against this value.

2. Degree of threat or fragility. Remote environments will not rank as high in priority as those close to possible perturbations of man. Also, areas which are highly fragile should be considered first.

3. Feasibility. Is the site available? Can it be properly financed, managed, and brought under the jurisdiction of a stable agency with proper organic powers? If the site is potentially valuable, can it be restored? Such questions are central to the suitability of areas as reserves.

4. Redundancy. Care must be exercised not to exclude areas with the statement: "We already have one of those!" Redundancy is important in the establishment of a reserve system and is essential from the genetic and ecological points of view.

5. National or international value. The Galapagos Islands is an example of an area of obvious international importance. Aldabra and the Bering Sea and Laguna Ojo de Liebre (Scammon's Lagoon) are others. Marine and estuarine areas should rank high in priority as reserve candidates because of their contribution to international fisheries production and as habitat for migratory waterfowl, for instance.

6. Educational, recreational and economic value. Tourist value is often extremely important in economic terms. However, recreation is not always in accord with the "conforming use" principle. Deleterious effects often result to stress reserves beyond their carrying capacity (Second World Conference on National Parks, 1972) when purely recreational values are placed above ecological ones, i.e., when such areas are "developed" rather than properly managed. Education also emphasizes the public as a user group, but generally more care is taken to preserve natural values than when emphasis is purely on tourism. Both tourism and education require facility development, requiring usually land-based access, and precise knowledge of costs and how development may alter the habitats preserved.

Area Description

There are several stages in this process from the most preliminary and short-range to the long-range, scientifically detailed matrix of data necessary to develop precise guidelines for management and monitoring. Obviously, the first step is the simple process of listing candidate areas. The next step is that which we shall consider here, that is, the assembly of available information in a computer-compatible format which allows concise information transfer on a world scale and which allows planning of later detailed survey necessary for protection and management.

Very often, reserves of large size, especially "natural" ones, will not be in proximity to "experts" who will be able to develop management guidelines, much less to maintain a long-range scientific programme. It is part of the educational process to train such personnel and to develop such programmes for this purpose. Therefore, after an area has been identified as having value or interest, facts of a very basic nature must be gathered as a prelude to the relatively detailed survey which will produce further information necessary for the recommendations that the area be set up as a reserve, and if so, when and how. It is suggested that this fact sheet include the following information:

1. Name of area.
2. Geographical location (nation, province, state district, etc.).
3. Latitude, longitude (supply map or chart).
4. Surface area (in square kilometres or hectares).
5. Type (from Classification Scheme code, i.e., zoogeographic and biotic, with habitats and relationship to coastal, terrestrial province specified).
6. Description should note:
   (a) Physical features - including water depths.
   (b) Dominant biota (ecologically).
   (c) Special scientific recreational or other interest.
7. Conservation status, degree of naturalness, degree and nature of threat (if any) and present jurisdiction(s) or ownership.
8. Character and use of contiguous land or sea areas emphasizing effectiveness as buffer areas.
9. Proposed purpose or present use of area, including suggested zoning, if any.
10. Knowledgeable contacts.
11. References to literature, both scientific and popular.

This description list is closely in accord with IUCN's World Directory of National Parks and Other Protected Areas (IUCN, 1975). It is essential that there be compatibility of descriptions so that computerization of data be possible. Darnell et al. (1974) give a model for such a system and point out the advantages that accrue through computer query. Answers to the following sorts of questions are obtainable.

1. What habitats are in any geographic area?
2. What areas are protected for a certain biotic province or habitat?
3. What is the state of research for a particular habitat type - i.e., printed publications or work in progress?
4. Search for key words: i.e., algal reef, manatee, detritus, organochlorine, etc.
5. Which areas are in ownership, stewardship, or controlled by administrative authority only?
6. What areas are most endangered?

Thus, a purpose for description is to enable the integration of a world-wide system. In no other way can marine ecosystems be comprehensively treated.

SUMMARY GUIDELINES FOR PROTECTION

The remainder of this paper summarizes specific matters which should be considered in marine habitat conservation. They may be used in at least two ways: first, to guide surveys and studies; second, to guide implementation. Each of the topics summarily treated below is complex in itself. Therefore, it is to be hoped that the following will be recognised as a matrix only and that site-specific flexibility will be required. Indeed, this is a "bare-bones" outline; each topic could - and should - become the topic of a detailed workshop related to site-specific issues and realities. Also, the guidelines represent a goal which may take some time to achieve.

These guidelines have been drawn from many sources, some of which have already been cited. More references of major importance to what follows are given in the Additional Bibliography (not included are references to the many survey reports directed towards marine parks). The structure below is from the general to the specific, not to imply a rigidity of approach. Thus, enabling legislation is considered first, parks and reserves last, but it could just as well be approached the other way around.

Enabling Legislation and Structure

The larger goal of legislation should be to encodify a zonation of the entire coastal zone, including land areas, drainage systems, estuaries, lagoons, and continental shelf. It should follow the initial survey and establish a policy for coastal development and preservation on an interdisciplinary and interdepartmental basis. Rarely can this derive from existing governmental bodies, i.e., tourism, fisheries, educational or parks departments, which are not generally mandated to manage the large problems involved, but which all have major interests. Enabling legislation must establish baselines for long-term financial and administrative control with an administration sensitive to the needs of land and water management as well as to those of educational, research, and public institutions.

A. Policy includes:

1. Wise use of marine, estuarine, wetland and upland areas;
2. Maintenance of natural ecosystems;
3. Provision of resources for the people;
4. Increasing the carrying capacity of the coastal zone through technical and managerial means;
5. Restoration of damaged environments; and
6. Clear evaluation of the burden of proof of deleterious actions, with identifiable liability.

B. "Central Authority":

A "central authority" should carry out the policy. It is essential that this authority coordinate the activities of all government and non-government agencies with important interests, most notably departments involved with fisheries, coastal zone development, conservation, national parks, tourism, and enforcement. Educational institutions and fisheries or conservation departments should cooperate on research. Public and private conservation or other interest groups should be included in an "advisory panel" (see C below) to contribute their expertise to an integrated policy. Policy should be subject to constant review and deliberations should be made public. The Central Authority may be a single government agency or coordinate several agencies. It should be empowered to:

1. Review existing information and activities in order to take immediate action on: selected areas having unique ecological character; wetlands and estuaries containing highly productive habitats, spawning areas or nurseries, or rare and endangered species; and coastal activities that will affect diversity and productivity of the ecosystem;
2. Initiate computer-compatible descriptions of areas, with the aid of a data-retrieval system;
3. Set up appropriate management guidelines;
4. Certify activities, by means of permits, licences, or authorizations and ascertain that activities are consistent with the purposes of the permit;
5. Initiate and administer research grants or contracts;
6. Record use and monitor system changes;
7. Maintain a consultative process to coordinate the interests of various departments and agencies, including management of fisheries resources, cultural resources, education and research, and those having responsibility for national security, transportation, and exploitation of mineral resources;
8. Establish public relations and increase public awareness by means of audio-visual or other materials, such as: illustrated pamphlet with boundaries and regulations for reserves noted; guidebooks; file and slide series of sample habitats and of man's use of these systems;
9. Provide for ranger and guide training; and
10. Recommend international agreements as necessary for protection of water quality or non-resident species.

C. "Advisory Panel":

Should be structured as a "scientific committee" and comprised mostly of, but not dominated by, ecologically-oriented scientists. Thus, it must include public interest groups (not special-interest groups, i.e., lobbyists) and, especially, environmental lawyers and land-use planners. The panel has the following functions:

1. Consults on long-term goals and policies;
2. Evolves model guidelines;
3. Determines research needs and reviews research proposals;
4. Provides for scientific evaluation, surveillance and enforcement;
5. Recommends an interpretative programme for public understanding;
6. Recommends specific functions for each reserve;
7. Recommends a management programme;
8. Helps government design the national programme;
9. Advises on regional problems; and
10. Aids in the development of innovative approaches, including new scientific, legal, and social methods and institutions.

D. Permits:

A permit or licence system for coastal activities should be put into effect and subject to periodic review. One should always carefully examine the need for paper work, but man's effects are so numerous that there is probably no alternative other than to consider most of his actions subject to review and permit procedures which may require both environmental and cultural impact statements. Statements and permits include:

1. Established need for proposed action;
2. The effect on human health and welfare, ecologically, economically, aesthetically, and recreationally;
3. The impact on traditional or subsistence-oriented life styles;
4. The effect of the action on fisheries, research activities, resources, plankton, fish, shellfish, other wildlife, shorelines, beaches, and marine ecosystems;
5. The persistence of the effect on the marine environment;
6. The most appropriate location for the action;
7. Special provisions, as monitoring the action and surveillance of the action; and
8. Fees.

E. Enforcement:

Enforcement will usually already exist in a multiplicity of agencies. The purpose is to coordinate and amplify these functions and it may also prove advantageous to set up a separate enforcement body under the "Authority". The nature of enforcement and the character and extent of punishment will vary according to local law and tradition.

Some of the problems to be faced are:

1. Jurisdictional:

   a. Conduct of citizens outside the country's territorial limits should be the same as that regulated by national law within national boundaries;
   b. Law of the sea, wherein many problems are currently unresolved, two of the most difficult being the protection of fisheries on the ocean "commons", and the implications of coastal development and pollution on oceanic productivity;
   c. Common property resource policy vs. resources subject to claim and ownership; and
   d. The confused legal situation with regard to delineation of agency duties and authorities in the coastal zone and territorial waters.

2. Public hearing and testimony:

   It is expected that the "Authority" will conduct hearings leading to recommendation of enforcement and penalties.

3. Penalties:

These must be substantial to be a real deterrent to violation. Close cooperation of the courts, notices of violation, and sufficient penalties are mandatory. Each violation must be treated separately. A highly recommended penalty is confiscation of boat or other equipment and/or suspension of licences. Nature of the penalty will vary according to, among other things:

a. whether the offence is civil or criminal;

b. whether the offender is commercial or private;

c. whether the offender is utilizing subsistence or traditional methods; and

d. the income level and capital investment of the offender.

Zonation, Research and Monitoring

Research is not a luxury, but is at the heart of any programme, whether for preservation or development, as it is essential to the development of a workable zonation scheme and to management and planning efforts. We have stressed the roles of a classification scheme and predictive models to aid in understanding the effect of man's activities upon the coastal and marine environment. A survey of coastal resources is essential to long-range ecological stability and must elucidate demographic patterns, ownership and land-use, and socio-economic data. These contribute to baselines of knowledge and lead to environmental and cultural impact statements for development schemes, such as the siting, construction and operation of industrial plants, harbour development, and the dredging and deposition of spoil.

A. Evolution of a plan for zonation and ecosystem protection. Initial surveys should establish land and water use practices in accordance with the nature of coastal systems, taking cognizance of socio-economic and other current practices, but also identifying those practices in need of cessation and/or modification. Research and monitoring will undoubtedly make alterations in this initial plan mandatory, and probably more restrictive. Randall (1969) emphasizes that prime research areas in the vicinity of coastal research stations should be protected. The nature of dynamic aquatic systems dictates that zonation be equally dynamic. Generally the following types of zones will initially be necessary:

1. Developed zones are those which are already developed to such an extent that they are almost completely man-dominated and have lost most semblance to the natural state, for example, cities, airports, industrial complexes, etc. The major emphasis should be on pollution abatement and restoration.

2. Conservation zones are those intermediate between 1 and 3, that is where careful planning can guide development within environmental guidelines.

3. Protection zones are "natural areas" such as:

a. critical areas in need of immediate protection;

b. formerly productive areas in need of restoration;

c. research areas;

d. recreational areas; and

e. buffer zones.

Boundaries between these zones are highly artificial and ideally the goal should be compatibility between environmental processes and man's activities throughout the entire coastal zone and adjacent sea. Research and monitoring, in any case, must play the primary role in determining this course of events.

Results of research must be capable of altering the course of man's actions and this capability should be clearly stated in the enabling legislation. This may be one of the most difficult of matters as most governments have shown little ability to plan for crisis, no matter how predictable, and society shows little desire to alter its ways, no matter how deleterious. In these regards, a systems model is useful in the following ways as Ketchum, Ed., (1972) states: first, it brings orderly criteria evaluation into management practice; second, it develops common concepts, measures, and languages; third, it brings to authorities a knowledge of natural environmental processes, institutions, and activities for complex decisions; and, fourth, it trains professionals and others to higher scientific awareness for greater competence in management.

B. Research needs

These must be long range. A primary need is to identify functional groups of organisms, that is those which process organic matter or which are important in the recycling process. Research should include such important topics as:

1. Ecological factors:

a. Role of nutrients and trace elements in ecosystem function and their recycling;

b. The relationship between nutrients, pollutant loads, and primary productivity to recreational and aesthetic use of water;

c. Information on the chemical characteristics of the systems involved;

d. Information on the physical characteristics of systems involved, especially hydrology, current structure, and geomorphological shore processes;

e. Information on the distribution and abundance of species at all trophic levels and their normal variations, emphasizing endangered species and those critical to the system;

f. Description of community structure with emphasis on natural rates of recovery from perturbation and natural successional change;

g. Studies on the nature of diversity and stability, especially the effects of predation in maintaining stability and the relationships between stability and successional change;

h. Studies on successional change;

i. Studies on processes of restoration;

j. Natural history of endangered species;

k. Nature of food chains and webs;

l. Horizontal and vertical migrations of constituent organisms;

m. The influence of climate and weather on living and non-living components;

n. Indicator species for water quality or environmental monitoring; and

o. "Assimilative capacity" (see p. 27-28) for wastes, i.e., in which organisms or physically where pollutants are accumulated and how they may be recycled.

2. Social factors:
These are essential and should lead to development of cultural impact assessments. Complex issues are involved which will not be considered here in greater detail (see Ecodevelopment, pp. 16-18).

3. Factors important for public health:

a. Surveillance of contamination input levels;

b. Effects of solid waste disposal;

c. Effects of contaminants on organisms and ecosystems;

d. Epidemiologic and virologic studies;

e. Accumulated effect on organisms of sublethal pollutant levels;

f. Effects on man and other "top" carnivores from eating these organisms; and

g. Water quality as it relates to ear, nose, and throat infections, or other public health considerations.

4. Techniques for increasing productivity and production:

a. Restoration of damaged environments;

b. Environmental enhancement, that is, increased carrying capacity of the environment for certain species under natural conditions;

c. Aquaculture and increased production of certain species for commercial utilization; and

d. Artificial reefs to increase the habitat of reef-dwelling species.

5. Factors related to industrial activities:

a. Bioassay methods for potential toxicants, including both lethal and chronic effects;

b. Identification of biological productivity inhibitors;

c. Released nutrients and/or pollutants from resuspension of bottom sediments;

d. Causes of nuisance algae and aquatic weed growth;

e. Flushing times of receiving waters;

f. Predicting fate and extent of warm water plumes;

g. Long term rate evaluation of biological, chemical and geological modifications;

h. Effects of sea water on organic and inorganic chemicals; and

i. Possible synergistic effects between wastes, as that between oil and oil-soluble organochlorines.

6. Factors related to the carrying capacity of reserves for human activity:

a. Environmental quality vs. recreational use, i.e., effects of recreation on biota or communities;

b. Impact of multiple recreational use on the environment;

c. Determination of probabilities of transmission of disease through recreational water contact; and

d. Influence of climate, weather and accessibility on numbers of human visitors.

C. Methods of analysis

Very often it is both instructive and practical to use a modelling approach which expresses the matrix of flows between man and his environment, producer and consumer, donor and receiver, and receiver and user. Models may be heuristic, stochastic, or deterministic and are especially useful in analyses of more than one variable or as a research tool, i.e., as a matter for validation and subsequent improvement. Rarely, however, is it wise to derive precision from models of entire marine systems. It is best to use models for:

1. Methods of analysis of environmental variables;

2. Information storage and retrieval;

3. Prediction of productivity and energy flow, nutrient cycling, diversity, recovery of ecosystems, and other process studies;

4. Establishing the periodicity of water quality analysis tests or other survey methods;

5. Evaluating user impact and use;

6. Evaluating consequences of pollution or other alterations to the environment; and

7. Analysing the dynamics of populations.

D. Monitoring

This must be on a systems level. The most important tool is the predictive ecological model in which data acquired from monitoring lead to its continual validation and improvement. Previous indices of diversity, involving analyses of single groups such as algae or diatoms to determine health of systems are no longer ecologically acceptable as there is no proven relationship between such diversity and stability. For example, natural successional change and the relative youth of some ecosystems strongly influence diversity and stability. Monitoring involves long term endeavours such as baseline surveys for the continuous collection of chemical, physical, and biological data. Great care must be taken to select "critical" or "indicator" factors, i.e., those "most sensitive species" and/or processes which relate directly to the predictive ecological model. Selection of such species and/or processes is a most difficult matter, however.

Tests of effects of various chemicals, natural or manmade, on organisms must not consider only lethal effects. Sublethal or chronic effects are ecologically more meaningful and must be determined and monitored.

Monitoring must take place both within controlled areas such as reserves and areas where perturbation is taking place in order that baseline data and data of perturbation be gathered and compared. It must involve:

1. Use of the most up-to-date methods, such as remote sensing of environments and telemetry and radio-tracking of large organisms;
2. Uniform sampling procedures;
3. Methods for long term effects on community structure and productivity;
4. Methods for quantitative description of biomass;
5. Methods for monitoring biostimulants;
6. Identifying criteria for waste discharges;
7. Development of methods for location, quantification and classification of heavy metals and other materials of acute or chronic toxicity;
8. Quantification and classification of persistent organisms;
9. Review of methods for detecting foreign materials; and
10. Quantification of floatable matter and films.

Maintenance of Environmental Quality

Coastal development and man's other activities need not be in conflict with the maintenance of environmental quality. However, it has been the practice to externalize the costs of these activities, often based upon acceptance of estimates of the "assimilative capacity" of the environment or what a "significant effect" may be (see p. 27-8).

A. Ocean dumping

The eventual goal should be an end to this practice and research and management criteria are needed towards that goal. Current international agreements prohibit dumping of such dangerous materials as high level radioactive wastes and agents for chemical or biological warfare. We are now aware that some "remote" areas such as oceanic trenches, fjords, and the abyssal ocean are biologically of great interest and value and the threat to them by dumping should be removed. It is necessary to establish more detailed baselines for:

1. The types of material to be dumped and the amount;
2. The location with stated alternatives;
3. The length of time dumping will be carried out; and
4. International complications.

B. Pollution and waste treatment

This differs from dumping mainly in that the site is usually close to the shore and that some alteration of material usually occurs before it is discarded. Effluents may be released continuously or "pulsed". The goal should be the cessation of all effluents containing known or suspected deleterious materials, either because of their toxicity or their nutritive (eutrophic) potential. Research is needed to design systems of treatment which are tailored to preserve the specific receiving waters. Design of systems should be by cooperation between ecologists and engineers, a feature usually sadly lacking! Detailed attention needs to be paid to the chemistry of the effluent, its physical and biological dispersion in the environment and physical or biological effects. For instance, more consideration must be given to:

1. "Point" or site-specific effects vs. dilution;
2. Synergistic effects;
3. Nutrient chemistry and biochemical changes;
4. The chemistry of receiving waters;
5. Current dynamics and basin topography of receiving water;
6. Prohibition of any material that combines the properties of mobility, chemical stability, low solubility in water, and high solubility in lipids;
7. Elimination of pesticides and heavy metals;
8. Trace elements in water and sediment;
9. Concentration of trace elements in organisms, especially amplification through food chains and food webs;
10. Control of thermal plumes;
11. Multiple jet diffusers;
12. Lateral spreading of wastes; and
13. Flows of suddenly released sinking sludge.

Continuous monitoring of the effluent within biotic communities should lead to modification of the nature and amount of released materials. For example, sewage systems might have to be altered for use of saline water. Vessels and small boats should not be exempt from restrictions on the dumping of sewage and other wastes, and the use of holding tanks with shore facilities for waste and oil disposal should be required.

C. Mineral extraction and dredging

Mineral extraction is in many cases equivalent to strip mining on land as it destroys the benthic surface, that is, the area where organisms are concentrated. Dredging usually occurs close inshore or in waters especially subject to siltation. Disturbance to the benthos has many severe effects. Excessive siltation kills coral reefs and can also reduce light needed by rooted aquatic vegetation. Exploitation for oil and gas may be much less deleterious in that only a small portion of the benthos is disturbed (nevertheless the possibility of oil pollution poses perhaps the most severe threat to shallow water environments).

A particularly severe effect of dredging, or mineral extraction in polluted areas, is the sudden release of pollutants from the sediments. Dangerous materials such as pesticides and heavy metals commonly accumulate in the anoxic sediments which lie beneath a thin surface of silt. Their sudden release can result in fish kills or other severe consequences.

D. Coastal development

This is among the most insidious and damaging activities of man, amplified by the fact of the extreme attractiveness of coasts for human habitation.

Shoreline, particularly, is subject to damage due to its extreme dynamism. Attempts at shoreline stabilization usually fail and lead to destruction of aesthetic qualities and to high maintenance costs. Inman and Brush (1973) eloquently describe "the coastal challenge", pointing to the futility of man's attempts to stabilize shore processes. Only one of their facts need be repeated here, that a wave 3m high transmits energy at the rate of 100 kw/m of the crest line, equivalent to a solid line of 270 Hp automobiles moving at full throttle! Such a fact points to a reason for failure of engineers and shore developers to "control" shore processes. Dolan and Hayden (1974) state the new U.S. Park Service policy of adjusting to, not controlling, shore processes. Previous control attempts have swallowed $20 million in Cape Hatteras National Seashore alone since the 1930s. The foregoing has led to the adoption of new procedures. "Set back lines" should be established, seaward of which no construction should occur. Jetties should be of open construction so as not appreciably to slow longshore currents. Groins are to be avoided. Damming of rivers and streams severely slows the deposition of both minerals and nutrients in the coastal zone and care must be taken that this is not excessive. Forestry, mining, and agriculture should not be practised near streams and rivers so that rates of flooding and siltation are not increased (for a history of the siltation of San Francisco Bay, see Pestrong, 1974, and for a description of the effect of land clearing on estuaries, see p. 10. Existing channels should be utilized for access to harbours rather than opening new ones. Cognizance must be taken of coastal circulation cells in planning for development which involves either alteration of shoreline or waste outfalls. Estuaries, marshes, and lagoons are "filters" (for both nutrients and pollutants) between land and sea, and if access through them is necessary, an offshore barrier of rooted vegetation should be provided beyond the channel.

In coastal development, the following should also be noted:

1. Adequate circulation in waterways, such as canals and marinas, with short residence time for water is mandatory;

2. One method of protecting the water line back of a "set back line" is a "coastal interceptor waterway" (Tabb and Heald, 1973) which preserves surface water sheet flow across coastal marshes and shores;

3. Development should emphasize highlands, not low coastal marshy areas, or low energy shores; and

4. Clark (1974) identifies many other effects, such as runoff as a consequence of development and agriculture, the effects of construction site preparation, pest and mosquito control, and residential development. Great care must be taken to thoroughly examine the inter-relationships of these actions in the preservation of our coasts and associated ecosystems.

Fisheries Research and Management

This is a large and complex, as well as highly controversial, subject of which only a few relevant features will be treated here. Below are mentioned matters of broader policy. The next section on Marine Reserves considers some additional fisheries matters (p. 49).

The essential point is the sharp contrast between freshwater and saltwater fishing as far as management is concerned. The former is sharply controlled and the latter hardly controlled at all, despite clear evidence of need in many quarters (most notably, high seas sport fishing for marlin, other billfish, and tuna, and the very destructive inshore reef fisheries of many nations). There is probably no fundamental difference between fresh and saltwater fishing other than a matter of scale. In any case, research and management must emphasize sustainably yield and should be dedicated to the following:

a. Licensing of all fishermen, the fees to be returned to research, management, and enforcement;

b. Establishment of game and non-game species in which only game species are allowed to be taken;

c. Establishment of season, bag, and possession limits on game species;

d. Establishment of zonation for various fishing activities;

e. Resolution of conflicts between fisheries, tourism, and parks;

f. Environmental enhancement, especially artificial reefs; and

g. The merits of limited entry to fishermen.

Management should also recognize fundamental differences between underwater (spear) fishing and surface (hook-and-line) fishing (cf. Barada, 1974). The former is more analogous to hunting and has three deleterious effects: (1) the inducement of fear of man, (2) the reduction in numbers of resident species, and (3) the hazards involved when swimmers, viewers, and hunters cohabit the same environment. Therefore, spear-fishing is completely incompatible with underwater viewing, recreational swimming, and photography. Surface fishing is capable of reducing some fish populations to an equal extent as spear-fishing and can be hazardous to swimmers, but does not induce fish to fear man.

Management of Marine Reserves

This section covers all "reserve" areas (see p. 22-27). Access by people to parks and reserves should be in accordance with conforming use in which protection is paramount. In some cases, human presence must be forbidden, for instance in a colony of animals where human activity would interrupt breeding. In other cases human activity is encouraged, for instance at national seashores emphasizing recreation. In either case, preservation and/or manipulative management (where natural succession might lead to habitat elimination) is paramount in "core" areas.

A. Core vs. buffer
In general, the core is to be left undisturbed and research is to be non-manipulative. Education, research, and recreation are not to alter the values for which the core area is established. Buffer zones are created to protect the core, to provide space

for wide-ranging movements of animals, to provide space for the existence of rare or endangered species or for manipulative research. In some important cases, the buffer may be primarily dedicated towards restoration, protection of naturalness, or understanding of natural processes. Most importantly, buffers must accommodate the shift of the core in cases of biological, ecological, or geomorphological change, for example, the growth of reefs or the movement of beaches. Buffers are usually of the same biome as the core and can usually accommodate manipulative research which should not be carried out in the core. Buffer zones may differ fundamentally from the core by not being under the direct ownership or jurisdiction of the agency which manages the core area. Therefore, control of human activity within the buffer may be through administrative action, easements, or by other means, emphasizing proper stewardship.

B. Land and sea inclusion
Deriving from the above, and the fact that the coastal zone is an ecotone, is the requirement that portions of land, especially watershed and drainage areas, be included in marine reserves. This can be accomplished by a variety of management or legal procedures which will not be detailed here.

C. Boundaries
Boundaries for core areas should encompass entire ecological units (habitats and communities) in so far as possible, including adjacent terrestrial areas. However, for whole ecosystems this will be difficult. Seaward boundaries should include the outermost reef or, for sandy shores, to at least the 20-metre contour line or the territorial limit, especially in areas where deep water is close to the shore. Buffer zones should encompass upstream effects and contiguous ocean water. The buffer area should be large enough to incorporate geomorphological changes which alter shore boundaries. Marking of boundaries should be by means of shore posts and buoys or natural marks, when these are available, and clearly visible. When it is impractical to establish such markers, various distance or depth delineation is required. In such cases problems will arise with regard to policing, requiring that these "invisible lines" be set with as much flexibility as possible. In any case, boundaries must be clearly delineated on all charts, maps, tourism brochures, etc.

D. Legal mechanisms
These will depend upon the enabling legislation. The uses of the coastal zone may fall under a multiplicity of agencies. However, regulation and enforcement within the core should be the responsibility of the "Authority" established under the enabling legislation. The buffer should also fall, if possible, under that "Authority". Obviously, legal mechanisms fall within at least two jurisdictions, the coastal state and law of the sea. The distinction between the two is presently undergoing rapid change, through both multinational and unilateral actions.

E. Multiple use
This may be permitted if no interference with the purpose of the park or reserve is contemplated. Severe threats to core areas may be through mining, dredging, oil and gas exploration or exploitation, and coastal development. In some nations dynamiting of reefs and shell and coral collecting also pose severe threats. However, rights of innocent passage and non-excessive fishing or hunting for migratory species in general pose little threat to core areas.

F. Regulations for protection within marine parks and reserves
These regulations mostly emphasize a series of restrictions which serve to protect living and cultural values. They are applicable in areas emphasizing protection (as National Parks):

1. The taking of any living creature is prohibited;
2. Non-living flotsam and jetsam may be taken from the beach;
3. There should be an admission fee, proceeds going to park research and management. Seasonal tickets should be provided for residents and tourists staying longer than one day;
4. No anchoring should be permitted on reefs. Buoys should be established for this purpose;
5. No person should cut, carve, injure, mutilate, remove, displace or break off any underwater growth or formation;
6. No person should dig in the bottom or in any other way injure or impair the natural beauty of the underwater schene;
7. No person should destroy, molest, remove, deface, displace, or tamper with wrecked and abandoned airborne or water craft or any of its cargo. An exception is dangerous cargo which require removal and safe disposal;
8. No person should molest, kill, wound, capture, frighten, or attempt to molest, kill, wound, capture, or frighten any animal within park boundaries; and
9. Removal of shells from coastal areas of parks in order to build roads or other industrial uses should not be permitted.

G. Regulations for specific recreational use within marine parks and reserves
These regulations will address several activities for which more specific guidelines for management are necessary. They are applicable variably for areas set aside (zoned) for specific uses or regulated in other ways. In either case, approaches to these activities are extremely subject to local needs, law and tradition.

1. Water skiing, underwater viewing and swimming:

   Specific zones should be set aside for these activities. Snorkelling and swimming are compatible with each other, but neither is compatible with water skiing.

2. Boating:

   Private pleasure boats to be used in parks or reserves should be authorized for seaworthiness. Anchoring on reefs should be prohibited and buoys for anchorage be provided in parks and reserves. All boats operating within park boundaries should be licensed, temporarily or permanently, or an entry fee charged.

3. Sportfishing and spear-fishing (see p. 45-6)

   The taking of fish within Parks should not be allowed, but taking in Reserves may be permitted under controlled conditions. The number of individual fish taken by these activities is usually small, with some notable exceptions. However, neither should be conducted in the presence of the other nor in the vicinity of commercial operations, due to the hazards involved. Spear-guns should not be permitted, that is, those operated by means of a trigger mechanism with the aid of elastic springs, or compressed gas. The only allowable spears should be the straight spear or Hawaiian sling, powered by a single elastic, at the most. There exist rare exceptions to this, either more restrictive or more lenient, but such exceptions deserve critical examination.

The taking of fish should not be permitted by the use of underwater breathing apparatus.

Particularly in the case of spear-fishing, regulations on permitted areas, species, season, and possession limits should be established, similarly to terrestrial hunting.

4. SCUBA (Self-Contained Underwater Breathing Apparatus) diving:

These regulations are largely oriented towards the establishment of a safety programme. They may be applied nation-wide, if this is suitable.

a. Only certified divers should be permitted to dive in parks and reserves or those not certified should be required to take a checkout dive;

b. Divers should be registered when in the park or reserve;

c. Diving should take place from registered diving or private boats, and/or within certain areas so zoned for the purpose;

d. Diving should be distant from areas of heavy boating use;

e. Special areas should be set aside for SCUBA-diving, off-limits to other use when the former activity is being conducted;

f. Chartered dive boats should be licensed to operate in parks and reserves. They should fly the diver's flag throughout trips and file a dive plan before departure. They should maintain radio contact with park headquarters throughout their trip. Special docking areas are advantageous;

g. The diver's flag should be exhibited during all dives and divers should stay within 50 m of the flag when at the surface;

h. Other boats should stay beyond 100 yards of a diver's flag;

i. Literature should be made available describing dive sites;

j. If at all possible safety equipment should be accessible, such as both fixed and portable hyperbaric chambers; and

k. An emergency system for search, rescue, and treatment, should be established. Coordination of park or reserve managers, police, and medical and rescue personnel is required.

H. Other activities within marine parks and reserves

The following apply to areas outside reserves as well, but must be given special attention within protected areas:

1. Coral, shell and fish collecting for souvenirs or pets:

Theoretically, these activities are permissible on "sustained yield basis". However, they should never be permitted in core areas. Practically speaking, knowledge of sustained yield and enforcement are both inadequate to regulate these potentially extremely harmful activities. Therefore, collection of coral and shells should be prohibited, even on a nation-wide basis, except in case of permit holders whose activities should be carefully regulated. No living shells, with rare exceptions, should be allowed to be taken and any living coral collection should be permitted only after a review of permit application by the Advisory Panel. The collection of fishes for the aquarium trade should also be subject to review by the Advisory Panel and in no case should collecting methods involve poisoning or destruction of the reefs.

2. Commercial fishing and collection of bait:

Bait gathering on reefs should either be prohibited or carefully controlled on a rotating zone basis, but never allowed in core areas. Commercial fishing must not involve uses of dynamiting or poisoning. Commercial fishing need not be prohibited in channels within reserves where migratory fish are caught, and commercial fishing for resident species should be allowed in reserves only after critical examination of need. The latter falls within general fisheries policy (see p. 45-6).

3. Legal resident recreation, fishing, and bait collection:

Legal residents should have a right to recreation or to earn a livelihood by fishing within designated boundaries of reserves, but not in core areas. However, they too are subject to rules and regulations set up by the "authority" or within fisheries policy. Spear-fishing should not generally be allowed, though traditional, conforming, and non-deleterious spear-fishing may be an exception.

Special recognition must be given to traditional or subsistence privileges. This does not include commercial fishing. Difficult site-specific problems arise over the definitions of "traditional" and "subsistence". From an ecological point of view, in no case should the employment of any method or its expansion because of population increase, threaten habitats or populations, since this is harmful to their own longer-term interests.

4. Charter boat tours:

These should be licensed to operate in parks and reserves. Anchorage sites should be specified, as should the routes for access. A policy of limited entry should be made within the confines of carrying capacity (see p. 41). Anchorage should not be on fragile reef areas and buoys should be provided for this purpose. Boat operators may be designated as rangers or wardens so as best to take advantage of their own interest in preservation of the area.

5. Underwater structures and vehicles:

There is a great range of technology, either existent or in planning, which enables an increased number of persons, such as non-swimmers and tour groups, quickly and easily to view underwater life. However, in many cases, this involves serious perturbation to and destruction of underwater habitat.

All such plans should be carefully examined for impact and the ability of the environment to withstand the technology and to recuperate.

6. Aquaculture:

This activity is heavily dependent upon maintenance of good water quality. It has vast potential in lesser developed and industrialized nations alike, but pollution poses serious problems for the latter. It is not generally recognized that aquaculture has potential pollution and other adverse effects itself. Odum (1974) points some out. They include: organic effluents from hatcheries, sedimentation from raft culture, toxic chemicals and to control algae or disease, physical alterations of the environment, removal of naturally productive estuaries from the ecosystem, introduction of exotics, eutrophic effects, and alterations of temperature or water flow patterns. The creation of artificial habitat is related to this subject and has been reviewed by Carlisle, Turner and Ebert (1964).

It is appropriate to create reserves for aquaculture, but this activity should not be permitted in most core areas.

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SOUTH PACIFIC COMMISSION

AND

INTERNATIONAL UNION FOR CONSERVATION OF NATURE

AND NATURAL RESOURCES

SECOND REGIONAL SYMPOSIUM ON CONSERVATION OF NATURE

(Apia, Western Samoa, 14 - 17 June 1976)

REPORT ON THE SPECIAL PROJECT ON THE CONSERVATION OF NATURE

SOUTH PACIFIC COMMISSION

by

Arthur Lyon Dahl

Regional Ecological Adviser.

REPORT ON THE SPECIAL PROJECT ON THE CONSERVATION OF NATURE
SOUTH PACIFIC COMMISSION.

The special project on the conservation of nature was approved by the Thirteenth South Pacific Conference in October 1973 and was activated by the appointment of Dr. Arthur L. Dahl as Regional Ecological Adviser, commencing in June 1974. It is therefore appropriate at this point, two years after the commencement of the programme to review its accomplishments to date and to suggest appropriate directions for its future development.

The goals of the project and the responsibilities of the Regional Ecological Adviser as originally defined were as follows:

1. Advise SPC Officers, Governments and territorial Administrations on environmental planning, including beautification, and the solution of environmental problems.

2. Organise and assist in conducting training courses and seminars in ecology and environmental conservation.

3. Undertake environmental surveys as requested and assist in environmental development planning.

4. Maintain liaison with appropriate international agencies.

5. Revise and apply quantitative tests for increasing effectiveness of conservation programmes.

6. Prepare articles, papers and educational materials within the scope of the Commission's Work Programme for publication by the Commission and elsewhere.

Funds were provided for short term consultants, meetings and training courses, and educ tional and technical publications. These aims were developed from the recommendations of the Regional Symposium on Conservation of Nature - Reefs and Lagoons which was held in Noumea in 1971.

Since this was a new activity in the South Pacific Region, the first priority was to make contact with island governments to determine accomplishments and requirements in the areas of conservation of nature and environmental planning, and to determine how a regional programme could best meet local needs. The Regional Ecological Adviser has therefore visited every major territory and country in the region to meet with governmental officials responsible for the various aspects of the environment and to discuss with them the needs within their countries and territories and on a regional basis. This in itself has helped to increase the awareness in the region of the need for management of environmental resources. The results of this survey were published in the first issue of the SPC Environment Newsletter as an outline for an SPC environment programme. The programme so developed served as an initial basis for discussions with a number of international organisations concerning outside support for environmental projects in the region. The needs as defined in this study and the progress to date in meeting those needs are discussed below in some detail.

The fundamental goal of environmental activities of the South Pacific Commission is to assist the governments and territories within the Commission area to meet the economic, social and health needs of their peoples without destroying the natural resources or upsetting the ecological equilibrium so necessary to the long term future of the islands and the quality of life of their peoples. This can only be accomplished with a multi-dimensional programme including the following components:

1. RESEARCH AND MONITORING.

Without adequate scientific information on the resources of the region, management decisions must be based on guesswork or extrapolation from other regions. It is also impossible to say what changes are taking place in island ecosystems with the increasing impact of man. A number of activities are therefore needed.

(a) Faunistic and Florastic Inventories.

In many islands the native plants and animals that make up the flora and fauna are still not completely known to science. The Commission has attempted to identify needs and to encourage researchers to study in the region. Scientists often write to the Commission for information on governmental regulations concerning research in countries to which they hope to travel and on local institutions or individuals with whom they can cooperate. More needs to be done to facilitate scientific research in the region (perhaps through the establishment of small field laboratories in each island group), to establish uniform regulations controlling the activities of outside researchers so that they do not abuse their responsibility to the island peoples and governments, and to ensure that the results of such research return in some useful form to the country or territory concerned. The Pacific Science Association can also be encouraged in its efforts to identify research needs in the region and to stimulate programmes to meet those needs.

(b) Coral Reefs

It is only in recent years that modern techniques have permitted major advances in the study of coral reefs. However these studies have been carried out at only a few restricted and not necessarily typical sites in the Pacific, with the result that for most of the region there is little information on which to plan for the management and development of reef resources. The Commission is developing techniques for surveying and monitoring reef resources and plans to make this a major programme emphasis in the future. Similar resource monitoring is also needed on land. Without such activities, many potential resources for islands may be lost before they are ever known.

(c) Mangroves

Mangrove swamps are an important but little understood resource for many island countries Some efforts have therefore gone towards encouraging local research projects to study the significance of mangrove habitats for fisheries and waste treatment and to measure the impact of developments on the mangrove system. More needs to be done to provide a sound basis for government management of this resource.

(d) UNESCO Man and the Biosphere programmes.

The Regional Ecological Adviser has cooperated with UNESCO to stimulate and coordinate MAB programmes in the Pacific, particularly under theme 7, Man in island ecosystems, and theme 8, biosphere reserves. The regional ecosystems survey in particular will help to identify potential biosphere reserve sites.

(e) Environmental monitoring.

It has become increasingly apparent that environmental management can only be undertaken with adequate knowledge of the often rapidly changing status of island natural resources. The Commission is continuing a small pilot programme in resource monitoring techniques, and has held discussions with a variety of resource specialists. This should be a major element in a continuing SPC environmental management programme, and outside funding is now being sought to increase regional capabilities and to train local personnel so that the necessary long-term monitoring of environmental resources can be undertaken as part of comprehensive government planning.

(f) Agricultural chemicals and integrated pest control

The Commission has advised a number of governments on the technical and legislative aspects of pollution prevention and control, and has helped to increase the utilization of biological controls. This will continue to be a major responsibility of a number of Commission officers.

2. TRAINING.

The initial needs for trained environmental personnel have been so varied that additional regional training activities were not justified, although some training has been provided in connection with local projects. With the increasing number of proposals for major development projects, however, there is an increasing need within governments for middle-level staff able to undertake basic environmental impact studies, and knowledgeable in the ecological understanding and practical field techniques necessary to ensure that outside developers or enterprises are fulfulling their environmental obligations. A training course to meet these needs is now being planned for the coming year.

There is also a great need for basic village level training in local resource management, since most environmental responsibility still rests at the village level. This can probable best be accomplished at a permanent training centre comparable to the SPC Community Education Training Centre and funding to establish such a centre is now being sought.

3. LEGISLATION AND GOVERNMENT ORGANIZATION.

The Regional Ecological Adviser has helped and is continuing to help several governments to develop adequate conservation and environmental legislation. The assistance of an outside expert is now being sought to complete the development of model legislative texts suitable to Pacific Island conditions. There has also been great progress within some Governments and Territorial Administrations of the region in the assignment and coordination of environmental responsibility. More still needs to be done, however, particularly with respect to coordination between separate departments, incorporation of environmental criteria and data into the planning process, and placement of an environmental "voice" at a high enough level that it can carry some weight against those arguing for immediate development regardless of the long-term cost.

4. PLANNING.

The Commission has provided governments with general information on environmental planning as well as specific advice on a wide variety of development projects and environmental impacts including wastedisposal, reef channel blasting, construction, mining, and processing-industry effluents. More needs to be done to increase government capabilities in this area, so it is expected that this will continue to be a major programme component. As an independent and unbiased source of expertise, the Commission can play an important role in helping to guide island development in those directions most beneficial to the island peoples it is intended to serve.

(a) Coastal Management

With the rapidly increasing experience in coastal zone management elsewhere in the world, much is being learned that could benefit island governments in their planning efforts, and that could help them to avoid the expensive and often irreversible mistakes made elsewhere. If it is possible for the SPC to expand its environmental programme, the accellerated transfer of this information to the Pacific region will be an important part of its activities.

(b) Eco-development assistance

Eco-development is basically development in harmony with the resources and limits of the ecological systems of which man forms a part. It aims towards a human scale of development based largely on self-help at the village-level, with benefits reaching immediately and directly to the people most in heed. The Commission has for many years been working in aspects of eco-development under other names, and is now reorganising its structure to enable it to undertake more integrated and complete programmes of eco-development assistance. The expansion of SPC technical assistance, training, education and extension activities in ecodevelopment is now planned, both through the redirection of existing resources and through external assistance.

5. CONSERVATION, PARKS AND RESERVES.

This has been a principal emphasis of the Special Project on Conservation including co-sponsorship of the South Pacific Conference on National Parks and Reserves (Wellington, N.Z., February, 1975) and the Second Regional Symposium on Conservation of Nature (Apia, Western Samoa, June 1976), and assistance to efforts to conclude a Convention on Conservation in the South Pacific Region.

(a) Regional Conservation Planning.

The Regional Ecological adviser has undertaken a regional ecosystems survey with the financial support of IUCN. This survey describes the many types of ecosystems or biological communities found in the region, summarizes the progress made so far towards the protection of viable samples of these ecosystems, and identifies the need for further conservation action.

(b) Parks and nature reserves.

In addition to aiding national surveys for parks and reserves, the Commission has worked to define conservation solutions most appropriate to island conditions. Such conservation approaches must take into account the limited resources on which the population must depend, traditional systems of land tenure, opposition to alienation of land, and the fragility and vulnerability of many island environments and species.

(c) Traditional conservation.

The successful management of environmental resources by traditional cultures can often provide models for the future, but much of this traditional knowledge is being lost. The SPC will continue its efforts to encourage the salvage of this invaluable dimension of island cultures.

(d) Cooperation with IUCN.

The Commission has worked very closely with IUCN in the development of regional efforts for conservation in the Pacific, and will presumably play an increasing role as a regional executing agency for IUCN programmes. Increasing attention will be given to the problems of conservation in the marine environment, and to the possible development of international or world parks and reserves in the Pacific area.

6. ENVIRONMENTAL EDUCATION.

(a) Curriculum development.

A consultant on environmental education, Mrs. Margie Falanruw, is presently working with the Commission under the Special Project on Conservation to develop curriculum outlines and instructional materials designed to help children to understand their village and island environment, and to assist teachers to include environmental concepts in their courses. Such efforts will be expanded if funds permit to include the development and distribution of audio-visual aids and other supplementary materials for school use.

(b) Museum programme.

Museums can be a powerful means to environmental education because they teach with objects and can thus reach every stratum of island populations. However this potential is largely unrealized at present. Museums can also serve as a center of scientific studies for an island country or territory and as a depository for scientific collections which can then be available for local reference. The Regional Ecological Adviser has undertaken an initial project in American Samoa to help to demonstrate this potential through the development of a planned environmental exhibits programme, the construction of the initial exhibits, the preparation of adequate collection storage facilities and the training of museum staff. Similar assistance can be provided to other Pacific Island museums on request.

(c) Adult Education.

If conservation and environmental resource management are to succeed in the Pacific, the message must reach the village level. Films can be a most effective means of communication with the villages, but they must specially adapted to the rural island situation. It is therefore planned to produce a series of films, radio programmes and other educational materials for village environmental education, to the extent that resources permit. Such materials can greatly amplify the impact and effectiveness of the Commission's small team of technical specialists.

7. INFORMATION.

(a) Scientific information.

One of the principal handicaps of the island situation is the remoteness and small size that inhibits the development of an adequate flow of information. With the development of modern communications and data processing technology, it may now be economically feasible to develop a scientific and technical information system capable of meeting most regional needs. Only in this way can governments, administrators and technical specialists hope to have available the information necessary for sound development planning and environmental management. The Commission is continuing to explore the possibilities of such a system and to seek the necessary financial support for its eventual establishment.

(b) Environmental inventories.

It is not possible to plan for resource development if the resources available are not known. Too many development projects have failed because the resources on which they were based were not adequately surveyed. The Commission has at present only a limited potential to assist in such surveys using the appropriate technical specialists on its staff, but it is hoping to expand its environmental resource survey capability if outside assistance becomes available.

(c) Introductions of alien organisms.

Some of the greatest existing environmental problems in the Pacific Islands are the result of the introduction of alien organisms (plant or animal) which have attacked crops and trees, invaded agricultural lands, and eaten, out-competed, or replaced native species. The prevention of further unwise introductions is often a question of adequate information, and the Commission will continue to provide every possible assistance in this regard.

8. FUTURE DEVELOPMENT OF THE SPC ENVIRONMENT PROGRAMME.

Since its inception, the SPC Special Project on Conservation of Nature has aimed to define the needs for regional environmental and conservation assistance and to develop programmes as described above to fill those needs. It should perhaps more appropriately be termed a project on Conservation and Environmental Management.

It is now necessary to define the future role of the South Pacific Commission in this area, particularly in this year when the functions of the Commission are being redefined and its structure reorganized, and this is one of the principal aims of this Symposium. The representatives of governments, international organizations, and scientific institutions gathered here are asked to make a critical evaluation of what has been accomplished during the past two years, and to recommend guidelines and specific action programmes for the continuation of conservation and environmental activities at the SPC, elsewhere in the region, and by international organizations.

With responsibilities of the scope originally defined in the Special Project, the human and financial resources of the Commission have been spread very thinly, and progress has necessarily been slower than desirable. As the only organization encompassing all the South Pacific Island countries and territories, the SPC is the logical regional environmental organization, and an appropriate executing agency for certain types of programmes of international organizations and other aid donors. The programme described above can only be carried to completion if substantial additional resources are made available. IUCN has already been most helpful in this respect, and negotiations are continuing with the United Nations Environment Programme concerning the form that their assistance might take. It would be useful if this meeting would comment on and assign priorities to the projects described above as an aid to further programme development and as a guide to interested funding agencies. In this way the programme undertaken will be fitted as closely as possible to the needs and desires of the governments and peoples of the Pacific Islands.

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SOUTH PACIFIC COMMISSION

AND

INTERNATIONAL UNION FOR CONSERVATION OF NATURE
AND NATURAL RESOURCES

SECOND REGIONAL SYMPOSIUM ON CONSERVATION OF NATURE
(Apia, Western Samoa, 14 - 17 June 1976)

THE SOUTH PACIFIC PROGRAMME OF IUCN

by

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SPC-IUCN/2RSCN/WP.7

The South Pacific Programme of IUCN

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1. Background

1. The International Union for Conservation of Nature and Natural Resources has a longstanding interest in conservation in the Pacific region. During the presidency of Dr. Harold Coolidge this interest was exhibited through close IUCN cooperation with the Pacific Science Congresses in Honolulu in 1961. Tokyo in 1966, and Canberra in 1971, as well as with the IBP-CT Pacific Island programme. IUCN, through the active interest of Dr. Coolidge and Sir Hugh Elliott, provided leadership in developing the concept of Islands for Science, and has prepared a draft Island for Science Convention which received favourable attention at the UN Conference on the Human Environment in Stockholm, 1972 but is still awaiting governmental action. One result of this proposal, however, was the establishment of the first "island for science" in the Pacific when the W.A. Robinson Integral Reserve was proclaimed, in 1972, on Taiaro Atoll in the Tuamotu Archipelago.

2. A more active role for IUCN in the South Pacific began with the joint sponsorship of IUCN and the South Pacific Commission of the first symposium on nature conservation in the South Pacific, held in Noumea in 1971. The outcome of this meeting among other things was an association of IUCN with the SPC in matters concerning conservation, and the development of a closer relation between IUCN and various island governments.

3. As a result of these closer relationships, Dr. Colin Holloway was requested by the Government of Western Samoa, with support from UNDAT, to carry out a survey of potential national parks on those islands in 1974. The survey was completed and the report forms a background for establishing a national park and reserve system.

4. Also as a result of these relationships, IUCN was asked to prepare a draft convention for conservation in the South Pacific. This was completed in January 1975 and has received formal attention from governments at the plenipotentiary conference recently held in Apia (June 9-11 1976).

5. In February 1975, IUCN and the Government of New Zealand sponsored the South Pacific Conference on National Parks and Reserves, held in Wellington, New Zealand. This gave added impetus to IUCN's

regional involvement and led to implementation of the survey of existing and potential national parks and reserves as well as other areas of conservation significance carried out by Dr. Arthur Lyon Dahl of the South Pacific Commission with financial support from IUCN. This survey was included in the UNEP/IUCN project (RA 1103-75-04) concerned with Ecosystem Conservation. This survey has been reported and action plans are being developed here at the Second Symposium on Nature Conservation in the South Pacific (Apia, Western Samoa, June 14-17 1976).

6. Various action projects have already resulted from these conferences. These include:

a. Request for assistance from the Gilbert Islands in (1) drafting legislation for wildlife protection (provided in 1975), and (2) providing a warden and other facilities to protect breeding bird colonies on Christmas Island and the other Line Islands (now being reviewed by IUCN/WWF joint projects operation).

b. Request for assistance from the Kingdom of Tonga in establishing more effective protection for their system of reserves. This is included in the IUCN/WWF 1976 programme for financial support.

c. Proclamation at the International Conference on Marine Parks and Reserves (Tokyo, May 1975) of Manuae Atoll in the Cook Islands as a World Park/Island for Science.

d. Request for assistance from the Cook Islands in developing Manuae as a world park, for salaries of a conservation director, and for funds for their conservation programme. These have been explored with the Governments of Australia and New Zealand, but are now under consideration for direct WWF funding.

e. Request for assistance from the Solomon Islands with drafting conservation legislation. This has been provided by the IUCN Environmental Law Centre at Bonn.

f. Verbal requests for assistance in implementing park planning from the Fiji Islands and Western Samoa. These are being explored now at this Apia Symposium.

11. <u>Development of South Pacific Programme 1975-1976</u>

1. <u>Components.</u> The South Pacific Programme provides for the integration on a regional basis of several IUCN activities. These include:

a. Assistance toward the development of an integrated system of national parks and other protected areas for the Pacific Islands, including marine parks and biosphere reserves.

b. Assistance toward the development of a programme for conservation of critical marine habitats in the Pacific region through appropriate conservation measures.

c. Development of approaches for integration of conservation with ecodevelopment, based on local cultures and traditions, in order to find patterns of development that will be ecologically viable and sustainable, and conservative of the life styles of the people involved.

2. Action in progress.

a. The survey recently completed by Dr. Arthur Lyon Dahl with support from the SPC and UNEP/IUCN was a first step toward the development of an integrated national park and reserve system. This should now be further developed and translated into action plans.

b. Materials have been prepared by Dr. G. Carleton Ray and associates for consideration at this Apia symposium. It is hoped that as a result of the discussions here a series of projects aimed at the conservation of marine habitats and species in the Pacific will be developed for funding from the IUCN/WWF "Front Line" marine programme during 1977. These projects may include conservation of sea birds; whales, seals and dugongs; marine turtles and crocodiles; marine fish; marine invertebrates as well as such critical habitats as coral reefs and lagoons, mangroves and sea-grass beds.

c. Background papers on ecodevelopment, traditional uses and tenure patterns, customary rights and practices related to conservation, have now been presented by Dr. Jimoh Omo-Fadaka, Mrs. Suliana Siwatibau and Mr. Robert Allen. These, hopefully, provide a basis for the formulation by this symposium of proposals for the integration of ecodevelopment and nature conservation in the South Pacific.

d. Legal and political issues related to conservation of marine and terrestrial environments are being explored in background papers prepared by Mr. Frank G. Nicholls and Mr. Cyril de Klemm for discussion here. These include the significance of the South Pacific Convention, World Heritage Convention, Endangered Species Convention and Wetland Convention, and also explore issues related to world parks, biosphere reserves, islands for science and developments from the Law of the Sea Conference. These background documents for discussion here in Apia will hopefully lead to appropriate political/legal action.

3. Up to the time of the Apia symposium most efforts have been directed toward identification and description of areas and issues for which appropriate action will be required. Following this symposium it is expected that recommendations will lead to a series of site-oriented or issue-oriented action plans and projects. All of these will require financing, but before that the identification of those individuals and agencies with the technical skills and time available to carry them forward. Although it is possible that certain activities may take place in international waters, for most projects the active interest and support of the island governments will be required as a first step.

4. The role of IUCN and its partner organization, the World Wildlife Fund, will necessarily be more limited in the action phase of the programme because of the availability of funds. It can be viewed as an initiatory and catalytic role - providing the means for starting conservation action, particularly for demonstration or pilot projects which can serve as models for other, more extensive, action. Neither IUCN nor WWF can be viewed as a means for long-term support of conservation or ecodevelopment programmes, nor can

they be expected to provide large amounts of money for any short-term activity. They have, however, an important role to play in assisting island governments or institutions in finding major sources of funds, e.g., from other governments or intergovernmental agencies. In the longer term, however, conservation must be viewed as an activity and interest of the island peoples and governments. If accepted as an integral part of development then the costs must be borne by those who expect to receive the benefits. IUCN can assist in providing a climate of public awareness of the importance of conservation, but any programmes that it helps to initiate must become self-sustaining if they are to succeed.

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INTERNATIONAL UNION FOR CONSERVATION OF NATURE
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SECOND REGIONAL SYMPOSIUM ON CONSERVATION OF NATURE

(Apia, Western Samoa, 14 - 17 June 1976)

THE CONCEPT OF WORLD PARKS AND INTERNATIONAL LAW

by

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318/76

SPC-IUCN/2RSCN/WP.9

THE CONCEPT OF WORLD PARKS AND INTERNATIONAL LAW

Cyril de Klemm

I. DEFINITION AND BACKGROUND

1. The Second World Conference on National Parks (Grand Teton, September 1972) recommended (Recommendation no. 5), that "the nations party to the Antarctic Treaty should negotiate in order to establish the Antarctic continent and the surrounding seas as the first world park under the auspices of the United Nations". It was considered however that, to be implemented, such a recommendation would require a revision of the Antarctic Treaty and that this would not be advisable since it would raise some matters affecting the sovereignty of contracting states over Antarctic territories. Consequently no further action was taken.

2. In February 1975, the South Pacific Conference on National Parks and Reserves, held in Wellington, New Zealand, recommended (Recommendation no. 5) that "the governments of the region examine the possibility of taking action to establish one or more world parks in the region to protect significant marine ecosystems, and bring forward and support this proposal at the Third United Nations Conference on the Law of the Sea".

3. If a definition of world parks is to be based on this recommendation, these parks should be considered as conservation areas, established on the high seas, where access should be, to some extent restricted, where pollution should be controlled and where fishing must be prohibited or regulated.

4. The purpose of this paper is to explore the present legal situation, examine further developments which may result from the adoption of a new convention on the Law of the Sea, and suggest possible ways to set up world parks on the high seas.

II. THE LAW OF THE SEA

1. Present state of the Law

1.1 The territorial sea over which coastal states exercise full sovereign rights has a width of 3 nautical miles measured from a base line connecting coastal headlands. An exclusive fishing zone usually extends beyond the 3-mile limit to a distance of 12 miles from the base line. This zone remains, legally, a part of the high seas but coastal states have the right to exercise in these waters their domestic jurisdiction with regard to fisheries. This means that they can take whatever conservation measures they deem appropriate and, therefore, exclude fishing by other states.

1.2 In the past, there has been an increasing trend, on the part of many states, to extend unilaterally the width of their territorial sea and national fishing zone. In some cases the latter has been extended to a distance of 200 miles from the base line. This has caused a considerable number of disputes between the states concerned and those that have been fishing traditionally in those areas. A good example is the current dispute between the United Kingdom and Iceland over the new 200 miles limit recently established by the Icelandic Government. There is no doubt that such unilateral extensions are not consistent with international law as it stands at present. On the other hand, it should only be fair that natural resources that are essential to the economic welfare of local populations be preserved from indiscriminate fishing carried out by large industrial fleets, often operating at very long distances away from their home countries. It is therefore clear that the present state of the law is not satisfactory, and that the law should be re-examined in the light of both conservation requirements and economic considerations.

1.3 Beyond national fishery limits, there are no restrictions to fishing operations on the high seas, other than those provided for in specific fisheries conventions which are binding only on those states that are party therein. Such conventions may apply to certain areas, or to certain species, or to both.

2. The United Nations Conference on the Law of the Sea

2.1 In view of the shortcomings of the present situation, many states, in particular developing countries, have asked for a revision of the existing conventions on the Law of the Sea. A conference has been convened and has met several times since 1974 in Caracas and Geneva; it is meeting again in New York in the spring of 1976. It is still too early to know exactly what new rules of international law will be adopted by the community of nations, but recent developments in the conference have resulted in a number of major trends which are likely to be incorporated in the future convention.

2.2 The width of the territorial sea will probably be extended to 12 miles from the base line. For archipelago states, the base line will encircle the whole archipelago.

2.3 The exclusive economic zone will probably be extended to 200 miles from the base line. In that zone coastal states will enjoy full sovereign rights over all natural resources, including living resources, and will be entitled to take any necessary steps to preserve the marine environment. They will, as a counterpart have the obligation to manage and preserve the living resources of the area. No other state will be authorized to exploit any resource in the zone except by agreement with the coastal state concerned.

2.4 On the high seas, fishing will remain free, subject to restrictions imposed under other treaties. There will, however, probably be an obligation on the part of all states to co-operate in the management and conservation of the living resources of the high seas. This will take place, in particular, through the establishment, where appropriate, of regional or sub-regional fisheries organizations.

III. PERSPECTIVES FOR THE ESTABLISHMENT OF WORLD PARKS

1. The problem does not arise in the territorial seas and exclusive fishing zones since all states will be free to prohibit or restrict fishing activities and regulate shipping in those areas. They will be entitled to set up national parks, or any other form of protected area to a distance of 200 miles from their coastline. This can be

done, either on an individual basis, or within the framework of such systems as the Islands for Science Convention (if and when it comes into force), the World Heritage Convention, or the UNESCO Biosphere Reserves Programme. There may be, in some cases, possibilities for international management of such reserves, provided that the states concerned will be prepared to relinquish some of their sovereign rights to an international body responsible for managing the reserves.

2. Beyond the 200 mile limit, the new Law of the Sea will probably provide for an obligation on the part of all states to co-operate in the management of high seas fisheries. This may well take the form of an agreement to close certain parts of the high seas to all fishing activities and to establish world parks. This will naturally require the concurrence of all states concerned, including that of any state not geographically present in the region, but which engages in fishing activities in the area. Such an agreement will necessarily have to take the form of an international convention, and will not be binding on non-party states. Nevertheless, if the fact that a state has not accepted to accede to a convention providing for the establishment of world parks can be construed as a refusal to co-operate in the management of high seas fisheries (in the sense of the future Law of the Sea Convention), it may constitute sufficient grounds to initiate proceedings against that state, on the basis of the procedure for the settlement of disputes which the convention will probably contain.

3. Another possibility consists in submitting new proposals to the Law of the Sea Conference in respect of world parks with a view to incorporating them in the draft convention before it is finalized. These proposals could, as an example, take the following form:

3.1 States that are located in a certain oceanic region or sub-region could be entitled, in order to protect certain living resources that are essential to the livelihood of their peoples, to declare high seas sanctuaries or world parks in certain maritime areas of that region or sub-region.

3.2 A special procedure might be established, at world level, to ensure the preservation of certain areas in the high seas which are of particular importance from the biological or ecological points of view. This could apply to unique or especially fragile ecosystems and to the breeding or feeding areas of important or rare species of fish, other marine animals, or plants. An example of such areas is the Sargassa Sea in the Western North Atlantic, an area of exceptional biological interest, which is, at the same time, the only breeding place of the European and North American eels.

A list of these areas could usefully be prepared by the appropriate scientific authorities, such as SCOR, and IUCN.

3.3 In the event that the foregoing proposals are retained by the Law of the Sea Conference and incorporated in the future convention, it will be necessary to determine suitable procedures for the establishment, administration, and management of world parks as well as for controlling unauthorized access into those areas.

3.4 There will first be a need for an internationally agreed definition of world parks which should probably be based on specific scientific, and perhaps economic, criteria. There will then have to be a special procedure for the establishment of these parks. In each case it will be necessary to obtain the agreement of all the states of the world, since such a decision would affect their freedom of action on the high seas.

3.5 There will be, next, a need to designate an authority that will be responsible for the administration and management of world parks. This can be done on a world scale. If it were decided to set up an international body that would be competent to manage all living resources in the high seas, such a body could well include the management of world parks among its tasks. Alternatively, world parks could be managed by regional or sub-regional fishery organizations which would be acting, in that respect, as the agents of the community of nations.

3.6 It will also be necessary to determine conditions of access to world parks. This should probably include a complete prohibition of fishing as well as of any other activity which may have adverse effects on the marine environment, as, for instance, the discharge of oil or other effluents from ships.

It will probably prove impossible to completely prohibit access to these protected areas since this would encroach upon the freedom of navigation on the high seas, and may therefore give rise to serious objections on the part of many states. A solution could be to only allow innocent passage, as in national waters. But to be effective such a provision should be accompanied by adequate means of enforcement put at the disposal of the international authority in charge of the management of world parks.

3.7 There may also be a need to control certain activities, in particular the release of polluting effluents in adjacent land or sea areas in order to avoid the transport of pollutants by the winds or the currents into the protected area.

3.8 Finally, adequate procedures for the prosecution of offenders will also be required. Since the institution of proceedings before the courts of the offender's flag state may not be sufficiently effective, it may be necessary to set up an international court. Enforcement of the court's judgements poses another problem, which can be resolved if, by international agreement, all states accept the possibility of enforcing such judgements on the offender's property, in particular upon his ships, wherever their location.

4. Conclusions

4.1 There is a need to clarify further the concept of world parks before a decision can be made on the best approach to solve the problem, and the best legal system under which these parks can be established. In particular the biological and economic factors involved should be defined in more concrete terms.

4.2 If the intention is merely to limit the catch, on the high seas, of certain pelagic species of fish such as tunas, marlins or sailfish, or of other organisms such as krill, a simpler solution may be found through the conclusion of an international convention, the purpose of which will be conservation and management of these particular species. There exists already a certain number of conventions of that type; e.g. the Inter-American Tropical Tuna Convention, the International Convention for the

Conservation of Atlantic Tunas and the International Whaling Convention. It is quite possible for conventions of that sort to provide for the establishment of closed areas, permanent or temporary, which could serve the same purpose as world parks. Indeed, the Whaling Convention contains an article specifically providing for the establishment of a sanctuary wherein all whaling operations may be prohibited. This provision has, however, not been enforced for many years.

4.3 For such conventions to be effective two essential conditions must be fulfilled.

(a) All the states that are fishing the species covered by a convention must be party to that convention. This seems essential for any system to work. It is to be hoped, but this is by no means certain, that provisions to that effect will be included in the future convention on the Law of the Sea. As a means of enforcement, the convention area could be closed to the fishing vessels of non-party states. Another possibility would be to not allow non-party states to land their catch or use harbour facilities on the territory of other states.

(b) There must be, on the part of all parties to the convention, a common will to preserve the resource. The best conventions will fail when contracting nations seek to obtain only immediate economic returns and do not give sufficient consideration to the long-term conservation needs of the resource they are exploiting.

4.4 This means that the future convention on the Law of the Sea will have to contain, if it is to be effective, provisions making it mandatory for any state that is exploiting a certain resource to become a party to the international agreement covering the conservation of that resource, and for all states that are a party to such an agreement to exploit that resource in the most rational way. Furthermore, the international community should be able to bring action against any state or groups of states that would not be complying with their obligations under the convention. This would be the case if they were over-exploiting, for instance, a certain resource.

4.5 If, on the other hand, the intention is the protection of certain specific regions of the high seas by the creation of special protected areas, because of their outstanding biological value, such a concept should be included in the new convention on the Law of the Sea. At the same time, there should also be included a definition of these protected areas, and a procedure for their establishment. The authority that will be responsible for the management and surveillance of these areas will also have to be clearly indicated.

4.6 Once the general principle of the creation of world parks is accepted, more specific matters such as the designation and establishment of individual parks, the control of pollution around protected areas, the powers of the managing authority, and the financing of the conservation and management measures, may best be left to a separate convention, or perhaps even to regional agreements which could be concluded under existing or future regional fisheries bodies.

It is important however to remember that with regard to access into protected areas, there should be no discrimination against any nation or group of nations, and that prohibition of access should therefore apply to all states.

4.7 World parks could well be linked with other networks of protected areas existing in the world. They could, for instance, be included in the network of Biosphere Reserves, which is being established under the auspices of UNESCO and its Man and the Biosphere programme. They could also be linked to the Islands for Science project, if and when the convention on that subject comes into force. This could be done in two different ways: a world park could be established beyond the exclusive economic zone extending around an island; alternatively, if the state to which an island belongs accepts to relinquish its sovereignty over that island, the whole of the island, its territorial sea and exclusive economic zone could become a world park, and that park could then be extended to a part of the high seas. It could then be managed by an internal scientific authority on behalf and for the benefit of mankind as a whole.

4.8 It is essential that any suggestion that would appear to meet with a reasonable consensus on the part of the states of the region be put before the Conference on the Law of the Sea as early as possible. Otherwise when the new convention is finalized, it will probably be too late to amend it for quite some time.

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ECODEVELOPMENT IN A PACIFIC ISLAND CONTEXT: I. THE ENVIRONMENTAL IMPACT STUDY

by

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1. Ideally, environmental and social factors are given as much attention in planning for and in executing development as are those relating to the anticipated economic benefits. Unfortunately nowhere has this happened yet.

2. In some countries in recent years however there has developed a new procedure whereby the environmental and social consequences of economic development projects are identified and proposals are made which would eliminate or minimize any adverse effects. This is achieved by a government agency requirement that a prospective developer, in order to gain final approval for a development scheme must arrange, at his own expense, for the conduct of an Environmental Impact Study (E.I.S.) along the lines indicated by the agency.

3. In a Pacific island context, simplified E.I.S. procedures, not too closely defined and introduced with as little as possible alteration to existing government practice may have best chance of early success. A continuing review and improvement of these procedures can then be undertaken against a background of an improving knowledge and understanding of the country's natural resources and environment, increasing appreciation within the country of the value of incorporating environmental principles in planning and decision-making and the gradual development of indigenous expertise in this area.

4. A requirement for an E.I.S. for every development project is unlikely to be necessary. Though every project should be considered in terms of its relationship to the environment in which it will take place it is possible to screen development proposals in order to identify those whose impact is likely to be of sufficient sugnificance to warrant the cost and effort of an E.I.S.

5. Some Pacific island governments interested in improving the quality of development projects by introducing E.I.S. procedures may be daunted by the unavailability or shortage of staff with environmental training and experience suitable to the task of screening and subsequent assessment.

6. Scattered throughout the SPC region is a number of individuals with training suited to some aspect of environmental impact assessment. The SPC Regional Ecological Adviser, who would be familiar with the env ronment of a country whose government might request assistance with the formulation of E.I.S. guidelines and the assessment of E.I.S , could perhaps play a role here in liaising with and coordinating the efforts of appropriate individuals and institutions. The Universities of Guam, Papua New Guinea and the South Pacific have, to varying extents been involved in studies of environmental impact of development projects and their efforts could be stimulated and made more effective by a coordination which might in due course become a basis for stronger, more productive links between them.

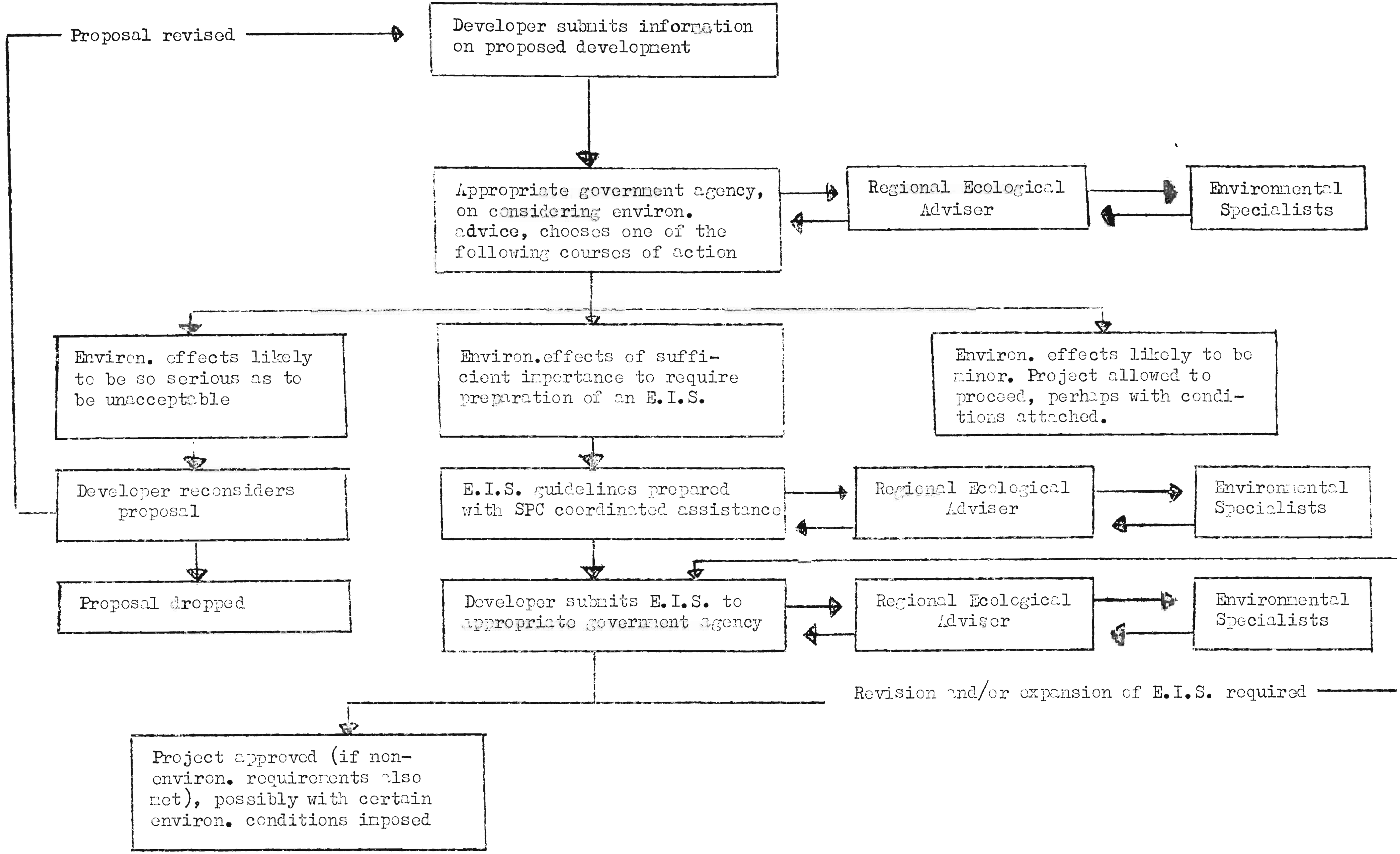
7. As a basis for discussion, generalized procedures for handling E.I.S. are outlined in Fig. 1.

8. Since few developers will be able to draw on environmental expertise from their own ranks for conducting E.I. Studies they will need to contract for the services of professional environmental consultants.

9. There has been a rapid proliferation of environmental consultant businesses in countries whose governments have instituted E.I.S. procedures. Inevitably, because it is a new profession, still groping to establish standards and highly competitive, there is uneveness of quality. Consequently there may be a tendency for developers in Pacific Island countries, when first faced with a need to prepare E.I. Studies, not to take this requirement seriously but to contract out environmental work to low cost, low quality consulting firms.

10. It will therefore be necessary to prepare a register of reliable environmental consulting firms, detailing their areas of competence. This could be done with little difficulty with the assistance of government environmental assessment agencies in Australia, New Zealand and the United States in particular, coupled with the experience being developed by environmental assessment units in Papua New Guinea and Fiji.

Figure 1: Generalised procedures for the consideration of environmental impact of development projects.



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ECODEVELOPMENT IN A PACIFIC ISLAND CONTEXT: II. PRIORITIES IN MANGROVE ECOSYSTEM RESEARCH

by

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1. For those South Pacific countries fortunate enough to have areas of mangrove a dilemma exists. Space occupied by these mangroves can be used to promote economic development by reclamation for roads, buildings or agriculture. However, the natural values of mangroves, particularly their important relationship with fisheries, are also appreciated.

2. The convenience and, often, the economic benefits of mangrove reclamation are readily understood. In the view of decision makers, however, the arguments for mangrove retention for their fisheries value are tenuous. Until more research is undertaken much of the evidence for a supporting role in fisheries remains circumstantial. This apparent link must be clarified by research in South Pacific mangrove ecosystems, not simply by extrapolation from the results of research conducted in mangroves of other regions.

3. There is considerable interest in mangrove research in the South Pacific at present and it appears that there are several possible sources of funding for this. However, if research results are to be of immediate value in the ecodevelopment of mangrove coasts then it is crucial that research programmes be appropriately directed.

4. The botany of mangrove ecosystems has received much more attention by researchers than has their fauna. It is studies of the latter particularly their subsistence and commercial fisheries significance, which are urgently needed and, very importantly, an extension of the as yet limited efforts to study ecosystem functions.

5. It would be useful if this meeting could work towards the definition of mangrove research topics having significance for ecodevelopment, with a view to prospects for a coordinated, cooperative South Pacific research programme.

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6. The following research areas are proposed for consideration:

6.1 Nutrient cycling: An understanding of the relationship between mangroves and mangrove-dependent marine biological resources requires investigation of nutrient cycling and energy flow. The need for studies of nutrient cycling is made more urgent by a growing interest in the use of mangrove areas for the disposal, with reduced environmental disruption, of treated sewage effluent - on grounds, proposed by Nedwell (1974)[1], that the mangrove ecosystem is able to accommodate high levels of organic matter and nitrates. An understanding of nutrient cycling is important also as a basis for decisions on ecologically appropriate use of land bordered by mangroves, from which land could originate freshwater runoff containing fertilizers, pesticides or industrial chemicals.

6.2 Secondary productivity: The mapping of mangrove areas, now being undertaken on some coasts, is certainly useful. However, the only convenient basis for mapping is floristic and yet, though certain faunal species may be positively associated with certain vegetation types, no clear relationship between these types and the secondary productivity of organisms useful to man has been established. If it were possible to zone mangrove areas in terms of their food production potential then decision makers would be much better prepared for rational allocations of these valuable resources.

In relation to this question of productivity, is it the whole of a mangrove area which needs to be retained where fisheries potential is to be preserved or is a strip of an "ecologically viable" width adequate, the areas beyond high water level having appreciably less significance for fisheries? This latter possibility would give scope for ecologically acceptable multipurpose development of mangrove areas.

6.3 Survey methods: Decisions on the use of mangrove areas cannot be delayed to await research results. Those decisions, however, would be better informed if government agencies were able to collect a modicum of ecologically significant information on those areas for which reclamation or modification is proposed. Simple survey methods, not costly in terms of time, personnel or money, are needed to provide information on such subjects as the standing crops of significant shellfish, crab and fish species and the numbers of their larvae and juveniles. Standardized data from the use of these methods could be of value not only for the surveys in question but also as contributions to a regional research programme.

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ECODEVELOPMENT IN A PACIFIC ISLAND CONTEXT: III. THE ADMINISTRATION OF MANGROVE ECOSYSTEMS

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1. A number of use options exist for mangrove ecosystems, ranging from preservation, through modification, to annihilation. Decisions on which use is appropriate in a given situation is made difficult by the inadequacy of basic ecological information and by the existence of bias deriving from an emotional view of mangroves as "unhealthy wasteland".

2. From the continuing use being made of mangroves by South Pacific village and peri-urban communities it is obvious that traditional views of these ecosystems reflected greater ecological understanding. The "unhealthy wasteland" concept was introduced by colonial administrations.

3. Development of more enlightened mangrove resource utilization policies, consistent with traditional concepts of their usefulness, is now taking place in some South Pacific countries. However, existing administrative techniques for the implementation of these policies are of limited effectiveness. An outline review of approaches already tried, both within and outside the region, could provide a useful stimulus to a discussion of appropriate administration for mangrove ecosystems. Some legal and administrative complexities of these land-sea interface ecosystems also need mention.

4. High water tide level usually consitutes the legal boundary between land, which may be privately owned, and foreshore which in many countries (e.g. those having legal systems based on that of the U.K.) is publicly owned. This level might divide a mangrove ecosystem and the situation can be complicated if there are differences of interpretation of high water level by different government agencies operating under different legal ordinances (e.g. Florida, U.S.A.).

5. It is not uncommon for a Fisheries Department to have jurisdiction over mangroves below high water levels while a Forestry or a Lands Department administers ecologically related adjacent mangroves. Yet mangrove ecosystems above and below high water level have sometimes been administratively treated as forests, no doubt because their most evident use was for timber and fuel.

6. In some countries (e.g. Australia, Fiji) for any alteration to those portions of mangrove ecosystems which are inundated by high tides a Foreshore Lease is required. The Lease application is considered in the light of governmental and public objections to the proposal. However, little account has been taken of the impact of foreshore developments on fisheries. These are sometimes difficult to predict and any losses even more difficult to quantify. Political pressure exerted by fishing interests may influence decisions on foreshore leases but, where leases are approved, no compensation is payable for any fisheries losses.

7. An innovative step of some significance for other South Pacific countries has recently been taken in Fiji. Where customary fishing rights may be affected a prospective foreshore developer must pay the costs of arbitration to decide any loss of fishing rights and to assess recompense for that loss. Any recompense fixed is invested, interest from this being paid annually to the community affected. This concept is attractive because it derives from the view that fishing rights are passed on to future generations and that payment should, accordingly, be paid in perpetuity. However, on a per capita basis the annual amount is usually infinitesimal. Recompense is assessed only on present usage of fishing rights, i.e. current harvests, and not on the fisheries potential of the area. The real cost of a foreshore development therefore may be much greater than that which is assessed. This is a cost which may have to be borne by the holders of customary fishing rights and balanced against anticipated gains from the foreshore development.

8. In Queensland recently, in an effort to slow the rate at which mangrove and adjacent shallow water ecosystems were being destroyed, legislation for the declaration of Fisheries Habitat Reserves was enacted. This reserve concept could be useful in the South Pacific. However, effective choice of reserves depends upon the use of ecologically-sound criteria for their selection, and such criteria are as yet poorly developed. In some situations the Fisheries Habitat Reserve concept could be regarded as synonymous with that of those national parks of which man is an integral, low impact component.

9. With improved ecological understanding of mangrove ecosystems the problems of their administration should be eased. Certain multiple use arrangements may be possible if, for instance, mangrove areas below high water mark prove to be of substantially greater importance for fisheries than those mangrove areas above high water mark. If parts of the latter are reclaimed, some nutrient and energy contributions to fisheries may then be lost. In some areas, appropriately treated and dispersed sewage effluent might help to make up such losses. In others some nutrient and energy contribution is likely from cultivated fields. Mangrove resource losses would be further reduced in situations where it is practicable for a government agency to require mangrove planting by a developer on the seaward edge of a foreshore development.

10. The most effective administrative view of mangrove ecosystems would be that in which these ecosystems were regarded as components of coastal regions. Decisions on mangrove ecosystem use could then be made in the context of their dependency on adjacent water catchment land use and on their important interrelationships with estuaries, lagoons and coral reefs. The legal revisions and administrative rearrangements necessary to permit and encourage such an ecologically farsighted perspective are formidable. The consequence, much closer approximation to optimal natural resource allocation, makes the efforts worthwhile.

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COMPARISON OF HYDROLOGICAL CHARACTERISTICS OF TWO CATCHMENT AREAS IN CENTRAL UPOLU, WESTERN SAMOA

HYDROLOGICAL SERVICES TECHNICAL REPORT NO.3

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SOUTH PACIFIC COMMISSION

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INTERNATIONAL UNION FOR CONSERVATION OF NATURE
AND NATURAL RESOURCES

SECOND REGIONAL SYMPOSIUM ON CONSERVATION OF NATURE
(Apia, Western Samoa, 14 - 17 June 1976)

COMPARISON OF HYDROLOGICAL CHARACTERISTICS OF TWO CATCHMENT AREAS IN CENTRAL UPOLU, WESTERN SAMOA

(April 1974 - June 1975)

HYDROLOGICAL SERVICES TECHNICAL REPORT NO.3

by

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1. Introduction

Investigations in various parts of the world have indicated that removal of natural forests affects the hydrological equilibrium in water sheds and has an adverse affect on water resources (Muller 1973 and others.)

In general the effects on the water balance are:

- reduced water retention and increased surface runoff, causing higher peak flood flows and the increase in erosion.
- reduced seepage and groundwater recharge, resulting in a reduction in spring flows and thus a decrease in dry weather flows.

Clearing of bushland also effects the quality of water: higher surface run-off and erosion cause an increase in sediment load and bacteriological contamination.

Attempts have been made to quantify these effects but, as each individual catchment area has different hydrological, geological and topographical characteristics, this has so far not resulted in the determination of a quantitative relationship between clearing of natural forests and its effects on the water balance and water quality in general.

This report attempts to describe some of the above effects. The study is based on the comparison of hydrological characteristics and runoff regimes of two catchment areas (Upper Vaisigano West and Fuluasou East) in Central Upolu, Western Samoa. Both catchment areas have rather similar geological and topographical properties and differ only slightly in area and riverbed configuration. The most obvious difference between the areas seems to be the difference in vegetation cover.

2. Description of the Catchment areas

The two catchment areas, Vaisigano Upper West (Tiapapata and Fuluasou East) are located on the north slope of Central Upolu. They are part of the Vaisigano and Fuluasou drainage basins. Their topographical boundaries are at the closest point only a few hundred meters apart (see Appendix I).

The Fuluasou East catchment area (6.7 km^2) has an elongated shape, and is approximately 6 km long and 1 km wide. Altitudes range from about 3000 ft. to 400ft above sea level at the outlet point (see Appendix II). The Vaisigano Upper West catchment area, size 7.2 km^2, has a more triangular shape, the outlet point is at approximately 1170 ft. a.s.l. (see Appendix III).

The upper parts of both areas are rather flat with slopes of less than 15% (1:7), the middle part of the Fuluasou East and the eastern part of the Vaisigano Upper West catchment dip more steeply northward with slopes between 15 and 35% (1:7 to 1:3). In these areas a number of small streams exist, most of which are not perennial, carrying only water during periods of heavy rainfall. The lower parts of both areas are almost completely dissected by deep gullies in which spring-fed perennial rivers run.

The surface geology of both areas is very similar, the formations consist of pleistocene Salani Volcanics resting on highly weathered, early pleistocene or pliocene Fagaloa Volcanics which are low in permeability. The latter formation is exposed in the bottom parts of the deep gullies.

Vegetation cover in both catchment areas differs. Approximately 37% of the Vaisigano Upper West catchment area has been cleared from native bush cover. In the Fuluasou East catchment this is only 15% of the area, not taking into account the 0.7 km^2 (or 10%) of natural forest that was removed recently. The cleared areas consist of plantations, pasture land and secondary forest.

A summary of topography, geology and vegetation of both areas is given in table below.

	VAISIGANO UPPER WEST (TIAPAPATA)			FULUASOU EAST		
	km^2	acre	%area	km^2	acre	%area
TOTAL AREA	7.2	1780	100	6.7	1660	100
TOPOGRAPHY*)						
flat	4.5	1110	62	4.2	1040	63
moderately steep	2.0	500	28	1.7	420	25
steep	0.7	170	10	0.8	200	12
VEGETATION**)						
bushland	4.5	1110	63	5.7	1410	85
cleared	2.7	670	37	1.0	250	15
recently cleared				0.7	170	10
GEOLOGY	Salani on Fagaloa			Salani on Fagaloa		
SHAPE	Triangular			Elongated		
ALTITUDE RANGE	3000 to 1170ft.			3000 to 400 ft.		

*) flat : slopes less than 15%

moderately steep : slopes between 15 and 35%

steep : slopes over 35%

**) bushland : native Bush cover

cleared : secondary growth, planations, pastures, etc.

recently cleared : cleared after April 1974.

3. Comparison of Hydrological Characteristics

Water level recorders at the outlet points of the Fuluasou East and Vaisigano Upper West catchment areas were installed in July 1973 and April 1974 respectively. Both gauging stations have provided reasonably accurate runoff records, Fuluasou East for the full range of flows and Tiapapata (Vaisigano Upper West) for discharges less than 3 m^3/sec. The hydrographs of both stations for the period of April 1974 through June 1975 are shown in Appendix IV. The flow duration (frequently of mean daily discharges) for the same period are given in Appendix V.

It is not possible to compute the actual rainfall input into both areas for the period of the study since the rainfall station network does not cover both areas adequately (see Appendix I). However, based on the long-term relationship between rainfall and altitude on the north-slope of central Upolu (increase approximately 100 mm per 100ft), it is possible to establish a ratio between long-term input into both areas. Rainfall input into the Vaisigano Upper West catchment computed this way is about 7.7% higher per unit area than rainfall into the Fuluasou East basin. Using the long-term mean annual rainfall computed for Afiamalu (2315 ft a.s.l.) of 5070 mm, the long-term basin inputs are 5070mm and 4710mm respectively.

Potential evapotranspiration (Et) for the Vaisigano Upper West catchment area is estimated to be slightly lower than the Et for the Fuluasou East area. Based on the long-term estimate of 1130 mm per year at Afiamalu (2315 ft a.s.l.) and 1330 mm per year at Vaipu (815 ft a.s.l.) the Et Vaisigano Upper West is 1130 mm per year (mean basin altitude 2350 ft) and the Et Fuluasou East is 1160mm per year (mean basin altitude 1970 ft). Actual evapotranspiration, although thought to be somewhat less than the potential, is estimated to be well within the tolerance about the estimated long-term Et value.

Because of the fact that at Tiapapata discharges over 3.0 m^3/sec. are not known and actual rainfall inputs and evapotranspiration rates for both areas are estimates, it is not possible to do detailed hydrograph analyses or to determine water balances for the two basins. Therefore the comparison of hydrological characteristics has to be based on the qualitative comparison of the hydrographs the flow duration curves and the groundwater depletion curves for the two stations.

In order to give an indication of rainfall inputs into the areas, daily rainfall figures at Afiamalu (2315ft. a.s.l.) for the period are included in Appendix VI.

Comparison of the two hydrographs shows that the Vaisigano Upper West catchment has a much more immediate response to rainfall than the Fuluasou East. The direct component of the runoff (surface runoff) is considerably higher and there is very little time lag between rainfall input and runoff peaks. Besides that the depletion process in the Vaisigano Upper West area is much quicker.

Peak flows recorded at the gauging station at Tiapapata and Fuluasou East during the November 1974 storm compared in volume as 25 to 1 (7.6 and 0.3 m^3/sec/km^2 respectively). In less extreme circumstances peak discharges at Tiapapata are frequently more than 10 times those at Fuluasou East. This indicates that, compared with the Fuluasou East, a large portion of the rainfall in the Vaisigano Upper West area contributes to surface runoff during heavy rainfall. It is estimated that in the Vaisigano Upper West under certain conditions more than 20% of the total area input runs off immediately, whereas in the Fuluasou East catchment this is at the most a few percent.

Comparison of rainfall figures (Appendix VI) with the hydrographs learns that there is hardly any time lag between rainfall and surface runoff in the two catchment areas. The hydrograph of the Fuluasou East, however, also shows secondary peak caused by interflow and groundwater baseflow. The time lag between rainfall and these secondary peaks, in particular where it concerns the slow component of the groundwater runoff, can be more than 15 days. This indicates that the Fuluasou East has a much bigger capacity to retain water for a long period of time than the Vaisigano Upper West basin.

The Fuluasou East catchment also releases water much more gradually than the Vaisigano Upper West area. Depletion curves of the latter basin are steeper and, apart from during peak flows, discharges are generally considerably lower than in the Fuluasou East basin.

This is confirmed by the groundwater depletion curves presented in Appendix IV. These curves show that during a long period without significant precipitation discharges from the Vaisigano Upper West area decrease rapidly to about 0.2 m^3/sec. After this the curve levels off considerably. In the Fuluasou East catchment on the other hand the depletion is much more gradual. Low flows are consistently between 2 and 3 times higher than those in the Vaisigano Upper West area. Assuming an equal flow of 0.6 m^3/ sec. at the two gauging stations and no siginificant rainfall, the depletion to a discharge of 0.2 m^3/ sec. would take about 20 days in the Vaisigano Upper West and about 90 days in the Fuluasou East area.

In comparing the hydrographs and the groundwater depletion curves it has to be realised that there are slight differences between the two catchments: in area, rainfall input and evapotranspiration. The Vaisigano Upper West basin is 7.5% larger, receives approximately 7.7% more rainfall per unit area but has an estimated long-term evapotranspiration that is 2.6% lower than the Fuluasou East catchment area. For the purpose of qualitative comparisons of hydrological characteristics it is considered, however, that there differences can be neglected.

The flow duration curves for the two areas given in Appendix V indicate that the discharge per unit area at the Fuluasou East gauging station is, during more than 90% of the time, higher than the discharge at Tiapapata. Only during peak flows following heavy rainfall do discharges at Tiapapata exceed those at Fuluasou East. This again confirms that the fast component of the runoff is much bigger in the Vaisigano Upper West catchment than in the Fuluasou East area. Surface runoff is at the expense of groundwater re-charge which explains the higher base flows in the Fuluasou East basin.

4. Conclusions

Despite the fact that the two catchment areas are comparable in many ways, they show marked differences in hydrological characteristics and runoff regimes. The Fuluasou East basin reacts as a typical groundwater catchment area, whereas in the Vaisigano Upper West basin the hydrological process is much more determined by surface runoff. The main causes for these differences must be sought in the differences in geology, topography and vegetation cover.

Geology - Although the surface geology of both areas is similar it is not known how the sub-surface geology compares. It is possible that the permeability of the top layers in the Vaisigano Upper West catchment is lower than that of the top layers in the Fuluasou East area. It is also possible that the structure of the subsurface foundations differs. However, it is considered unlikely that these differences are the major cause for the differences in hydrological characteristics between the two areas.

Topography - Despite the fact that the percentages of areas with flat, moderately steep and steep slopes are approximately the same in both catchment areas (see table chapter 2), there are differences in shape and river pattern (see Appendices II and III).

The triangle shaped Vaisigano Upper West area will no doubt respond quicker to rainfall than the elongated Fuluasou East catchment, the more there the eastern part of the Vaisigano area is dissected by a number of shallow gullies that add to the quick component of the runoff. But, again, this is not considered to be the main reason for the hydrological differences between the two areas.

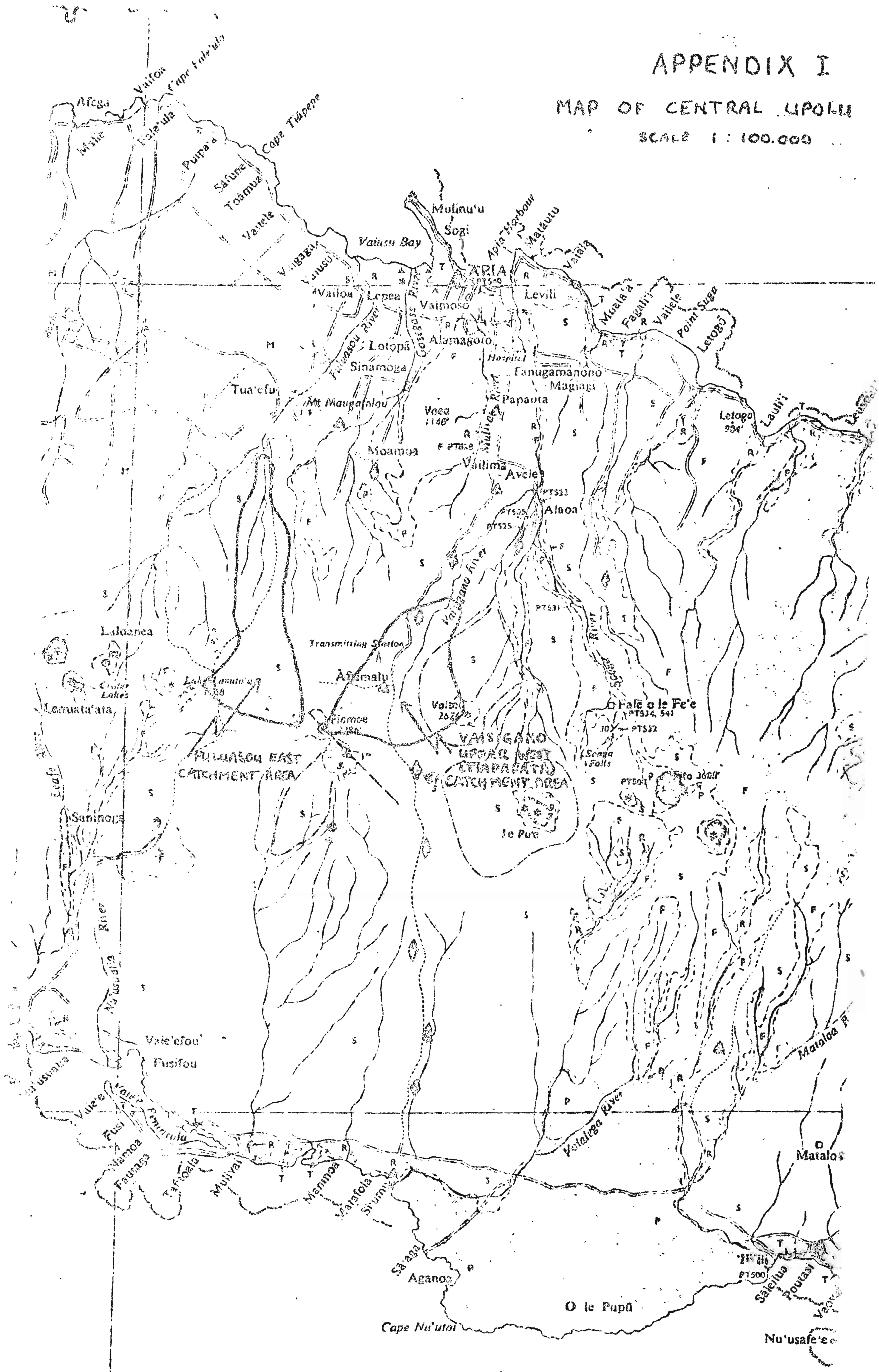
Vegetation - The major reason for this is considered to be the difference in vegetation cover. More than 35% of the Vaisigano Upper West area is deforested, whereas in the Fuluasou catchment this is only 15% (not taking into account the 10% of the area that was cleared only recently). The effects of forest clearance on the amount and temporal distribution of runoff resources were described already in chapter 1. The differences in the runoff regimes of the two areas, described in chapter 3 (more intense runoff peaks and re reduced base flows in the Vaisigano Upper West catchment), seem to be to a large extent the result of the differences in deforested area.

It can be concluded that the hydrological differences between the Vaisigano Upper West and Fuluasou East drainage basin are the result of a number of factors of which the difference in extent of forest clearance seems to be the most important one.

APPENDIX I

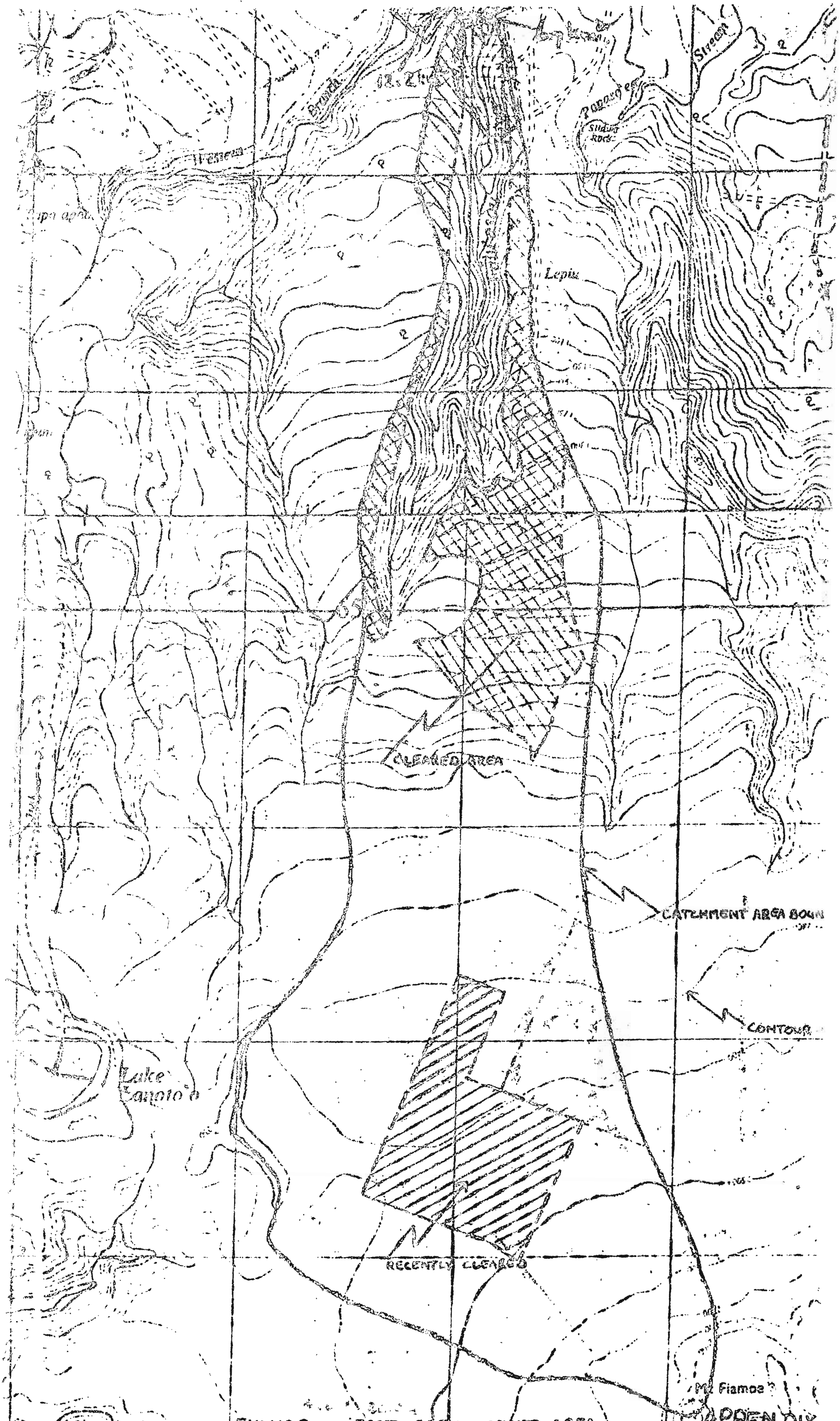
MAP OF CENTRAL UPOLU

SCALE 1 : 100.000



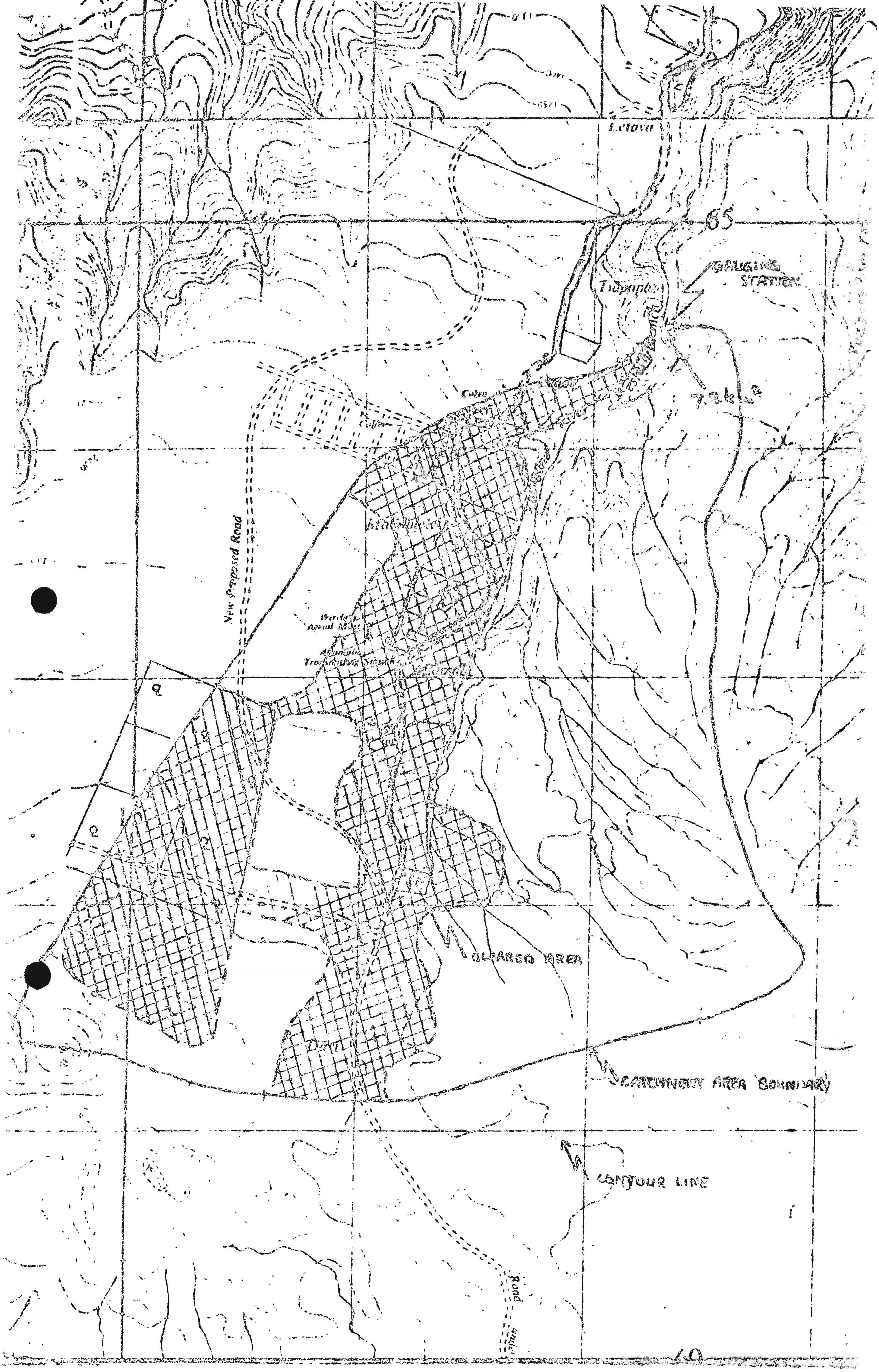
△ CLIMATE STATION

◇ RAINFALL STATION



FULIHASOU EAST CATCHMENT AREA

APPENDIX



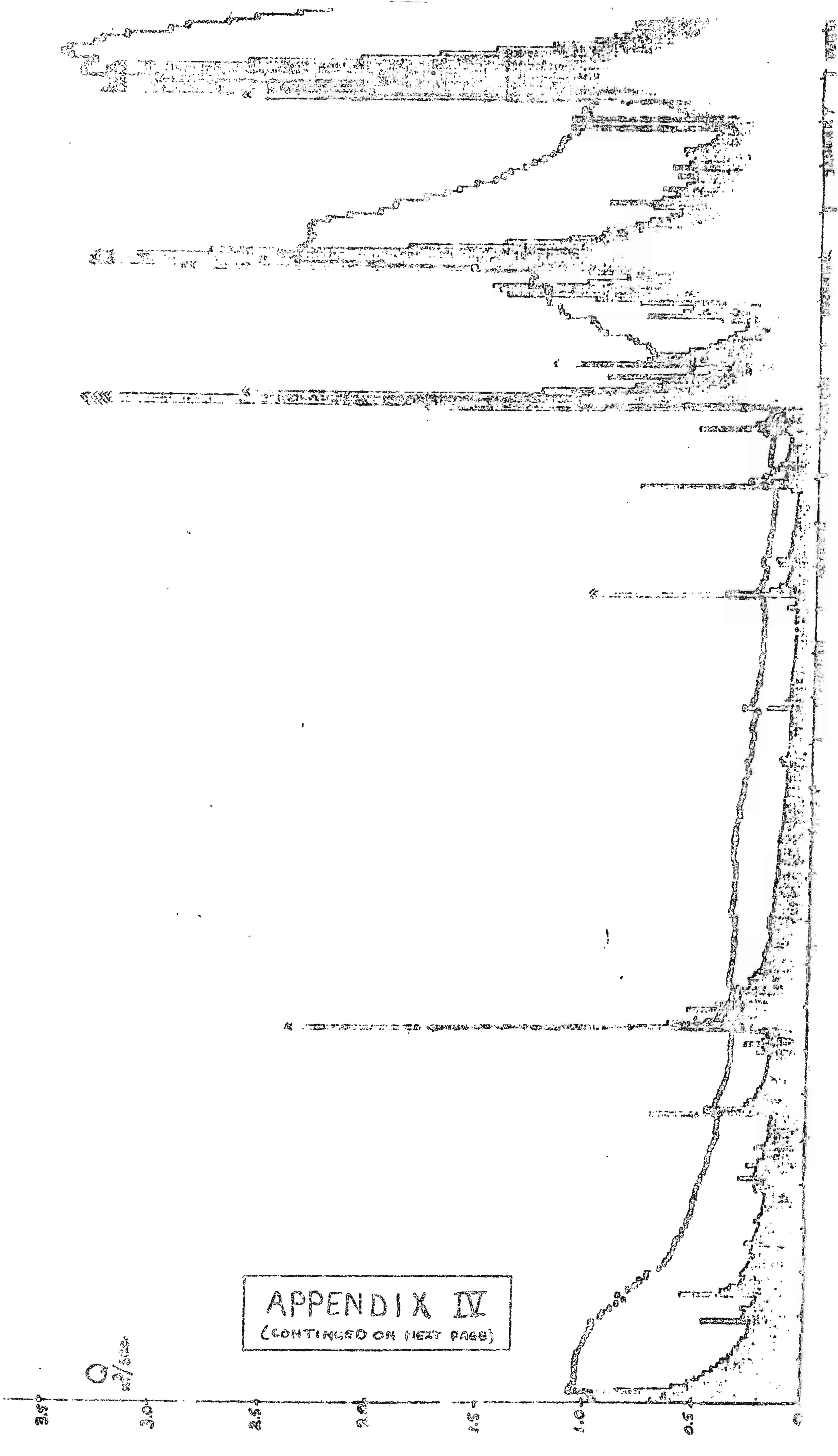
VAISIGANO UPPER WEST (TIAPAPATA) CATCHMENT AREA

SCALE 1 : 20.000

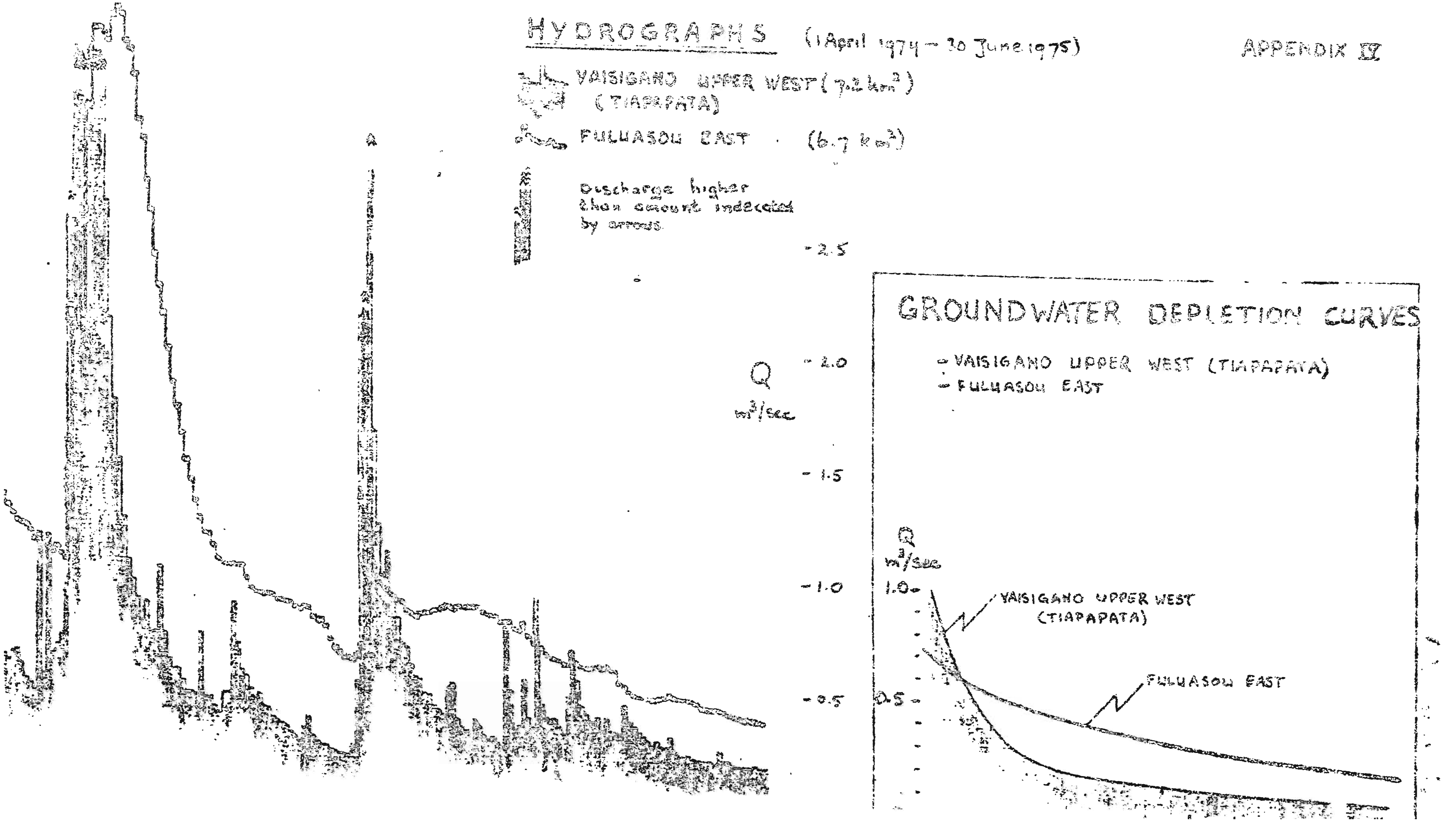
APPENDIX III

APPENDIX IV

(CONTINUED ON NEXT PAGE)



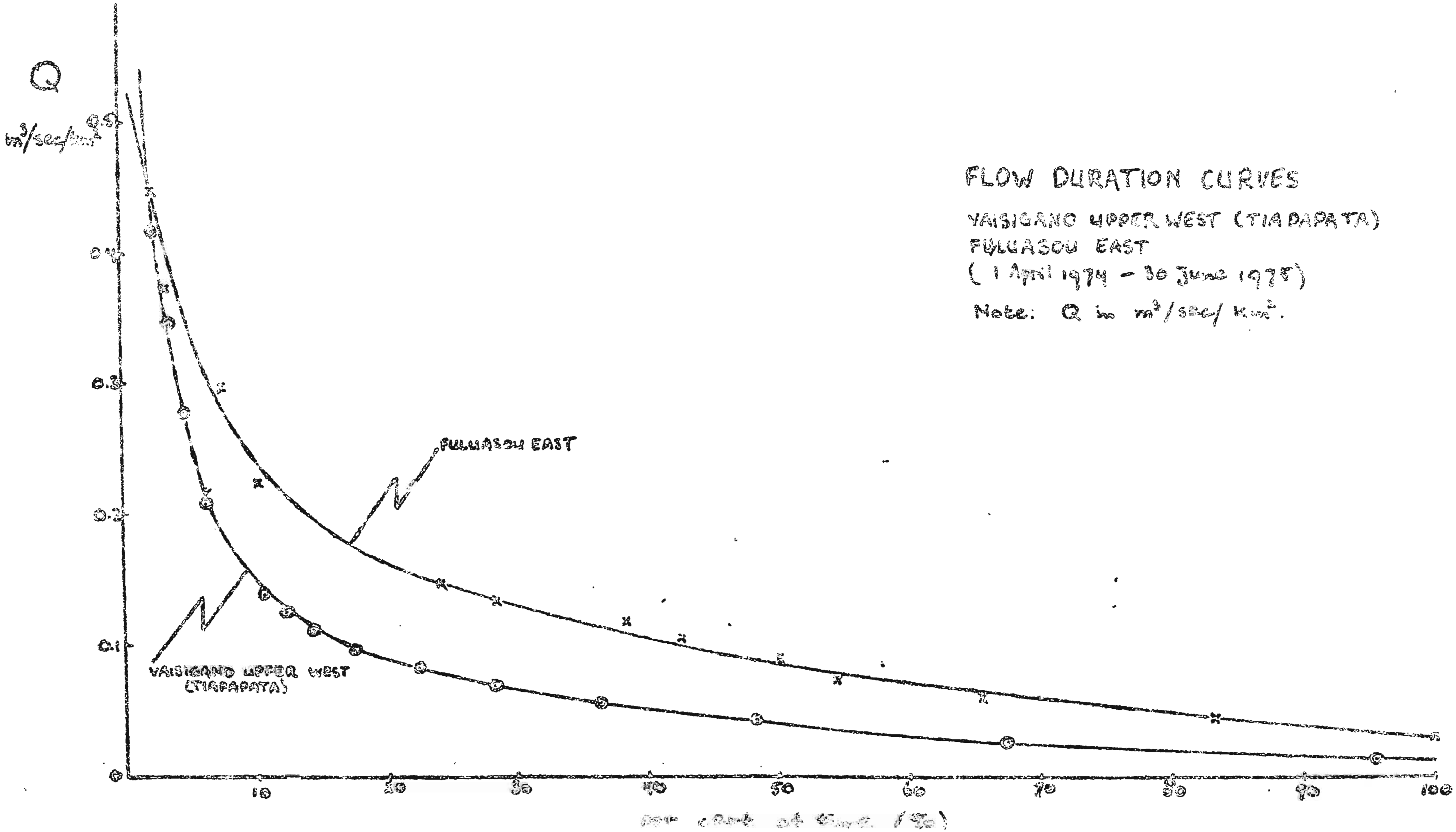
APPENDIX IV


HYDROGRAPHS (1 April 1974 – 30 June 1975)
VAISIGANO UPPER WEST (7.2 km²) (TIAPAPATA)
FULUASOU EAST (6.7 km²)
Discharge higher than amount indicated by arrows
Q m³/sec
2.5
2.0
1.5
1.0
0.5
GROUNDWATER DEPLETION CURVES
VAISIGANO UPPER WEST (TIAPAPATA)
FULUASOU EAST
Q m³/sec
1.0
0.5
VAISIGANO UPPER WEST (TIAPAPATA)
FULUASOU EAST

APPENDIX V

FLOW DURATION CURVES

YAISIGANO UPPER WEST (TIAPAPATA)
FULUASOU EAST
(1 April 1974 - 30 June 1975)
Note: Q in m³/sec/km².



DAILY RAINFALL AT AFIAMALU (mm)

	1974									1975					
Date	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
1	2.7		1.5				45.2	0.9	6.2	79.5	80.2	18.4	81.4		9.8
2	1.4	4.2	4.9	T	3.0			28.0	7.2	23.2	0.5	32.5	239.7	0.6	0.4
3	47.9		0.4	7.8	T	8.0	54.5	6.2	3.5	7.1	0.8	76.4	8.8	43.0	3.5
4	1.2		0.2	1.3			131.3					17.0	16.5	37.8	
5		11.3	1.7	20.4	1.6		16.5			10.0	37.5	2.8	21.5		0.4
6		20.4	58.7	12.0	4.2	0.2	2.5		28.4	T	20.1	3.1	9.2	20.5	8.6
7	0.7	2.5	50.7	0.5	1.3	30.5	T	0.2	75.6	27.2	2.8		33.1	27.0	1.8
8			13.6		1.2	39.6	4.4	3.3	6.9	4.5	6.4	4.1	13.4	2.4	23.5
9			1.2		1.7	2.1		48.9	1.5	33.0		11.5		T	
10			8.8		2.2	3.1		11.9	57.6	10.6	12.6	4.9	5.6	67.3	
11		1.0	T		0.1	0.3	42.4	20.4	59.7	10.0	0.3	2.4	3.9		
12	T	12.8		3.0		T	0.4	12.4	77.6	17.3	11.9			3.8	5.2
13	T	T		5.5		0.7	3.8	4.2	5.8	11.7	17.6	5.3	0.3	1.6	3.0
14		T	T	1.5		1.3	0.6	1.2	61.2	11.5	7.5	0.2	7.1	16.0	
15	2.7	0.1	0.4	0.3	0.4	T	0.5	92.5	11.0	7.2	52.1	7.6		5.8	
16		0.1	3.1	T	0.3	2.3	1.9	293.0	32.7		0.1		2.4	T	0.2
17		T		1.3	T	0.5		288.8	101.7					78.2	9.9
18	7.6		1.0	2.1	0.3	0.3	2.2	29.4	201.0	1.3			2.7	42.4	0.2
19	57.1	35.8	2.8	0.9		0.2	0.4	32.4	192.1	64.2	14.3	18.2	1.1	0.2	1.2
20	6.2	8.3	27.7		0.4				45.6	46.8		31.8	39.9		22.8
21	12.2	1.2	18.7	3.8				17.6	43.2	17.2	5.1	T	1.2		4.3
22	13.5	31.8	14.0	T		0.8	T	1.1	2.0	2.2	15.1	3.3	0.5	3.4	10.6
23	1.1	5.0	4.4				T	40.1	11.2	16.9	3.0	2.3		15.0	1.3
24	7.9	29.3	2.2			T	1.2	3.0	4.6	43.2	39.9	0.4	0.1	2.0	0.8
25	69.6	T	238.7	3.1		0.1		91.9	T	95.0	6.0	2.9		19.6	0.6
26	16.3	8.9	46.4		39.7		1.0	30.2	24.8	229.7	7.5	0.1	32.2	8.1	1.4

			1974							1975					
Date	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
27	T		6.0		T	0.6	7.7	17.1	7.9	250.6	1.4	0.3	5.0	1.9	3.8
28	7.4	19.4	0.3	T		6.9	73.0	1.7	23.8	43.0				14.2	2.1
29	14.3	4.3	2.1	0.7		24.0	79.2	0.9		237.8		3.5		28.6	2.2
30	2.3	0.8	17.9		T	1.8	1.7	3.4	12.7	157.7		26.0	6.2	7.1	3.0
31		1.8		T			2.1		4.1	125.6		146.6		14.0	

SPC-IUCN/2RSCN/WP.14
8th June 1976
ORIGINAL: ENGLISH

SOUTH PACIFIC COMMISSION

AND

INTERNATIONAL UNION FOR CONSERVATION OF NATURE

AND NATURAL RESOURCES

SECOND REGIONAL SYMPOSIUM ON CONSERVATION OF NATURE

Apia, Western Samoa, 14 - 17 June, 1976

CRITICAL MARINE HABITATS AND INSECT CONTROL IN THE SOUTH PACIFIC

Karl Joseph Marschall

Project Leader
Rhinoceros Beetle Project
Apia, Western Samoa

SOUTH PACIFIC COMMISSION

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by

Karl Joseph Marschall,
Project Leader,
Rhinoceros Beetle Project
Apia - Samoa.

CRITICAL MARINE HABITATS AND INSECT CONTROL IN THE SOUTH PACIFIC

In tropical seas, corals are next to the plancton probably the most important and also the most sensitive organisms. Their conservation is of greatest importance for all islands in this area. Corals live in a very narrow margin of favourable conditions and are extremely sensitive to changes in the environment.

The following are some observations on the effects of pollution on reef-forming corals.

Chemical pest control with chlorinated hydrocarbons, mainly Lindane (Benzene Hexachloride (gamma BHC)) was used in the past in the South Pacific area to control the rhinoceros beetle (Oryctes rhinoceros), a serious pest of the coconut palms. This method was used in particular in Fiji and on the Nukunono Atoll in the Tokelau group. However, it neither controlled the beetles nor did it prevent them from spreading. Between 1967 and 1970 the use of these chemicals was abandoned and biological means of control were introduced.

On a visit to the Nukunono Atoll in 1969, it was discovered that the reef in the lagoon along the motu Te Kakai was completely destroyed. Subsequent closer investigation revealed that with the exception of one species of Porites absolutely all corals were dead. There were not even a few tips of the branches left alive. It was inferred from the appearance of the coral's skeletons that they had all died at the same time about two to three years ago. Alcyonaria (soft) corals and algae typical for polluted areas by rivers and human waste were absent. No Acanthaster (Crown-of-Thorns Starfish) were found, only two specimens were seen about 3 - 4 kilometres away from the reef on live coral. The extent of dead reef was confined to a stretch of about 2 km along Te Kakai. At both ends of that stretch there was an area of moderate damage to corals. Beyond this area the rest of the reef inside and outside the lagoon showed no sign of destruction or damage.

It was learned that Lindane had been applied only on Te Kakai, and that also a whole bag of the insexticide had accidentally got into the lagoon at the same place.

No similar damage was found in any other part of the Nukunono lagoon or in the two other atolls, not even near the inhabited islet.

In October 1975 the reef in Nukunono was again briefly surveyed. It was found that the damaged reef had begun to recover in some parts, but large portions were still dead, only large colonies of Hydrocorallia had developed. Clams and some sponges as well as ascidians apparently had survived for many years from the time before the damage had set in. In the recovered areas the new corals were only Pocillopora species. The first new colonies had started to grow since about one to two years. Colour slides of the reef before and after the damage and of the recovering areas are shown.

On the atoll of Fakaofo in the Tokelaus, a bag of DDT was thrown accidentially into the lagoon in May 1975. In the following days thousands of fish were reported to be dead and two pigs died some time after. The development of the corals in this place is being closely observed.

A similar case of destruction of the reef, possible by chemical pollutants, was reported two years ago from Tutuila, but I never had a chance to look at this place. It was believed that chlorinated hydrocarbons are harmless to corals. Therefore, laboratory experiments were conducted to test the effects of these substances on live corals. The tests were conducted with DDt. It was found that DDT in extremely small quantities could kill corals. The experiments are described in detail and a sixteen-mm Film demonstrating the reactions of the coral polyps to the DDT is shown.

Reactions of some other marine animals to the poison are also briefly described.

The observations in the field and in the laboratory have exposed some of the hazards of indiscriminate application of insecticides. The consequences to be drawn from these observations are to use biological control measures wherever this is possible.

The Rhinoceros Beetle Project has developed methods of biological control of rhinoceros beatles with specific diseases without any side effects. This method is an example of a feasible, advantageous and cheap control of agricultural pests. Chemical control of the rhinoceros beetle in the South Pacific has cost enormous amounts of money, but it could not control the beetles nor prevent their spreading. In Samoa, chemical control was practised only to a very small degree, simply because there was no money for it. In all places where the virus disease caused by Rhabdienvirus oryctes or the entomophogus fungus Metarrhizium anisopliae had been introduced, the beetle damage had been reduced to an unprecedented degree at much lower costs and with less efforts. Owing to the nature of the biological control agents, no side effects are possible. This control method can be considered as appropriately suited to the ecology and the conditions of the islands in the South Pacific.

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SECOND REGIONAL SYMPOSIUM ON CONSERVATION OF NATURE
Apia, Western Samoa, 14 - 17 June, 1976

A PROPOSAL FOR A RESOURCE PLANNING AND CONSERVATION PROJECT IN WESTERN SAMOA

Dr Stephen G. Reynolds
FAO Soil and Plant Nutrition Specialist
WES 72/007 Project, Western Samoa

A PROPOSAL FOR A
RESOURCE PLANNING AND CONSERVATION PROJECT
IN WESTERN SAMOA

By

Dr Stephen G. Reynolds
(F.A.O. Soil and Plant Nutrition Specialist)
WES 72/007 Project, Western Samoa

Western Samoa is a small and beautiful country with finite quantities of different natural resources. As her population increases and agriculture, light industry and tourism are developed, increasing pressures are being placed on these resources. There is an urgent need for resource inventories, more meaningful and detailed land use maps, the identification of problem areas and the degree of environmental pollution, and the preparation of plans for the future utilization and conservation of resources.

... Attached are details of a proposed project shortly to be submitted to the Western Samoan Government for consideration and for onward transmission to UNDP and UNEPA if endorsed by Government. This three-year project will initiate resource planning and conservation studies and lay the foundations for a Government Resource Planning and Conservation or Environmental Control Unit. Although the project will initially have no regulatory powers, the necessary legislation will be prepared and training opportunities for local counterparts provided in readiness for transfer of responsibility to National staff.

It is proposed that UNDP/UNEPA would contribute US$230,350 to cover the services of a Resource Planning and Conservation Specialist, various stores and equipment, and fellowships. The Western Samoan contribution of WS$46,500 would cover counterpart and support personnel and additional local supplies.

This document is circulated for information and discussion. As the author is unfortunately unable to be present at the conference it would be appreciated if comments could be passed on via Mr W. Schreckenberg, F.A.O. representative at the conference.

I. BACKGROUND AND SUPPORTING INFORMATION

A. Justification for the Project

Western Samoa is a small and beautiful country with finite quantities of different natural resources such as land, soil, water, timber, fish and natural scenery. While the population remained relatively small, few problems of a resource pollution or resource dissipation nature arose. As the population increases greater demands will be placed on these resources. If a resource is used faster than it can replenish itself or if the resource is spoiled by pollution, then future generations will have little share in the resource, whereas wise use will ensure that future generations will benefit.

Samoa has reached the stage where many of her people wish for more than a simple subsistence way of life. The population, demands for imported goods and foodstuffs, tourism and utilization of natural resources are all increasing. In at least three areas there are signs of increasing pressures. Samoa's fresh water resources are replenished and maintained by the rainfed, forested, catchment areas running along the highland areas of both islands. Rapid land development has already resulted in some indiscriminate tree clearance. Also, poor siting of buildings, roads, etc., may destroy the natural beauty of Samoa, and inadequate provision of waste disposal services may add to pollution problems and spoil the general environment, lowering the overall quality of life. With constant fishing lagoon fish populations have declined markedly in recent years.

There is a need to consider what steps are being taken to plan and supervise the development and use of natural resources.

A proposal for a Regional and Town Development Planning Bill, drafted in collaboration with a United Nations Planning Legislation Adviser (1973), reached committee stage, but has apparently made no further progress. This recommended the establishment of a Regional and Town Development Planning Board, and the setting up of a Technical Planning Section, staffed by a Technical Planning Officer and others, in the Department of Public Works. More recently (1975) in response to a request from the Western Samoan Government, Holloway (IUCN) and Floyd (UNDAT) prepared a report on "A National Parks System for Western Samoa". They indicated that the Government had decided that the Lands and Survey Department should have executive responsibility for the parks system. However, it was appreciated that a very wide range of expertise was required for effective management of different park system components and the active cooperation, involvement and assistance of other government departments would be essential.

Because of the urgent need for resource inventories, more meaningful and detailed rural and urban resource and land use maps, the identification of problem areas and the preparation of plans for the future utilization of resources, it is felt that there is an urgent need for the establishment of a Resource Planning and Conservation or Environmental Control Unit at the focal point of Government. Resource categories to be studied include land, water, minerals, forests, air, fish and natural scenery, as well as the social and physical aspects of town planning, the degree of pollution and measures required for the future conservation of resources.

UNDP/UNEPA assistance would be required for a period of 3 years initially. Future developments depend on Government action on the Planning Bill and the proposed Parks System, and steps taken to establish a formal Planning and Resource Conservation Unit as a part of Government structure. In the project period considerable progress should be possible in initiating resource planning and conservation studies and in laying foundations for later government legislation and action.

B. Institutional Framework

The Government's cooperating agency for the project will be the Prime Minister's Department.

The Resource Planning and Conservation Specialist will be responsible for carrying out the agreed program in collaboration with the related Government institutions where necessary, and for submitting official reports.

As Government is actively considering the type of planning and resource conservation facilities it will establish, this project is a temporary one which will serve to coordinate the considerable body of material already available in Agriculture, Public Works, Lands and Survey, and other departments, collect further information in collaboration with the various departments, prepare tentative plans and suggest legislation required. The project would have no regulatory powers, and in future implementation would best be carried out by the various functional departments such as Agriculture, Public Works, Lands and Survey, etc. The information, planning and preparation of legislation, should be of considerable value in itself, but will also serve as an important basis for a Government Resource Planning and Conservation Unit.

C. Other Related Activities

The project duration of a total of three years will cover the period January 1977 to December 1979 when the Government Resource Planning and Conservation Unit will absorb the project and assume full responsibility for planning and conservation matters.

Although based in the Prime Minister's Department the project will have close contacts with all other Government departments, especially Agricultrue, Lands and Survey, Public Works, Economic Development, etc., on which the project will largely depend for data collection, and on which the future Resource Unit will depend for plan implementation.

D. Future UNDP Assistance

The project is designed as a short term measure to fulfill some of the resource planning and conservation needs of Government. However, should further assistance be required when the Government unit is established, then further consideration will be given at a later date.

II. OBJECTIVES OF THE PROJECT

A. Long Range Objectives

The Project's long term objectives relate to advising the Government on resource utilization patterns and methods which will ensure that Samoans for many generations to come can share in the benefits derived from these resources. This is in line with one of the main objectives of the Third Five Year Development Plan (1975-79) which is to improve the welfare of all the Samoan people.

B. Immediate Objectives

The Project's particular objectives are to assist the Government in the following:

1. Preparation of inventories of available resources.

2. Preparation of plans for future use of resources.

3. Preparation of necessary legislation and regulatory powers which may be required to ensure sound resource development and conservation.

4. Provision of training opportunities and extension support.

C. Investment Potential

No expected investment potential.

III. WORK PLAN

A. Relationship of Specific Programme to Previous Project

Although not directly related, the project would expand on the work of the U.N. Planning Legislation Adviser (who assisted in drafting the Regional and Town Development Planning Bill) and Holloway and Floyd, and work closely with Fisheries, Hydrology, Forestry, Agriculture, Lands and Survey and Public Works projects.

B. Project Review

The project will be subject to a tripartite project review by January 1978 in accordance with UNDP policy and procedures established for this purpose. The organization and terms of reference and timing of the review will be decided by mutual consultation between the Government, UNDP and UNEPA.

C. Description of Project Activities

1. Immediate Objective Number 1 - Resource Inventories

		Location	Starting Date and Duration
1.1	In collaboration with various Government departments identify resource areas and social and physical factors relating to rural and urban planning that require study.	Apia	January-March 1977
1.2	In collaboration with various Government departments collate existing data and collect detailed information relating to 1.1	Apia	March 1977-December 1978

		Location	Starting Date and Duration
1.3	Where necessary undertake field studies to corroborate information or obtain fuller details.	Country-wide	March 1977-December 1977
1.4	After evaluating information available, previous data storage systems and land use maps, select systems for storing and mapping information for future rural and urban planning purposes.	Apia	March 1977-June 1978
1.5	In consultation and collaboration with various Governments departments, prepare a detailed central record of all available data using selected data storage and mapping systems.	Apia	June 1977-December 1979

2. Immediate Objective Number 2 - Resource Planning

2.1	In collaboration with various Government departments, prepare plans for future use of resources.	Apia	January 1978-December 1979
2.2	Consult with relevant departments in identifying sound practices for the development of each resource.	Apia	January 1978-December 1979
2.3	Where applicable, and in consultation and collaboration with relevant departments, set tentative targets for degree of utilization and resource replenishment requirements.	Apia	January 1978-December 1979
2.4	In collaboration with various Government departments, especially Public Works, prepare plans for the development of Apia and other urban centres, and for the provision of services in urban and rural context.	Apia	January 1978-December 1979

3. Immediate Objective Number 3 - Legislation and Regulatory Powers

3.1	Study existing legislation that relates to resource planning and conservation.	Apia	June-December 1978
3.2	Consult with appropriate authorities as to the likelihood of certain legislation or regulatory powers being accepted by Parliament or the people of Western Samoa.	Apia	June 1978-December 1979

		Location	Starting Date and Duration
3.3	In consultation with appropriate division of Prime Minister's Department prepare details of necessary legislation and regulatory powers which may be required to ensure sound resource development and conservation.	Apia	June 1978-December 1979

4. Immediate Objective Number 4 - Training and Extension

4.1	Provision of in-service training for counterparts and other staff.	Apia	January 1977-December 1979
4.2	Assist Government Departments of Broadcasting, Education, Agriculture, Public Works, and others as appropriate, in popularizing concepts of resource planning and conservation.	Country-wide	January 1977-December 1979

Timing for Transfer of Project Responsibility

Responsibility will be gradually taken over by the national staff as of the second half of 1977. In fact the project may be merged into a locally drawn up structure before then. In the meantime guidance will be provided by the UNEPA experts assigned to the project.

Inventory and Disposition of Equipment and Other Facilities

September 1979.

Terminal Report

The Terminal Report will be addressed to the Prime Minister with copies to the Ministers of Economic Affairs, Lands and Survey, Works, Agriculture and Communications and Transport and will:

(a) assess the need for resource planning and conservation activities in Western Samoa;

(b) present details of available resources with degree of exploitation and reserves, and environmental statements relating to both rural and urban areas;

(c) present detailed plans for future use of resources and for the development of Apia and other urban centres;

(d) suggest legislation which will be required to implement resource conservation plans and urban and rural planning;

(e) outline plans for a permanent Resource Planning and Conservation Division within the Western Samoan Government structure.

The Terminal Report is scheduled for presentation to the Government by the completion date of the project. A final field draft must therefore be sent to UNEPA Headquarters for review, endorsement and reproduction not later than four months before the end of the project.

To facilitate preparation and review of the report, an annotated outline should be prepared and submitted to UNEPA for review by June 1979. The draft report should be submitted to UNEPA for review by September 1979. (Should the project's activities be extended beyond 1979, an Interim Report will be submitted by the end of 1979. This report will summarize project results and make recommendations for future work.)

D. Description of UNDP Inputs

1. Assignment of International Staff (all located in Apia)

	Duration	Starting Date
(i) Resource Planning and Conservation Specialist The Resource Planning and Conservation Specialist will be responsible for the overall implementation of the project, and specifically for the implementation of activities 1.1, 1.2, 1.4, 1.5, 2.1, 2.3, 2.4, 3.1, 4.1, 4.2	36 m/m	January 1977
(ii) Associate Expert, Resource Planning The associate expert will work under the direct supervision of the Resource Planning and Conservation Specialist. He will be jointly responsible for the implementation of activities 1.2, 1.3, 1.5, 2.2, 2.3, 2.4, 4.1.	36 m/m	January 1977
(iii) Associate Expert, Planning Legislation The associate expert will work under the direct supervision of the Resource Planning and Conservation Specialist. He will be jointly responsible for the implementation of activities 3.1, 3.2, 3.3.	18 m/m	June 1978

2. Training Provisions

The principal aim of the fellowship training programme is to assist the Government of Western Samoa in securing training requirements for national staff. The fellowships include degree, post-graduate and technical study awards.

		Duration	Starting Date
(i)	Fellowships		
	Resource Planning	36 m/m	1977-1979 (Australia)
	Town and Country Planning, post-graduate award	24 m/m	1977-1978 (New Zealand or Australia)
	Resource Mapping Techniques	6 m/m	1977 (Australia)

(ii) In-service training of national counterparts will continue under the immediate technical supervision of UNDP/UNEPA staff.

3. UNDP Provided Supples and Equipment

Expendable items

Delivery of supplies is required over the three years of the project in connection with field research, office mapping and documentation and extension activities. Breakdown of requirements is as follows:

		Location		US$
(i)	Office stationery, mapping pens, etc.	Apia	1977	1,000
			1978	1,500
			1979	1,500
(ii)	Field tapes, spades, etc.	Project sites	1977-1979	1,000
(iii)	Miscellaneous materials for project support	Project sites	1977-1979	1,000
	Expendable equipment TOTAL :			$6,000

Non-expendable items

(i)	A major requirement for the efficient performance of field duties is the provision of a 4-wheel drive vehicle for use by project staff.			
	1 Toyota LWB Land Cruiser	Apia	January 1977	7,000
(ii)	Equipment required for field and office use associated with various mapping activities. Items will include survey equipment, draughting equipment, map cabinets, etc.	Apia	January-June 1977	15,000
	Non-expendable equipment TOTAL:			$22,000

4. Miscellaneous

(i)	Operation and maintenance of equipment	500
(ii)	Reporting cost - terminal report	750
(iii)	Sundry	1,000

E. Description of Government Inputs

1. As per the attached Project budget covering the government contribution in kind.

2. Government will be responsible for providing insurance, repairs and maintenance costs for the project vehicles.

3. Government will make available to Project staff government houses for rent.

PROJECT BUDGET COVERING GOVERNMENT CONTRIBUTION IN KIND

COUNTRY : WESTERN SAMOA

PROJECT NO :

TITLE : RESOURCE PLANNING AND CONSERVATION

		TOTAL		1977		1978		1979	
		m/m	$	m/m	$	m/m	$	m/m	$
10	PROJECT PERSONNEL								
11.01	COUNTERPART TO RESOURCE PLANNING SPECIALIST	36	9,000	12	3,000	12	3,000	12	3,000
11.02	ADMINISTRATIVE SUPPORT STAFF CLERK/TYPIST	36	3,180	12	1,060	12	1,060	12	1,060
11.03	DRAUGHTSMAN	36	6,000	12	2,000	12	2,000	12	2,000
11.04	FIELD ASSISTANT	36	3,780	12	1,260	12	1,260	12	1,260
11.05	DRIVER	36	1,860	12	620	12	620	12	620
19	COMPONENT TOTAL	180	23,820	60	7,940	60	7,940	60	7,940
40	EQUIPMENT								
41	EXPENDABLE EQUIPMENT		6,000		2,000	2	2,000		2,000
42	NON-EXPENDABLE EQUIPMENT		4,500		2,000		1,300		1,200
43	PREMISES		2,000		2,000				
49	COMPONENT TOTAL		12,500		6,000		3,300		3,200
50	MISCELLANEOUS								
51	OPERATION & MAINTENANCE EQUIPMENT		1,500		500		500		500
53	SUNDRY (Computer & Flying Time, Photo Services)		5,080		1,700		1,700		1,630
54	OTHERS: (WAGES CASUAL LABOURERS)		3,600		1,200		1,200		1,200
59	COMPONENT TOTAL		10,180		3,400		3,400		3,380
99	GRAND TOTAL		46,500		17,340		14,640		14,520

PROJECT BUDGET COVERING UNDP CONTRIBUTION

COUNTRY: WESTERN SAMOA

PROJECT NO:

TITLE: RESOURCE PLANNING AND CONSERVATION

		TOTAL		1977		1978		1979	
		m/m	$	m/m	$	m/m	$	m/m	$
10	PROJECT PERSONNEL								
11	EXPERTS								
11.01	RESOURCE PLANNING SPECIALIST	36.0		12.0		12.0		12.0	
11.99	SUB-TOTAL	36.0	136,800	12.0	45,600	12.0	45,600	12.0	45,600
15	TRAVEL	36.0	5,400	12.0	1,800	12.0	1,800	12.0	1,800
19	COMPONENT TOTAL		142,200		47,400		47,400		47,400
31	FELLOWSHIPS		57,900		26,700		22,200		9,000
39	COMPONENT TOTAL		57,900		26,700		22,200		9,000
49	EQUIPMENT		28,000		23,666		2,166		2,168
59	MISCELLANEOUS		2,250		600		500		1,150
99	TOTAL		230,350		98,366		72,266		59,718

TOTAL UNDP CONTRIBUTION : $230,350

TERMS OF REFERENCE

RESOURCE PLANNING AND CONSERVATION SPECIALIST

The Resource Planning and Conservation Specialist will undertake the following duties:

1. Coordinate Project activities.
2. Coordinate collection of resource information.
3. Supervise preparation of a detailed central record of resource data and information.
4. Supervise preparation of resource statements relating to rural and urban areas.
5. Coordinate preparation of plans for future resource use.
6. Participate in the preparation of guidelines for sound resource development.
7. Participate in the preparation of resource legislation and regulatory procedures.
8. Organize and conduct in-service training for counterpart and supporting staff and assist in popularizing concepts of resource planning and conservation.

ASSOCIATE EXPERT, RESOURCE PLANNING

Under the direct supervision of the Resource Planning and Conservation Specialist, the Associate Expert, will undertake the following duties:

1. Assist in the collection of resource information.
2. Undertake field duties related to resource information collection.
3. Assist in the preparation of a detailed central record of resource data and information.
4. Assist in the preparation of resource statements relating to rural and urban areas.
5. Assist in identifying sound production practices for resource development.
6. Assist with extension activities.
7. Participate in all other activities as required by the Resource Planning and Conservation Specialist.

ASSOCIATE EXPERT, PLANNING LEGISLATION

Under the direct supervision of the Resource Planning and Conservation Specialist, the Associate Expert will undertake the following duties:

1. Undertake studies of existing planning legislation.
2. Assess anticipated planning legislation in relation to local customs and practices.
3. Assist in the drafting of necessary legislation and regulatory procedures which may be required in implementing future resource management activities.
4. Participate in all other activities as required by the Resource Planning and Conservation Specialist.