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Conservation in Mauritius

A report to the Government of Mauritius

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FOREWORD

Arising from the visit by Sir Peter Scott to Mauritius in 1973, proposals were made for a further mission by specialists in terrestrial and marine conservation. After discussion with the Government of Mauritius, IUCN/WWF agreed to provide the services of Mr. John Procter, made available by the good offices of the Institute of Terrestrial Ecology of the UK Government's Natural Environment Research Council, and Mr. Rod Salm, as consultants to advise on the conservation requirements of Mauritius and to make recommendations for a conservation programme.

The present report has been compiled and largely written by Mr. John Procter who accepts responsibility for all the opinions and recommendations.

The sections on marine life and marine reserves were written by Mr. Rod Salm (Sections 1.23, 2.49, 2.491, 2.5 and Appendices 4 and 5).

Their mission to Mauritius took place during October and November 1974.

Section 2.6 (WILDLIFE - LAND) and Appendix 7 are abridged and edited, with the authors' permission, from Temple, Staub and Antoine's 'Some background information and recommendations on the preservation of the native flora and fauna of Mauritius'.

Appendix 6 was written specially by Stan Temple.

The underwater photographs were taken by Rod Salm.

The land photographs were taken by John Procter.

It is submitted to the Government of Mauritius by IUCN/WWF as providing the basis for a national conservation policy and action programmes.

TERMS OF REFERENCE

The terms of reference set out by IUCN were as follows -

1. The Consultant will advise on the conservation requirements of Mauritius and on a programme for their implementation.
2. The duties required by the project are -
 - (a) to review the status of the natural resources of Mauritius and associated areas with particular reference to:
 - (i) present Government policy and the means for its implementation,
 - (ii) the extent and characteristics of the wildlife resources,
 - (iii) the present state of wildlife resource management,
 - (iv) the potential values of the wildlife resources.
 - (b) on the basis of (a) above, to consider how the maximum long-term benefit might derive to the people of Mauritius from these natural resources, with particular reference to:
 - (i) policy revision,
 - (ii) legislative facilitation,
 - (iii) intensified management; including research.
 - (c) on the basis of (a) and (b) above, to make appropriate recommendations for the formulation and implementation of a programme for the conservation and management of these wild-life resources.
3. The requirements of paragraph 2 above shall be achieved by a visit by the Consultant to Mauritius for the purpose of -
 - (a) on-the-spot survey
 - (b) consultation with officials
 - (c) collection and collation of relevant data.
4. The Consultant shall render to IUCN/WWF a Report on his work required by paragraph 2 above; with a view to its eventual transmission to the Government of Mauritius.

SUMMARY

1. The wildlife of Mauritius is very near the point of no return. Destruction of habitats started more than 300 years ago. Successive administrations, through 400 years of history, have failed to capitalize most of the renewable natural resources available to them.

2. It is possible to save the remaining wild resources by decisive action. The attack should be three-barrelled -

(1) Development of National Parks, leading to a positive return in the short to medium term and incalculable long-term benefit.

(2) Education - investment in the future.

(3) Conservation of genetic resources - a joint responsibility of Mauritius and the rest of the world.

3. Government should without delay make a public statement of its policy.

4. Mauritius has a long tradition of scientific research, cultural activity and thoughtful law-making. These form an adequate background for the first decisions and the first stages in planning.

5. Mauritius is cooperating in the UNESCO MAB Programme, and in the International Council for Bird Preservation. It has signed the African Convention on the Conservation of Nature and Natural Resources (Algiers 1968) and has ratified the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, DC 1973).

6. Planning and action will require discipline and restraint in the short term, but will result in economic advantage in the medium term and permanent benefits of a priceless kind in the long term.

7. Wild-land and coral-reef uses must be understood, planned, developed and managed as unified complexes.

8. Land still exists in Mauritius which is under-used or derelict. Mauritius cannot afford this luxury.

9. A central authority, with adequate powers, should control the use and management of wild-land and coral-reef resources.

ACKNOWLEDGEMENTS

It is a pleasant duty to record our debt of gratitude to the many people who helped us in so many ways during our visit to Mauritius. We would particularly like to thank Wahab Owadally, Conservator of Forests, and David Ardill, Chief Fisheries Officer, who gave generously of their time and knowledge, and placed many of the facilities of their Departments at our disposal. We are also most grateful to Dr Robert Antoine, Director of the Mauritius Sugar Industry Research Institute, for allowing us to use his cartographic, herbarium and library facilities. Sharing, as we do, his concern, we feel that Dr Antoine's acceptance of the burden of playing a leading role in natural resource conservation in Mauritius will prove to be a turning point of the greatest significance. Below is a list of the people whom we met and with whom we discussed problems of wildlife and natural resource management, or who helped our project in various ways. To all of them we owe our grateful thanks.

His Excellency the Governor-General, Sir Abdool Raman Mahomed Osman.

The Prime Minister, the Rt Hon Sir Seewoosagar Ramgoolam.

The Minister of Agriculture, Natural Resources and the Environment, The Hon Satcam Boolell.

The Minister of Fisheries, the Hon Ramsoondur Modun.

The Cabinet Secretary, Mr D Burrenchobay.

The Permanent Secretary to the Ministry of Agriculture, Natural Resources and the Environment, Mr L Purmessur.

The Project Manager of the Rural Development Unit, Ministry of Economic Planning and Development, Mr O Hawoldar.

Administrative Assistant, Ministry of Agriculture, Natural Resources and the Environment, Mr Diouman.

Administrative Assistant, Ministry of Agriculture, Natural Resources and the Environment, Mr Seewoorattan.

The Director of the Mauritius Sugar Industry Research Institute, Dr Robert Antoine.

The Director of the Mauritius Institute, Chairman of the Ancient Monuments and Nature Reserves Board, Mr Claude Michel.

The Chairman of the Royal Society of Arts and Sciences, Mr M Rouillard.

The Conservator of Forests, Mr A W Owadally.

The Deputy Conservator of Forests, Mr A M Gardner.

The Chief Fisheries Officer, Mr D Ardill.

The Chief Information Officer, Mr P D'Arcy Champney.

Professor Manrakhan, Professor of Agriculture, University of Mauritius.

Mr R Davis, Acting Director, Institute of Education, University of Mauritius.

Mr M Masudevan, UNESCO Expert, Ministry of Education.

Mr G van den Enden, UNESCO Expert in Agricultural Education.

Mr M Chadwick, ACTS Science Adviser.

Mr J Birt, UNDP Country Representative.

Mr E de Casterlais, UNDP Deputy Country Representative.

Dr A T Schumacher, IBRD Representative.

Mr O Lafoureaude, IBRD Representative.

Mr Ganguly, Forest Officer, Rural Development Unit.

Mr Claude Noel, CMG.

Mr Clement Rey, Manager, Constance Sugar Estate.

Dr R E Vaughan, formerly Botanist, Mauritius Herbarium.

Mr L Edgerley, formerly Conservator of Forests.

Dr F Staub, Chairman, Mauritius Section, ICBP.

Mr J de B Baissac, formerly Chief Fisheries Officer.

Mr P de B Baissac, Fish biologist.

Mr D Pelicier, diver extraordinary.

Dr R Julien, Botanist in charge, Mauritius Herbarium.

Mr J Gueho, Botanist, Mauritius Herbarium.

Mr N Akaloo, Mauritius Broadcasting Corporation.

Mr I Jhoty, Scientific Assistant (Cartography).

Mr A Hosanee, Technician (Cartography).

Mr D Apave, Le Mauricien newspaper.

Dr S Temple, ornithologist.

Mrs J Horne, ornithologist.

Mr A Cheke, leader, BOU Mascarene Expedition.

... of one ... and ... National Park ...

... agreements over National Park land in private ...

... for National Park and Nature Reserves ...

... the Black River National Park ...

... plan for the Black River National Park ...

... extension of the Black River National Park ...

... the site in National Park ...

... of National Park development ...

LIST OF RECOMMENDATIONS

Section	Recommendation
<u>Immediate Action</u>	
4.222	Elimination of rabbits and goats on Round Island.
4.223	Establishment of a scientist/warden on Round Island.
4.224	Infrastructure for scientist/warden on Round Island.
4.227	Implementation of Round Island management plan.
4.231	Guardian for Ile aux Aigrettes Nature Reserve.
4.232	Funds for Ile aux Aigrettes.
4.241	Appointment and duties of Conservation Officer.
4.251	Planned allocation of funds from Conservation Coinage Issue.
4.262	Conservation and hotel development.
4.271	Captive breeding programme for endangered birds.
4.272	Captive breeding programme for endangered birds.
4.281	Checklist of endemic Mascarene plants.
4.292	Cooperation in forest enterprises.
4.293	Survey of firewood supply and demand.
<u>Mainstream proposals</u>	
4.322	White Paper on Conservation Policy.
4.332	National Parks legislation.
4.333	Revision of conservation legislation.
4.341	Appointment of Board of Trustees.
4.342	Responsibility and membership of Board of Trustees.
4.343	Functions of Board of Trustees.
4.344	National Parks and Wildlife Service.
4.351	Procedure for estimating revenue and expenditure for Board of Trustees.
<u>National Parks</u>	
4.361	Creation of one land and one marine National Park initially.
4.362	Management agreements over National Park land in private ownership.
4.363	Management plans for National Parks and Nature Reserves.
4.364	The Black River National Park. Management plan for the Black River National Park. Future extension of the Black River National Park.
4.365	The Baie de l'Arsenal marine National Park. Coordination of hotel and marine National Park development.

Section	Recommendation
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National Parks (Continued)

- | | |
|-------|--|
| 4.366 | Northern islands National Park.
Serpent Island and Pigeon Rock to be Nature Reserves. |
| 4.367 | Flat Island/Gabriel marine National Park. |
| 4.368 | Blue Bay marine National Park. |
| 4.369 | Future land National Parks. |

Rare species

- | | |
|------|--|
| 4.43 | Endemic species in Nature Reserves. |
| 4.44 | Captive breeding programmes for endangered birds. |
| 4.45 | Cultivation programmes for endangered plants. |
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Research

- | | |
|------|---|
| 4.52 | Collection of basic biological information. |
| 4.53 | Botanic gardens and endangered species. |
| 4.54 | Ecology of endangered species. |
| 4.55 | Ecology of coral reefs. |
| 4.56 | Pesticide and other residues in coral reefs. |
| 4.57 | Ecology of rare birds. |
| 4.58 | Flora of Mauritius and the distribution of rare plants. |
| 4.59 | Recommendations of the Mauritius UNESCO/MAB Committee. |

Education

- | | |
|------|--|
| 4.64 | Specialist on environmental education. |
| 4.65 | Support for specialist on environmental education. |

Miscellaneous proposals

- | | |
|------|--|
| 4.71 | Allocation of abandoned tea land. |
| 4.72 | Perrier Nature Reserve as a research area. |
| 4.73 | Ratification of International Convention on Trade in Endangered Species. |
| 4.74 | Supporting legislation for the OAU Convention on the Conservation of Nature and Natural Resources. |
| 4.75 | Records of old research plots in Bel Ombre and Belloguet. |
| 4.76 | Casual access into Nature Reserves. |
| 4.77 | Black River Gorges lookout as a visitor centre. |
| 4.78 | Second edition of Brouard's 'History of the Woods and Forests of Mauritius'. |
| 4.79 | Stamps based on endemic flowering plants. |

Future progress

- | | |
|-----|-------------|
| 4.8 | Guidelines. |
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PART 1

1. INTRODUCTION

1.1 Framework

1.11 Several reports on the subject of wildlife conservation in Mauritius have been written in the last five years. Our purpose in this report is not to produce a fresh set of recommendations, some perhaps conflicting with previous ones, but to draw together past proposals into a workable system, within the framework of a number of policy statements already made by the Mauritius Government. The principal recent reports dealing particularly with wildlife conservation are those of Kai Curry-Lindahl (1971), Sir Peter Scott (1973), Iain J B Robertson (1974) and Temple, Staub and Antoine (1974)*. H C Pereira's report of 1969 was mainly concerned with water resources and contained recommendations on catchment management.

1.12 This report is specifically a follow-up to Sir Peter Scott's 1973 recommendations. It is not exhaustive. Mauritius has a long history, a large population, a complex social structure and a buoyant economy. The whole of the very wide field of conservation in Mauritius could not be covered in a two month survey and cannot be covered in a single report of this type. Many subjects require further investigation. Some are mentioned briefly; others await identification. Our task was the practical one of establishing priorities and finding the points at which effort would be most likely to be effective.

1.13 The Mauritius Government has made important policy statements in its Four-year Plan for Social and Economic Development (1971-75). A further important declaration of intent was made in His Excellency the Governor-General's Speech at the opening of the Legislative Assembly in March 1974.

'Steps will be taken to implement the recommendations of the committee set up under the aegis of the National Commission for UNESCO to study and advise on environmental problems. My Government proposes to give effect to the main recommendations of the Scott Report and of the African Convention on the Conservation of Nature and Natural Resources aiming principally at the conservation, utilisation and development of the flora and fauna of Mauritius.'

1.14 The Mauritius Government is to be warmly congratulated on the steps it has already taken to safeguard its remaining wild resources by joining the international community of concerned nations. Mauritius is cooperating in the UNESCO MAB (Man and the Biosphere) Programme and the International Council for *Curry-Lindahl has also commented extensively on conservation problems in Mauritius in a recent article (Curry-Lindahl 1974).

Bird Preservation. It has signed the African Convention on the Conservation of Nature and Natural Resources (Algiers 1968) and has ratified the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington DC. 1973).

1.2 The resources

1.21 The motto of Mauritius 'Stella clavisque maris Indici' embodies within itself the background to many of the problems which face the island in the final quarter of the 20th century. The early recognition of the strategic value of Mauritius has ensured a long history of human occupation and exploitation. Its beauty and scientific interest have ensured a long succession of distinguished visitors and abundant documentation of its unique natural history. The fertile soil of the island has led to the development of the sugar industry (more than 60% of the land area of Mauritius is under sugar cane) which has on the whole ensured a buoyant economy but at the same time has resulted in one of the world's highest population densities (about 450/Km²).

1.22 These historical and geographical facts have inevitably led to the depletion of the wildlife resources of the island to the point where many of the management concepts worked out in other countries are no longer applicable.

The dominant features of the terrestrial ecology of Mauritius today are -

- 1 The human population density, which, at around 450/Km², is one of the highest in the world.
- 2 The intensity of land use over most of the island, throwing into sharp relief those areas which are not well utilized.
- 3 The very large numbers of introduced species, both animal and plant.
- 4 The restriction of natural habitats to a few small areas.
- 5 The relatively large number of species unique to Mauritius which have been exterminated or are in grave danger as a direct or indirect result of man's activity.

1.23 In contrast with the terrestrial systems, no marine organism, so far as we know, that was endemic to the island, is extinct. A single species (an oyster) has been deliberately introduced, and a copepod and a starfish may have been introduced inadvertently. The problem of displacement of native marine flora or fauna by exotics does not, as yet, exist. The problem in the marine environment is one of thoughtless, virtually unchecked destruction of the complex ecosystems of coral reefs by coral and shell collection, damage by boats, wasteful fishing

techniques and overfishing. The physical limits of the resources are obvious on land; they are less so in the sea, but the coral reefs around Mauritius are strictly limited in area; beyond the reef front, the sea floor drops away to oceanic depths, where corals cannot grow.

1.24 Nevertheless, the point of no return, though close, has not been reached. Mauritius has the opportunity now to capitalize on its remaining natural resources and at the same time to preserve its unique heritage, while remembering that many options are no longer open.

1.3 Some basic principles

1.31 It is the task of the resource manager to husband the natural wealth of the reefs and mountains and forests so that they continue to provide benefits tangible and intangible to the human community in whose trust they lie. This is the essential interpretation of conservation, which I have defined (Procter 1971) as 'the wise use or management of a renewable natural resource, so that at the end the resource is no poorer or less able to renew itself than at the beginning'. In the case of resources already depauperate or degraded, 'conservation' will imply a period of building up or regeneration. An essential ingredient of this definition of conservation is the implication of beneficial use by man. In the economist's terms 'conservation is a public policy which seeks to increase future usable supplies of a natural resource by present actions' (Scott 1955, quoted by Johnston et al 1967). It is thus the task of the resource ecologist to examine the pattern of land use to ensure that land which is not already committed to a long-term beneficial use, is not allowed to lie idle or deteriorate, but is brought into wise, planned use.

1.32 Up to about 200 years ago, man's use of the world's natural resources was reckless. He believed that the resources were limitless and there was little evidence to suggest that he should restrain his exploitation of them. Writing in 1699, Governor Deodati (of Mauritius) stated 'Wood is so abundant in the forests that 2000 men continually felling trees for 200 years would never see the end of it' (Brouard 1963). Today this can be seen to be a ridiculous exaggeration but it was a common attitude at the time. However, already about 50 years earlier the Governor-General at the Cape had sounded a note of warning in a report to the Directors of the Dutch East India Company (in charge of Mauritius). - 'In 20 years not a single tree worth exploiting will be found in the whole island' (Brouard 1963).

1.33 Today, it is coming to be realised that the resources of the world are

strictly limited and must be husbanded and managed if man himself is to survive. This is particularly true of countries that are highly industrialised or densely populated. The problems which face the Mauritius Government today are not of recent making. They are the direct results of the economic, social and political history of the island and have their origins in some of man's earliest acts here, starting 400 years ago. That Mauritius is not alone in facing such problems is emphasised in such statements as the following by F E Popper, Assistant Director General (Fisheries) of FAO. 'Concern about the degree to which man is tapping natural resources available to him, the way in which he does so, and the effects of his actions on the environment, has intensified in recent years. It has reached a point beyond that of academic interest and, in many societies, is a subject of constant public concern.' (Popper, 1972).

1.34 There are two fundamentally different kinds of renewable natural resource. The first of these consists of species which have an extensive distribution and which can be managed and exploited directly. Examples are green turtles, fishes and timber trees. The second consists of communities which may sometimes be restricted in area, fragile in ecology and may contain rare species. Such communities must be understood and managed as entities if the species which comprise them are to survive. Examples are the coral reefs and mountain forests of Mauritius.

1.35 It follows that no amount of protective legislation will do a threatened species any good unless every essential feature of its environment is in balance. Therefore it is necessary to consider habitats before inhabitants.

1.36 Conservation cannot be considered apart from the general questions of land use, economics, ecology and sociology. The history of land ownership, forest and agricultural development in Mauritius has resulted in a close interdigitation of wild-land uses. These include forestry, catchment protection, meat production (from deer), recreation (including hunting), research and education. These should be planned and managed as a single complex.

1.37 One view of the dedication of land to uses other than short-term financial gain used to be that this was a sterile objective, and that the land so reserved was somehow removed from the national stockpile. It cannot be emphasized too strongly that this is not so. Especially in a small country like Mauritius, where the land resource is so obviously limited in area, it is essential to bring all land into beneficial use. This is discussed further in Section 2.2. The criteria for the decision on the use of any given piece of land must be a balance

of three groups of factors, economics, ecology and social requirement. The proposals in Part 4 of this report are framed on this assumption.

1.38 What is the value to Mauritius of its wild-land and coral-reef resources? The time has long passed when the natural forests were an important part of the economy, or even when they were a major factor in stabilising water run-off from catchment areas. Likewise the reef-dependent fishes are no longer the main source of protein. If this is so, is it worth while working and planning to preserve the remaining natural ecosystems? This report will show that the conservation of the resources of the remaining natural forests, the islands and the coral reefs can be made to yield both material benefits and an enrichment of the environment of the Mauritius people which may be of incalculable benefit in the future. At the present time there is inadequate information to attempt to put a numerical value to the benefits to be expected from a balanced conservation policy.

PART 2 FACTS AND PRINCIPLES UPON WHICH THE PROPOSALS ARE BASED

2.1 POLICY, LEGISLATION AND ADMINISTRATION

2.11 Policy and legislation

2.111 Study of such compilations as Brouard's excellent History of the Woods and Forests of Mauritius shows that policy towards the utilization of wild-land resources has evolved in a consistent way, although implementation by Government has been less consistent and frequently less than vigorous. As is the case in many countries, policy has evolved piecemeal, without the view of the overall national picture that perhaps only hindsight can give. Thus, as will be seen later, many options are no longer open today either because of past policy decisions or because events were allowed to take their own course without firm guidance.

2.112 Over at least the past century, a series of consultants, mainly from India, have visited Mauritius to advise on forest management and legislation. The first technical report was Thompson's of 1880. This was the foundation for the forestry programmes of the whole of the succeeding period of nearly a century, up to the present day. The dual emphasis on the protection of natural forests in mountain and river reserves and on the supply of forest produce has remained the guideline for the Forestry Service. Thompson's work was effective in giving support to legislation enacted in 1854, 1872, 1874 and 1875. This legislation covered the subjects of the administration of Crown Lands, Woods and Forests, Mountain and River Reserves and the first steps towards deer management.

2.113 The work of R E Vaughan, P O Wiehe, H C King and others in the 1930's and 1940's drew attention to the scientific value of the native forests and led ultimately to the creation of National Reserves (now Nature Reserves). However this work had a strong botanical emphasis and the selection of the reserves did not necessarily reflect the distribution of organisms other than plants. Thus major portions of the habitats of several endemic bird species are not contained in the reserves declared up to mid-1974 (an additional area was declared in November 1974 which rectified this to some extent).

2.114 Legislation for the protection of wild birds has evolved since 1869, when birds were afforded some protection under the Game Ordinance. Laws of 1922 and

1939 were specifically directed to the protection of wild birds. They were replaced in 1967 by the Act which is currently in force. Reptiles were not protected until 1973. These laws are purely protective and do not cover the management of the habitats of the birds and reptiles.

2.115 A major gap in the evolution of policy and legislation has been the concept of the permanent dedication of land to forestry or wild-land uses. The only exception has been the creation of the Nature Reserves mentioned above. The reasons for this have undoubtedly been first, the specific creation of Mountain and River Reserves on private land, with a primarily protective function, and secondly that the Forestry Service was charged with the control and supervision of Crown Lands, which thus became loosely to be regarded as forest reserves, but available for afforestation only until they were required for some other purpose.

2.116 Even when, in 1950, Allan and Edgerley compiled their draft White Paper on Crown Forest Land and Forestry, the creation of Forest Reserves did not follow. Nevertheless this draft White Paper (which, incidentally, was never endorsed by Legislative Council) has served as an admirable guide-line for forest policy and practice during the past quarter-century. Currently, the legislation governing forestry, deer management, game and wildlife protection is being reviewed and revised.

2.117 In contrast to the gradual evolution of policy for natural resource conservation on land, marine resources received little attention beyond exploitation until very recent years. Even today the old-fashioned myth that the resources of the sea are somehow limitless, persists in a remarkable way. Only on the island fringe of coral reefs is it becoming evident that the resources have been over-exploited. In the past 30 years, it has been estimated that the catch of reef-dependent fish has decreased by 50%, despite an estimated six times increase in fishing effort.

2.118 As part of the attempt to mitigate this situation, fisheries reserves have been created under the Fisheries Act, in which certain fishing methods are prohibited. Further, certain methods of fishing are declared illegal everywhere. However, breaches of these controls are all too frequent and the conclusion is inescapable that the prohibitions are largely ineffective. Although fisheries as such are not within the terms of reference of this report, they are so intimately related to the general health of the reefs and marine environment that they cannot be ignored.

2.119 The Four-Year Plan for Social and Economic Development is the definitive statement of Government Policy for the years 1971-1975. It contains outline proposals for the establishment of one land National Park (the Black River Gorges and adjacent areas) and three marine National Parks. (Vol I, p 134; Vol II, pp 75, 78, 93). However, the means for attaining these objectives are not given.

2.12 Administration

2.121 At present, responsibility for the administration of Crown Lands rests with the Ministry of Agriculture, Natural Resources and the Environment. Until 1973, Fisheries were also the responsibility of this Ministry. Now they are the responsibility of a separate Ministry of Fisheries. The Forestry Service is the executive arm of the Ministry of Agriculture directly in charge of the Crown Lands and Nature Reserves. Since six of the Nature Reserves are islands, the Fisheries Service has in practice undertaken their guardianship and servicing, in addition to its primary duties as the executive arm of the Ministry of Fisheries.

2.122 The Ancient Monuments Board, set up under the Ancient Monuments and National (now Nature) Reserves Ordinance, is advisory in function and has the duty of recommending to Government, areas for the creation of Nature Reserves, or buildings and other structures as Ancient Monuments. The Chairman of the Board is also the Curator of the Museum and Mauritius Institute Library. Since Museums are the responsibility of the Ministry of Education, the Ancient Monuments Board answers to the Minister of Education.

2.123 The U N E S C O M A B (Man and the Biosphere) Committee is also advisory in function, with responsibility to the Minister of Agriculture, Natural Resources and the Environment. Its aims are -

- '(a) To draw the attention of Government, private bodies and the public to the value of our environment.
- (b) To point out to the relevant bodies specific threats to the surroundings owing to harmful human interference.
- (c) To make the public aware of what it can do to preserve and improve the environment.
- (d) To recommend measures for maintaining or improving the quality of the relevant aspects of the environment.'

A resume of its recommendations to Government is given in Appendix 3.

2.13 Finance

2.131 Apart from the cost of the Natural History Museum and the salaries of Forestry and Fisheries staff, the total budgeted expenditure on nature conservation for 1973 was Rs 3000 (£225). This was in the form of a vote for the maintenance of Nature Reserves.

2.132 the U N D P Country Representative informed me that funds are earmarked in the current Country Programme for the recruitment of an ecologist or conservation officer. Release of these funds has not yet been requested by the Government.

2.133 The Conservation Coinage Issue. (See Sir Peter Scott's report 9.3 and his Recommendation 9.3.1.). The arrangements for the issue of special conservation coins with 'legal tender' status are far advanced. It is understood that a total of \$500 000 is likely to accrue, with the first amounts becoming available in 1975.

2.2 LAND USE

2.21 Mauritius is a classic example of the intensive use of land for direct economic advantage or human welfare. The intensity of land use and the

TABLE 1
CHANGES IN LAND USE OVER THE PAST DECADE

Use	1965		1974	
	acres	hectares	acres	hectares
Sugar	242 377	98 087	261 000	105 623
Tea	8 171	3 307	9 120	3 691
Vegetables	5 166	2 091	5 200	2 104
Built-up areas	29 293	11 854	29 300	11 857
Roads	3 354	1 357	3 400	1 376
Savanna	17 876	7 234	17 850	7 224
Rock (mountains only)	3 097	1 253	3 100	1 255
Reservoirs and ponds	2 917	1 180	2 900	1 174
Swamps	439	178	420	170
Plantation forest	21 582	8 734	26 000	10 520
Natural forest	5 880	2 380	4 500	1 821
Scrub*	120 648	48 825	98 000	39 660
Totals	460 800	186 480	460 800	186 480

*Includes many of the Mountain and River Reserves, private land used for deer ranching and agriculturally derelict or marginal land.

demand on land in Mauritius have reached a point where it is no longer admissible to have land which is badly or only partly used. Neither is it admissible to regard the small remaining area of wild land under State control as a reservoir to be drawn upon and developed for the satisfaction of short-term economic needs, while some land in private ownership remains in a derelict state. As part of Government's attack upon this problem, a Land Resources and Agricultural Suitability study was commissioned and carried out by FAO/MSIRI (Arlidge 1973). The resulting map and companion tables are of a very high standard and form an excellent basis for this component of decisions on land use.

2.22 It is a cardinal principle of land development that the best economic returns are to be sought from a further intensification of use of the most productive land, not by seeking to bring more marginal land into use. There is, however, a form of use of marginal land which would not be worth while in many countries, but which could be especially valuable in Mauritius. It is important to make the distinction between land on which the native vegetation has already been destroyed and which is not intensively managed, and land which still carries substantially natural vegetation and wildlife habitats. The latter is not regarded as marginal land for the purpose of this section.

2.23 There are considerable areas of land on which the native vegetation has been destroyed but which are not capable of being developed for intensive agriculture. These could, by labour-intensive methods, play a part in meeting the large and unsatisfied demand for forest produce, particularly poles and firewood. Most of these areas are privately owned; many are in or adjoin Mountain Reserves over which the Government already has a large measure of control. To bring them into production will require careful planning and skilled management, but would result in their contributing their full share to the national economy while at the same time relieving the pressure on the native forests. There are also areas of agricultural land which are not fully utilised. That Government is aware of this section of the problem is illustrated by the Speech from the Throne of 10 November 1970. It is likely that some of this land could justifiably be devoted to the production of timber, poles, or firewood.

2.24 The remaining area of wild land is wild because succeeding generations of woodcutters, farmers and land developers have found it too difficult and inaccessible to develop intensively. Only the recent economic and demographic pressures have served to mask the fundamental unsuitability of this land for intensive investment. Unused, it is a liability, but, regarded from a different angle, it is an asset of the greatest long-term, if unquantifiable value. From this standpoint, it is clear that the creation of National Parks is not the segregation of land for the benefit of a minority, but the first step towards the development of a previously under-used asset for the benefit of all.

2.25 It is at this point that the concept of multiple use becomes valuable. There is already in Mauritius a category of land which is a good example of multiple use. This is land which is managed primarily for 'La Chasse'. The plant and animal life of the privately-owned 'deer forests' is only rarely native to



Aspects of deer management : Hunting lodge on a deer-shoot leased from Government, on Crown Land, adjoining a Nature Reserve, with pine plantations beyond.

Aspects of deer management : Management of forest for deer-grazing in lower part of Black River Gorges. National Park Management demands reconciliation of deer-ranching, wildlife and forestry interests.



Mauritius but these productive semi-natural ecosystems must be included in any evaluation of the wild-land resources of the country.

A typical 'deer forest' yields the following products.

- 1 Meat. The yield of meat could no doubt be increased by skilled range management, but is already high in a few 'deer forests'.
- 2 Water. Most 'deer forests' are catchment areas of greater or lesser importance. The range management regime can have a profound effect on the quality and regularity of water-yield.
- 3 Recreation/sport. This is confined to a privileged minority but is highly valued by them and cannot be ignored in an assessment of national well-being. An important secondary 'product' here is good-will towards the continued existence of wild-land.
- 4 Forest produce. In money terms, forest produce could compete with meat as the most valuable crop produced in the 'deer forests'. It is clear that cunningly managed forest plantations would not only be advantageous to the deer but would help to satisfy the great demand for forest produce. Again, a few 'deer forests' already contain well-managed forest plantations.

2.26 Many countries have already learned that productive forestry, catchment management, recreation and meat production can be successfully combined on the same land management unit. This approach is likely to be increasingly valuable in Mauritius, but carefully integrated planning is vital. Deer and deer management are discussed by Owadally and Butzler (1972) and by Douglas (1967). An excellent recent analysis of the present state of deer management and prospects for the future has been made recently by Mr. Claude Noël, C M G

2.27 In any area managed under the concept of multiple use, it is essential to have a full understanding of the ecological basis for the different management objectives. It is also necessary to plan the achievement of the objectives as a complex and not individually. Thus it may be necessary to manage deer at a stocking less than the maximum in order that some other objective, such as forest regeneration, may be achieved. Likewise it may be necessary to settle for less than maximum timber production so that enough grazing may remain for the planned deer population or so that enjoyment of the scenery by visitors is not impaired. It may be necessary to regenerate forest by special techniques so that land is not exposed to erosion and water-yield or quality thereby impaired.

2.3 FORESTRY

2.31 Four hundred years ago, when man first arrived on Mauritius, the island was covered with tropical vegetation. The poor soil at high elevations supported a stunted heath and dwarf forest. The dry eastern regions carried palm savannas. Everywhere else, on the lowlands and the fertile parts of the uplands, the island was covered with dense tropical evergreen forest (Vaughan and Wiehe 1937 and 1941). This forest was exploited and destroyed. It was not regarded as an asset to be husbanded and managed. The concept of sustained yield was not considered. In economic terms, the asset was never capitalized. Today the total area of native

TABLE 2 REDUCTION OF FOREST COVER
(after Temple, Staub & Antoine, 1974 and Brouard 1963)

Year	Approximate area of native forest (acres)
1753	406 137
1770	388 705
1804	313 000
1836	300 000
1846	142 000
1852	70 000
1872	70 000
1880	35 000
1936	7 000
1974	4 500

or semi-native vegetation covers barely 5% of the land area; true forest less than 1%. This great asset has been replaced by intensive agriculture which must support the bulk of the economy, including the provision of foreign exchange for the importation of timber.

2.32 The Mauritius Forestry Service is one of the oldest in the Commonwealth. It has been in formal existence since 1777 - some 35 years before Mauritius came under British administration - although it did not become fully autonomous until 1883. Moreover, it has its foundations in some of the earliest activities of man on the island. In 1671 the Chief Woodcutter was even appointed Governor - but



The native mountain forests of Mauritius have evolved in balance with cyclones. But man has added new factors - invading plants, woodcutters, fire. This relict forest on Le Pouce, a proclaimed Nature Reserve, needs skilled management and strict protection if it is to survive as a reminder of their heritage to the many Mauritians who climb the mountain at weekends.

Mountain Reserves, even when not proclaimed Nature Reserves, offer refuges for endemic species in near-natural ecosystems, such as on Pieter Both Mountain. But the demand for firewood places a continuous biological drain on all such areas.



was later replaced because his lack of education made him an inadequate administrator. The Forestry Service today is charged with the guardianship of the Crown Lands. Thus, in addition to acting as the main agent for home-grown timber supply, it is responsible for protecting the Mountain and River Reserves and managing Nature Reserves (formerly National Reserves). For the past 25 years the work of the Forestry Service has been based upon a policy statement contained in a White Paper.

2.33 Matching the long technical experience is a body of legislation with an equally long history. (see Section 2.11). However, the Forestry Service is handicapped in the administration and execution of legislation and policy in a number of important ways. The first of these is the fact that the Forest Estate is not formally demarcated and gazetted. The Crown Lands have traditionally been regarded as a reservoir of land, available for forestry where not required for any other purpose. It is surprising that this state of affairs has been allowed to remain. Security of tenure over land is the first pre-requisite of good management. Without it, management becomes a hand-to-mouth, second-rate activity. The second handicap that forestry is currently facing is a staff shortage at the senior level. There are currently two vacant professional posts. At the intermediate level, the Foresters, though loyal and well experienced in Mauritius forestry, have had inadequate formal technical training.

2.34 In recent years the decision has been made to increase greatly the extent of forest plantations for utility timber production. The decision was made to administer this programme, not through the established Forestry Service, but through a separate organisation, the Development Works Corporation, responsible for many activities in addition to forestry and answering to the Minister for Development Planning. Both the funds and the technical direction for this forestry programme have been drawn from overseas. A number of features have already had or are likely to have unfortunate consequences. Some of these are -

- 1 Failure of communication and consultation, resulting in overlap of effort and administration, and misunderstanding of objectives.
- 2 The planting of areas which have not been demonstrated to be capable of producing a reasonable timber crop or economic return.
- 3 In some cases the choice of species which are either unsuited to the soil and climate or are unlikely to resist future cyclones.

4 In the event that the plantations are successful, the production of a glut of timber in 20-30 years' time, which will place a strain on the timber industry, followed by a shortage when the blocks are replanted.

5 In the event that a proportion of the plantations are unsuccessful, the unnecessary destruction of areas of native vegetation which have evolved in equilibrium with the environment, together with their associated wildlife, both plant and animal.

6 The placing of a heavy technical and administrative burden on the Forestry Service in the future. At its present strength and with its present commitments it will have difficulty in shouldering this burden.

2.35 The demand for forest produce other than timber - poles and firewood - is placing a strain on the concept of sustained yield management which it cannot long support. It is also resulting in continuous theft of produce from natural forests including gazetted Nature Reserves which they cannot long support biologically. Particularly urgent is the problem of firewood. As long as the demand for firewood remains it must be met. Because of its origin, at the lower end of the income scale, it cannot easily be diverted into another sector of the economy. Only a proportion of the demand can be met from the produce of cleaning pine plantations of guava undergrowth. The removal of guava and other weeds from Nature Reserves would also provide some firewood, but this is work which must be done skillfully and carefully if the forest is not to suffer. Yields are therefore likely to be low. A considerable volume of filao poles and firewood is produced on the Pas Geometriques and other land. No quantitative estimate of demand or supply is available and forecasts are therefore difficult, but it is suggested that some of the effort now going into pine plantations on marginal sites (for pine) might beneficially be diverted into fuel and pole crops, which could be produced on land unsuitable for pine.

2.36 The production of utility timber is a demanding activity, economically, ecologically and technically. It is a mistake to suppose that marginal land can profitably produce such material, even by making use of a temporarily available source of cheap labour. The demand for utility timber is large and will grow, especially in response to the development of industry in Mauritius. However, the proportion of utility timber which can be produced locally and economically will remain low, unless it is possible to re-allocate some land now under sugar or tea. This is an example of an option for development which is rendered impracticable or extremely difficult by a previous development policy.

Mountain and river reserve laws protect forest on river banks in private land. Such forest strips, though often invaded by exotics, provide a refuge for many endemic plants and those animals that can use them.



River banks in Crown Land may be vulnerable to the removal of native vegetation in the name of reafforestation, while contributing little to the total production of timber.





Relics of former upland dwarf forest - Sideroxylon sp,
Helichrysum sp (above) and the spectacular Pandanus eydouxiae
 (all found only in Mauritius), survive in land recently cleared
 and planted with slash pine (Pinus elliottii) and eucalyptus.
 Will the timber produced from the pine in this marginal site with
 shallow rocky soil, compensate for the loss of a unique ecosystem
 with many plants and birds found nowhere else ?



2.4 NATIONAL PARKS

2.41 A widely accepted definition of a National Park is an area where ecosystems are not materially altered by human exploitation, where the highest competent authority has taken steps for its protection, and where visitors are allowed to enter (of Dasmann et al, 1973, p 118). Some countries, particularly in Africa, which have or have had large areas of uncommitted land under natural or sub-natural ecosystems, have been able to designate such areas as National Parks. In Mauritius, many options of this type are no longer open. Past development decisions, irrevocable in ecological terms, have removed the possibility of choice.

2.42 A working definition for a National Park in Mauritius might be - an area where the long-term cultural needs of the nation are not sacrificed for short-term economic gain. The object of management of a National Park (as distinct from a Nature Reserve), is to bring people into contact with nature, while at the same time ensuring that nature is not itself destroyed by the very presence of the people. People need wild places as an antidote to the increasing strains and pressures of urban life. Parks are for people. There is already a considerable demand in Mauritius for open air recreation. This varies from snorkelling to mountaineering but on any weekend or public holiday many hundreds of Mauritians from all walks of life go to the mountains - on foot to Le Pouce or Pieter Both, by car to the Plaine Champagne and Black River Gorges - or to the coast - to the public beaches or to private 'campements'. If this demand should grow, as it almost certainly will, without adequate provision being made to absorb its pressure, the result will be the degradation of the very asset which the people seek. The beginnings of such degradation can already be seen in some areas.

2.43 No mention has yet been made of tourism. Visitors find the scenery of Mauritius breathtakingly beautiful and are irresistibly attracted by the vibrant life of the towns. In an era of rising prices, bookings at the excellent and well-sited hotels will have a better chance of staying high if the wild resources are consciously developed as an asset and marketed as such. There are many as yet untapped opportunities for the combination of hotel and National Park developments.

2.44 National Parks in Mauritius must therefore be managed in such a way as to meet the recreational needs of the people who visit them while at the same time deriving the optimum benefit from other kinds of use, with especial emphasis on the maintenance of their natural state. A National Park has a carrying capacity for visitors which depends upon the ability of its landscape, flora and fauna to withstand visitor use without deterioration. This sets limits on the development of

facilities for visitors. Some countries have found it necessary to limit the number of visitors allowed into National Parks. In countries where there is a long history of human land use there may be few natural or near-natural areas remaining. Such countries have found that concepts of multiple use have provided opportunities for planning recreation. For example, in Morocco, forest plantations of pine and eucalyptus are developed for their recreational value as well as their primary purpose of providing forest produce. Such areas need not be excluded from National Parks. In Britain, forest plantations are often sited in areas of great beauty. The careful development of such timber-producing forests as Forest Parks is currently paying rich cultural dividends.

2.45 Another line of development, especially in England, is the concept of the National Park as primarily a recreational area in a region of scenic beauty, where the protection of wildlife as such may not be a primary consideration. An outstanding example is the Peak Park in the Midlands of England. Virtually the whole of this 1400 Km² (550 sq ml) Park is privately owned. No less than 17 million people live within 80 Km (50 ml) of the Park boundary. The 40000 people who live inside the Park have 5 million visitors every year. Access to private land is by formal agreement with the owners. The scenery remains attractive because it is well cared-for.

2.46 If Parks are for people, the concept of a National Park as a Nature Reserve needs to be examined closely. Many natural ecosystems are sensitive to disturbance. Mauritius birds, in particular, have not been able to adapt to secondary habitats. Therefore the extent to which they can absorb visitor pressure is strictly limited. In countries with large land areas where complete ecosystems may occupy great areas, recreational use is extensive rather than intensive. Here, there may be little conflict between such use and the concept of the maintenance of healthy ecosystems. But in a small island, especially one with a large population, a number of other factors become important. The use of natural areas for recreation must be planned so as to make the best use of zones which can best absorb pressure. Coral reefs, the sea, and forest (taken as a whole) are ecologically robust. The mountains and coasts, the basis of the scenery, are in a sense immutable, though they may be disfigured by building or other development. These must therefore be the zones chosen to bear the brunt of recreational pressure. The reefs and the sea are large in area and will support a large visitor pressure, provided the pressure itself is not destructive. The forests, being small in area, offer a more limited opportunity for recreational use. There are, however, many places where the natural forest has been destroyed or replaced by secondary growth or plantations, which could easily be developed as viewpoints and walks. The spectacular volcanic mountains, many of



Pieter Both and other spectacular volcanic mountains offer a challenge to climbers and dramatic views. They are an essential component of an overall plan for National Park development.



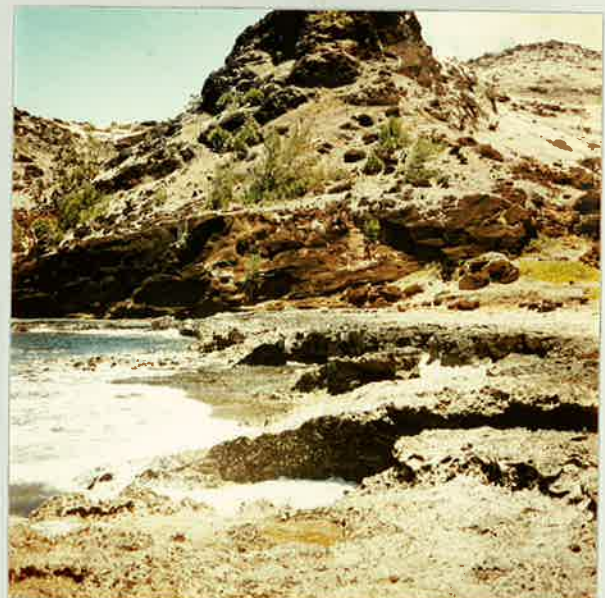
Geology :

The northern islands show spectacular geological formations and have a complex geological history. On Flat Island a basalt lava flow has been overlain by later tuff deposits of two different ages (right).



Below left : water-worn basalt pebbles and chunks of coral from a previous reef have been cemented together by calcareous sand to make a conglomerate beach rock.

Below right : a raised wave-cut fossil coral reef, now itself being dissected, has had tuffs from a later phase of volcanic activity deposited over it and later worn away.





Black River National Park (proposed) : The Black River Gorges viewpoint (see Fig). Viewpoints such as this, with minimal development of facilities, already attract many visitors, both Mauritians and tourists.

Black River National Park (proposed) : Bassin Blanc, in the south-east, on private land in Mountain Reserve.





Black River National Park (proposed) : The northern part - Montagnes Vacoas and Montagne du Rempart - partly private land in Mountain Reserve.

Black River National Park (proposed) : The Black River Gorges, home of the Mauritius kestrel and other wildlife.





Islands : Flat Island and its reefs (Ilot Gabriel far right) seen from Gunners' Quoin. The Mascarene endemic plant, Lomatophyllum sp, related to the aloes of Africa and Madagascar, in the foreground.

Islands : Mauritius is rich in military history. The powder magazine on Ile de La Passe, long garrisoned by the 86th Regiment. The Bamboo Mountains, with a good area of native forest but few endemic birds, form a background across the entrance to Grand Port.



them relatively easily climbed, also offer obvious locations for National Park Development.

2.47 There will remain communities and populations of rare species so sensitive that they must not be subjected to any tourist pressure and must be treated with the greatest care even by the trained scientist. These would appropriately be contained in Strict Natural Reserves which may be very small in area and would usually be closed to almost all access.

2.48 The need for the development of recreational areas and the need to distinguish between National Parks and Nature Reserves has been recognised to some extent in Mauritius by the proposals in the Four-Year Plan. A network of Nature Reserves is already in existence and the Four-Year Plan envisages the creation of a land National Park in the Mare aux Vacoas - Black River Gorges area and the creation of three Marine National Parks in unspecified localities. However, study of the various proposals and legislation and the areas themselves suggests that objectives have not always been identified clearly. The existing Nature Reserves, although proclaimed formally, are not demarcated on the ground and there is no subsidiary legislation to regulate their protection or management. The Four-Year Plan does not, perhaps, sufficiently stress the work which has already been done in this field, particularly the establishment of the existing Nature Reserves.

TABLE 3 PROCLAIMED NATURE RESERVES

Name	Approx. Area
1 Perrier	3 acres
2 Macchabe and Mare Longue	1200
3 Corps de Garde	214
4 Ste Marie and Cocotte	387
5 Pouce	163
6 Bel Ombre	2173
7 Cabinet	42
8 Petrin	245
9 Round Island	374
10 Ile aux Aigrettes	70
11 Gunners' Quoin	
12 Ile Plate	
13 Ilot Gabriel	
14 Ilot Marianne	
15 Combo	490
16 Doulypere and Les Mares	12
17 Black River Gorges (part)	

2.49 The possibility for choice of areas for future Land National Parks in Mauritius is set by the existing pattern of land use. In the selection of areas for Marine National Parks, the choice is wider, and the following criteria were used. As far as possible, the areas selected should -

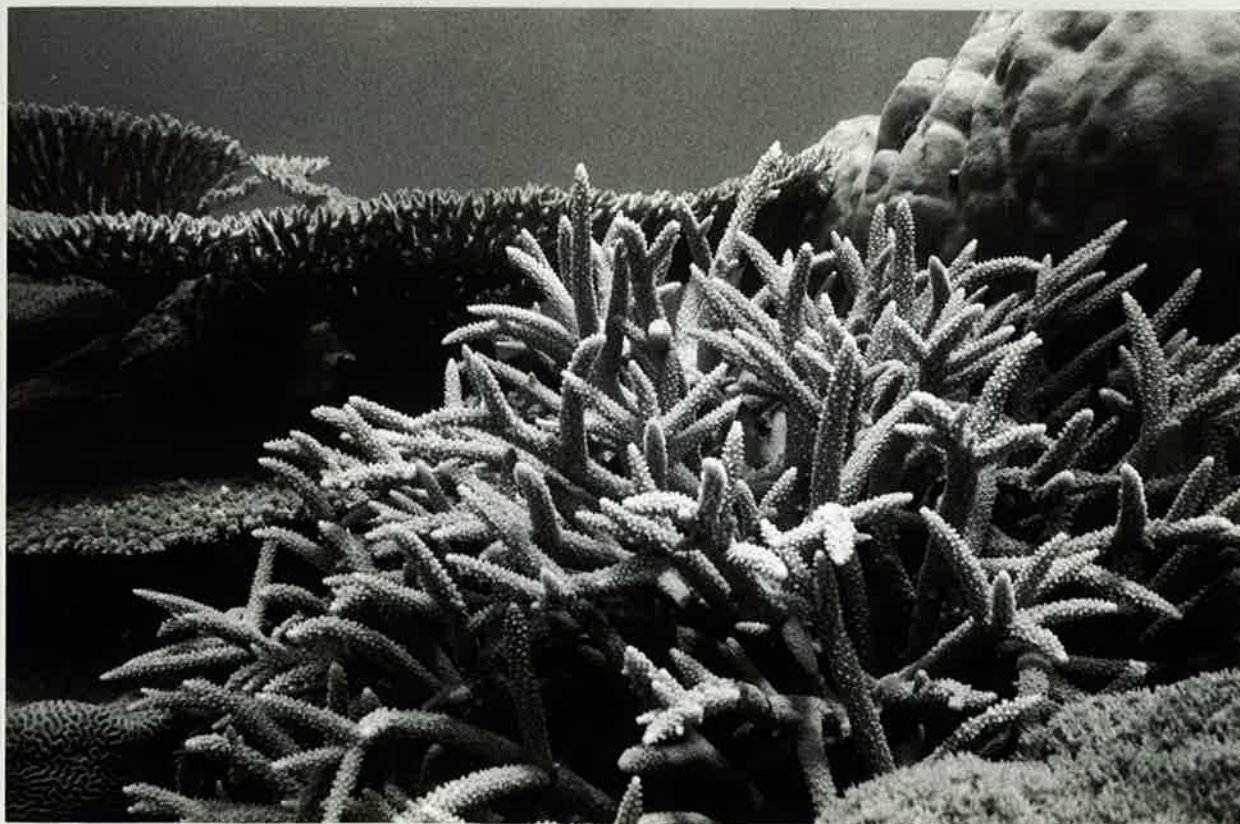
- 1 Exhibit a diversity of habitats and species.
- 2 Exhibit a high percentage coral cover.
- 3 Have the coral colonies intact.
- 4 Be away from a major fishing area and have few reef-dependent subsistence fishermen.
- 5 Be readily accessible - both the area by road and the reef to swimmers.
- 6 Have clear water.
- 7 Have no surf or strong currents over the sheltered reefs.
- 8 Have easily defined natural boundaries.
- 9 Have tracts of land bordering the sea available for inclusion in the park.
- 10 Be easy to police - easily watched, patrolled and defended.
- 11 Be away from sources of accidental poisoning such as large ports or large river mouths.
- 12 Have additional points of interest such as beaches, scenery, wrecks or ruins.

2.491 The first Marine National Park in Kenya was opened during March 1968. More than 16,000 people visited the 10 Km² of protected coral waters during the first ten months. The visitors were taken on to the reef by local Bajun fishermen in their outrigger canoes. Before the establishment of the Marine Park the Bajun were stripping the reefs for bait and to collect shells, corals and lobsters to sell to the tourists and other commercial interests. One and a half years after the establishment of the Marine Park, the same fishermen were earning more money by taking visitors to view undamaged natural reefs, the reefs and fish stocks substantially recovered, and the fishermen's catch improved. Mauritius can benefit from Kenya's successful experience.



Thickets of fragile and vulnerable stagshorn coral in lagoons shelter clouds of the smaller reef fishes and juveniles of some of the commercially important fishes.

Such colonies of stagshorn and tabular Acropora corals are part of the dense and diverse coral cover of sheltered fringing reefs in Baie de l'Arsenal.



2.5 WILDLIFE - MARINE

2.51 Introduction

2.511 Visitors to Mauritius during the sixteenth, seventeenth and eighteenth centuries were enthusiastic in their reports of the abundance of fish life, the enormous spiny lobsters, the dugongs and the turtles. Exploitation and depletion of these stocks started with the earliest visitors, but the effects were unnoticed. In 1706 the turtle, dugong and fish populations were reported considerably diminished. After the Dutch left Mauritius the marine animals were able to regain their original numbers. By 1804, however, dugongs had become rare.

2.512 The dugong is now extinct around Mauritius. Darwin, after his visit in 1836, mentions a decrease in the number of coconut crabs. The coconut crab, Birgus latro, is now extinct on Mauritius. Turtles, which were once abundant and nested on Mauritius, are occasionally seen but no longer nest on the island.

2.513 Uncontrolled hunting of dugongs and turtles, and the raiding of turtle nests resulted in the disappearance of these creatures from the Mauritius lagoons. Extensive overfishing, coinciding with the levelling of great tracts of coral reef, poor control of destructive fishing methods such as small mesh seine nets and dynamite, and ineffective policing and poaching control are together responsible for the great depletion of fish stocks. Since 1945 it is estimated that the annual catch has decreased 50% despite a six times increase in fishing effort. Fortunately, fishing operations are unequally distributed around the island and, while the fish fauna is generally impoverished, the corals on a few reefs remain more or less intact.

2.514 The Mauritian reefs are being destroyed. Already a plague of sea urchins probably resulting indirectly from overfishing is destroying seagrass beds and reef on the east coast and is causing the silting up of once productive lagoons. Reported dense concentrations of the crown-of-thorns starfish, Acanthaster planci, indicate the possibility of a plague of these reef destroying animals. Only scattered individuals were seen during our survey. The crown-of-thorns is a notorious coral predator that has wreaked havoc on many Indopacific coral reefs, of which Australia's Great Barrier Reef is probably the best known example. Overfishing, coral and shell collection, and coral breakage are the popularly blamed causes of reef deterioration. These undoubtedly contribute, but they are

only a part of one answer.

2.515 The first colonisers of freshly exposed substrates on Mauritian coral reefs - such as coral skeletons exposed by crown-of-thorns predation, breakage, siltation - are algae, including certain blue-green algae which may be the precursors to ciguatera poisoning in fishes. A relationship between the rapid growth of algae on newly exposed surfaces on coral reefs and the development of ciguatera has been conclusively demonstrated elsewhere. Ciguatera is currently a problem in Mauritius which it is impossible to exaggerate.

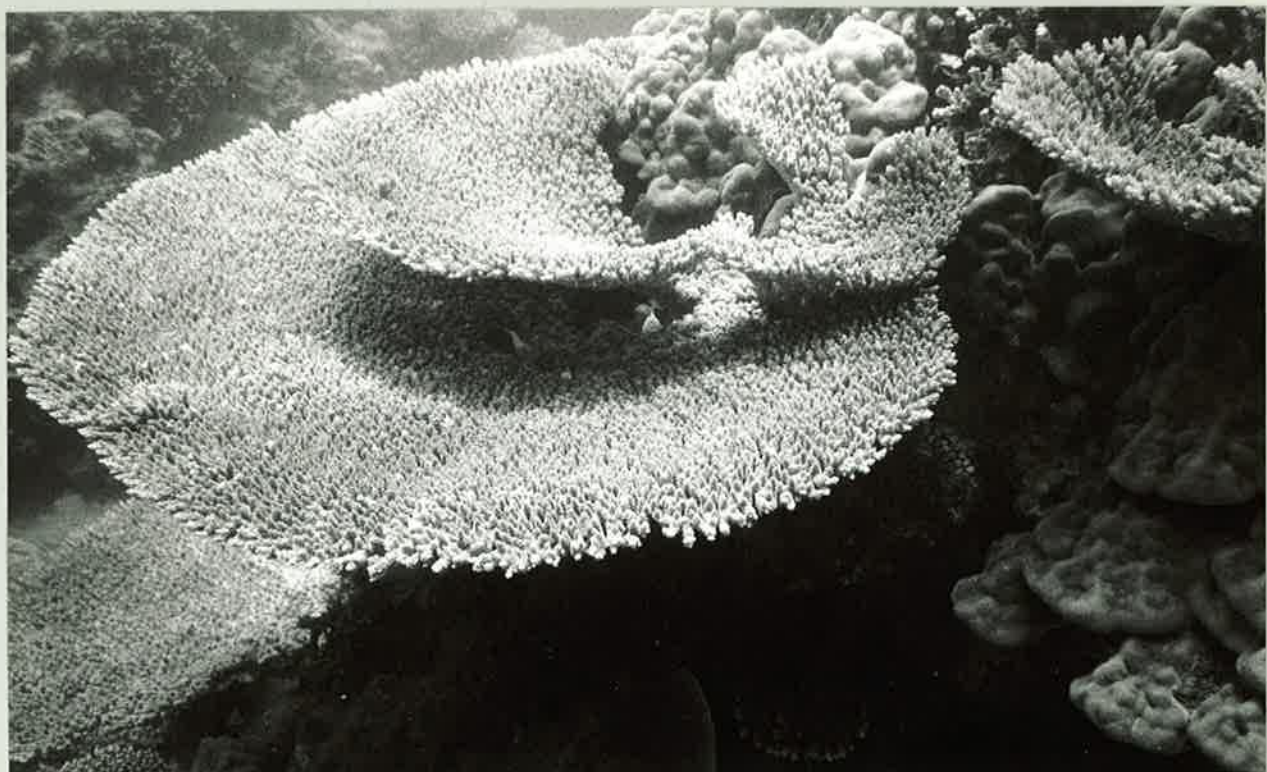
2.516 Odum (1971) has shown that coral reefs are among the most biologically productive of all natural marine or terrestrial systems. When corals are killed - as they are here by lime-mining, indiscriminate breakage and siltation - death or migration of much other reef fauna follows. So, corals are essential in the reef community and their environmental tolerances cannot be exceeded if the reef community is to remain intact. Mauritians are dependent on reef fishes and shellfishes to provide high quality protein because terrestrial sources are inadequate. The reefs must remain intact. In contrast to the reefs of nearby Madagascar, the reefs of Mauritius are narrower, the reef fauna is impoverished and less diverse, and the lagoons are shallower. The Mauritian reefs are comparatively poorly developed and hence easily destroyed. But conditions seem to favour coral growth in certain areas around Mauritius and these reefs would recover their full aesthetic quality and original productivity given time and practical management. Mauritius has the potential to develop marine parks that could serve as examples not only in the Indian Ocean but throughout the world.

2.517 To feed and accommodate more than 3,000 species in the limited area of a coral reef there has to be great specialisation of the constituent species which results in their being highly inter-dependent. Unchecked tampering in a system with the complex species inter-dependence of a coral reef causes imbalances and rapid disorganisation. Many of the reefs off the Florida coast are dying or dead. Dredging, resulting in increased silt load, is largely blamed, but it seems that chemical factors such as pesticides, detergents and heavy metals probably cause ill health of the reefs by interfering with the coral's metabolism. Erosion resulting from inland deforestation has destroyed acres of coral reef off Hawaii. Heavy and indiscriminate spearfishing pressure and coral breakage contributed to the weakening of reef defensive mechanisms off Grande Comore thereby allowing the crown-of-thorns to become established and destroy large areas of coral reef. Goats



Species-rich assemblies of colourful corals are common in the sheltered waters of Baie de l'Arsenal.

At Baie de l'Arsenal, large tabular colonies of Acropora often grow from the base of large Porites boulder-corals.





Enormous, brittle but intact colonies of the cabbage coral, Montipora foliosa, are abundant at Baie de l'Arsenal.



are the major threat to Africa's southernmost coral reef by their contribution to beach erosion.

2.518 It is therefore urgent to retain suitable areas of coral reef intact for their inherent beauty, recreational and scientific value, and to preserve the reefs as an important habitat for the many fish species, both juveniles and adults, which shelter or hunt on the reefs by day and by night. To achieve this it is necessary to:

- 1) Determine and map the variety of coral reef ecosystems and their living components for the Mauritius coast (in particular the rare biotic elements).
- 2) Determine the ecological limits for all proposed marine national parks.
- 3) Determine the key limiting factors, vulnerability and successional status of the coral reefs.
- 4) Plan the recreational and educational use of each marine park site according to its intrinsic properties.
- 5) Determine suitable methods of marine park use which will aid regional and local development and will encourage the involvement and support of the local populations to protect these sites.
- 6) Baseline studies should be carried out over the reefs least disturbed by human activity. These should be used as a 'natural measure' against which the status of other Mauritian coral reefs could be assessed and as a baseline from which the recovery of the reef and fish stocks could be monitored within the marine parks.

2.52 General description and distribution of coral reefs around Mauritius

2.521 There are three types of coral reefs around Mauritius: peripheral fringing reefs, sheltered fringing reefs and lagoonal patch reefs.

2.252 Peripheral fringing reef in a narrow rim, seldom as wide as 25 m, almost entirely encircles Mauritius (see map). The reef is cut at frequent intervals by surge channels and narrow passes scoured by strong rip currents. Also, there are large breaks in the reef positioned opposite the river mouths. Peripheral fringing reef is absent from a 15.5 km stretch on the south coast and two stretches totalling 10.5 km on the west coast.

2.523 These reefs are exposed to oceanic swell. During the greater part of the year the eastern and southern reefs are pounded heavily by surf generated by the SE trade winds. Consequently, in order to resist breakage by buffetting surf, the coral colonies are small and exhibit massive, encrusting or robust-foliaceous growth habits, the reefs are unapproachable, and rip currents through the reef are particularly strong and dangerous. The western peripheral reefs, despite being sheltered during the SE monsoon, have continuous though feeble surf.

2.524 The rough conditions prevailing over the eastern and southern peripheral fringing reefs protect these reefs from the ravages of human activity. There is, however, evidence of damage to corals on the more protected peripheral reefs. This damage increases away from the surf zone both down the fore-reef slope and into the lagoon. The back-reef Acropora zone is virtually self-protecting because of its proximity to the surf and its continuous shallow character. The coral colonies in the surge channels and upper fore-reef slope are intact and beautiful, but one soon encounters broken coral further down the slope. Branching and tabular colonies, which afford refuge to many fish species, are scattered thinly throughout the fore-reef zone and every broken colony reflects a reduction in the shelter available to the reef fishes. Broken or overturned colonies die.

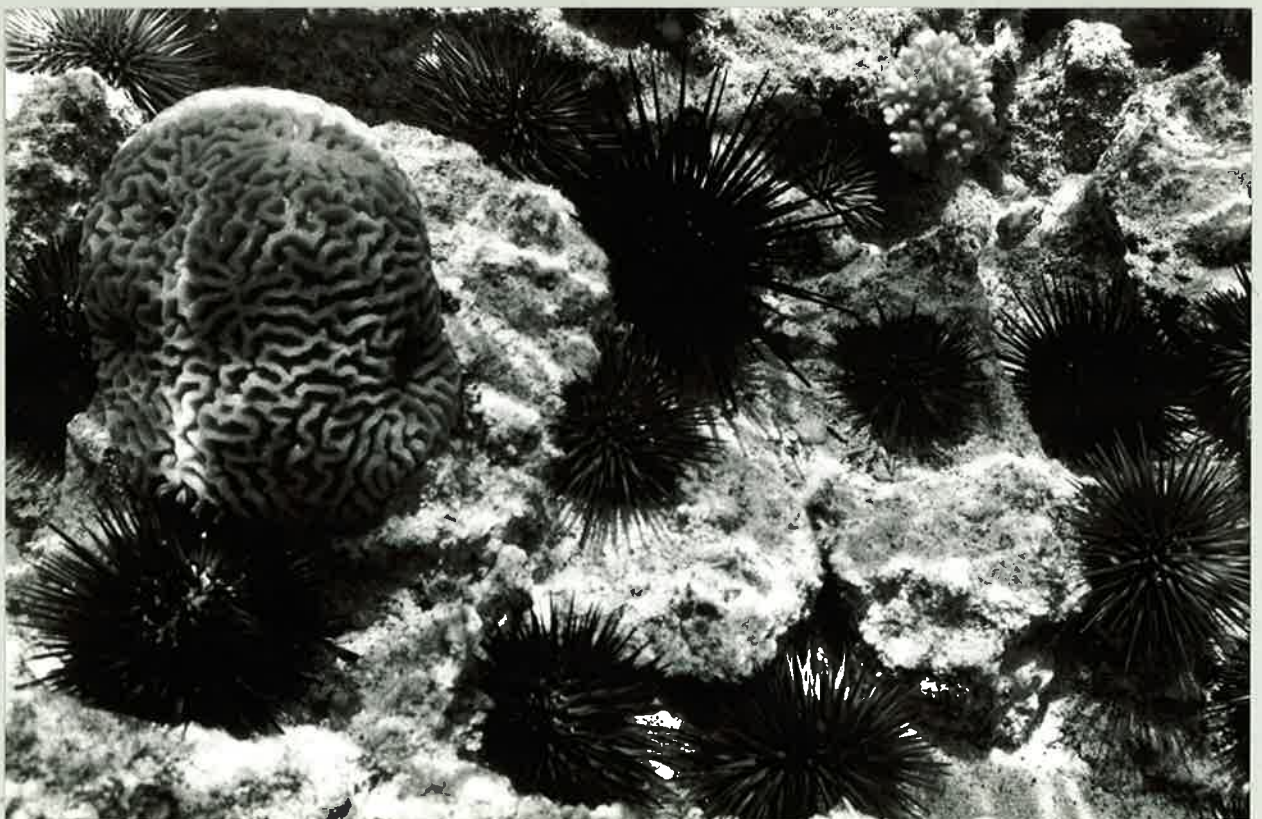
2.525 Sheltered fringing reefs border such deep water channels as exist within the peripheral reefs or protected bays. These reefs are characterised by a dense cover of large and fragile colonies, notably stagshorn, tiers of tabular Acropora and foliaceous Montipora. There is no surf over the sheltered reefs and currents, if present, are weak. Consequently these reefs are easily accessible and extremely vulnerable. Fortunately, most broken or overturned corals continue to live and simply reverse their direction of growth.

2.526 Lagoonal patch reefs occupy the lagoons of greatly varying width between the peripheral fringing reefs and the shore. The lagoons tend to be wider, up to 5 km, off the eastern shores. The depth of the lagoons is determined by local conditions. It averages between 1 and 2 m but increases to about 4 m in the north. The lagoon substrate is composed of tracts of coral fragments chiefly originating from branching corals, blocks of dead massive corals, patches of loose sand and sand consolidated by beds of seagrasses, or patches of living corals. Extensive patches of stagshorn coral or tabular Acropora are established in the deeper lagoon waters. In shallower areas the Acropora patches are generally small, frequently dead or replaced by fields of hardy Pavona coral.



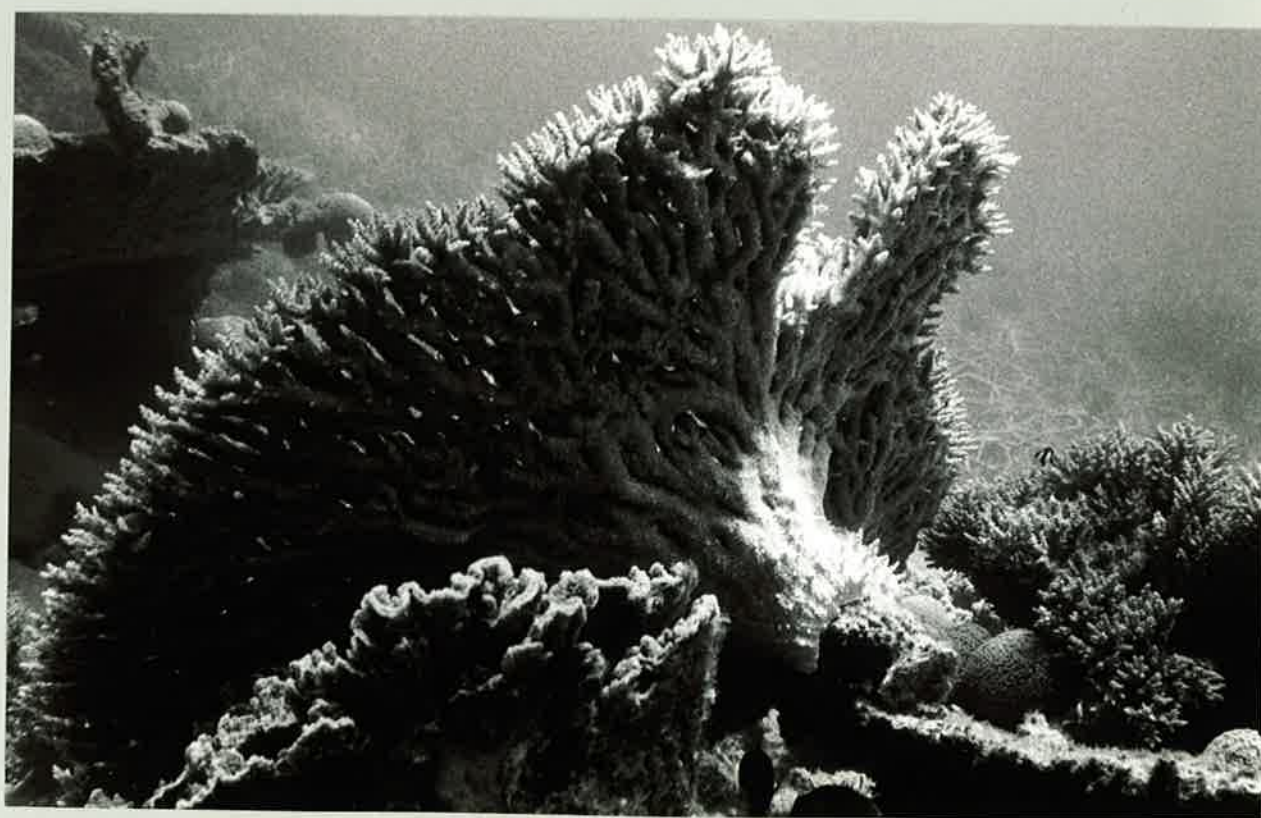
Spawning aggregations, such as this one of the moorish idol, Zanclus canescens, over a coral patch at Le Chaland, are nowadays rare around Mauritius.

The sea urchin, Echinometra mathaei, bores into the rock, weakening it, undermining coral colonies and contributing to silt production. Photographed at Poste Lafayette.





Large, perfectly developed colonies of tabular Acropora are common at Baie de l'Arsenal (above) and elsewhere. But their fragile stems make them vulnerable to breakage by the careless use of boats or anchors. The photograph below shows a recently broken colony at Le Chaland.



2.527 Lagoonal patch reefs are especially vulnerable because their principle constructors, the brittle stagshorn and tabular Acropora, are so fragile. Also, the lagoons are intensively exploited for recreation and subsistence fishing. The lagoonal corals are constantly broken by boats, poles, oars, outboard motors, casiers, careless spearfishermen, shell and coral collectors, anchors, and the removal of coral for the lime kilns. They are accessible even during adverse weather conditions. Once broken, lagoon corals die.

2.528 The effects of breaking these lagoon corals is to remove the refuges of many fish species, including the juveniles of commercially important varieties, and to accelerate sediment production. In addition, sediment production, which has caused major siltation problems in some lagoons, is largely the result of explosive increase in the populations of two sea urchins, Tripneustes gratilla and Echinometra mathaei. Overfishing, mainly of the Tripneustes-eating octopus and of certain Scarid, Labrid and Balistid fishes, is the widely proclaimed cause of the echinoid plague. Certainly, the hordes of Tripneustes are reducing the seagrass beds to bare stems. Currents quickly remove the now unconsolidated sediments and coral rubble exposing compacted reef rock or basalt beneath. Echinometra then bores into the exposed rock weakening it and undermining the developing coral colonies.

2.53 List of areas surveyed

2.531 The following is a list of the areas recommended by Sir Peter Scott and Iain Robertson in their reports. In addition, there are two outstanding areas recommended by local sources. The suitability of each area was assessed according to the criteria listed in section 2.49 (Page 2/14). Some areas are better than others on certain points; for example, the narrow spurs and deep grooves of La Preneuse are spectacular and unmatched at any of the selected areas. However, the areas selected satisfy most criteria while compromising least. (see map for areas visited).

TABLE 4. AREAS RECOMMENDED FOR ASSESSMENT FOR MARINE PARK DEVELOPMENT

Area recommended	Location	Suitability
Le Morne Brabant	SW	low
l'Harmonie/La Preneuse	W	fair-high
Flicq en Flacq	W	fair
Baie de l'Arsenal	W	high
Trou aux Biches	W	fair
Grande Baie north	NW	fair
Roches Noire	E	low
Poste de Lafayette	E	low
Boste de Flacq	E	low
Trou d'Eau Douce/Ile aux Cerfs	E	low
Blue Bay/Le Chaland	SE	fair-high
Flat Island/Gabriel	N	high

2.532 Short list of most suitable areas. (For detailed descriptions of these three areas, see Appendix 4)

Baie de l'Arsenal
 Flat Island/Gabriel
 Le Chaland/Blue Bay



A boat's keel has ploughed through this thicket of fragile stagshorn coral. Such damage takes a long time to repair and reef ecology is disturbed.

Smashed corals at Le Chaland. There is hardly any regeneration and the corals on the left are infested with a filamentous alga. Fishes are virtually absent from such areas.



2.6 WILDLIFE - LAND

2.61 Introduction

2.611 In section 2.3, the history of forest destruction was briefly outlined, but the forest as a wildlife habitat and its scientific importance were not discussed. The vegetation types of Mauritius were described by Vaughan and Wiehe (1937) in their classic account, which must remain as the basis for all future descriptive ecological work.

2.612 The remaining native vegetation still contains hundreds of plant species which are found nowhere else in the world. Furthermore, the native fauna depends heavily on the native vegetation habitat. Unlike the fauna of some other oceanic islands, the endemic species of Mauritius, particularly the birds, have mostly been unable to adapt themselves to the secondary habitats and other environmental changes brought about by man.

2.613 If this native vegetation is allowed to disappear, the unique Mauritian fauna will also disappear. The preservation of the remaining areas of indigenous vegetation is, therefore, central to the concept of conservation on Mauritius.

2.614 The surviving indigenous vegetation can be divided into several discrete types, each of which is a special ecological unit. Below, we consider each of the surviving vegetation types, giving a very brief description of its characteristics, with its associated wildlife.

2.615 The native fauna is described in more detail in Appendices 6 and 7.

2.62 Indigenous coastal vegetation

2.621 Although most of the Mauritian coastline has been altered greatly by man, there are some places where the original indigenous vegetation still occurs. These natural seaside habitats can be divided into two main groups: coastal marshes and beaches.

2.622 The indigenous coastal marshes of Mauritius are found mostly along the tidal creeks and sheltered lagoons of the east coast. The most characteristic plants of these salt water marshes are the manglier (Bruguiera gymnorhiza) and the

paletuvier (Rhizophora mucronata). These two trees grow only in the narrow intertidal zone. Both trees have a distinctive root system in which breather roots grow down off the trunk or upwards from the true roots. These stilt roots sometimes form an impenetrable thicket. The seeds of the manglier and paletuvier are specially adapted for the salt water environment. They germinate while still hanging from the parent tree and fall into the water only when they are ready to take root.

2.623 The coastal marshes are an important habitat for many marine animals such as crabs, oysters and many fish. The gasse (green-backed heron) and certain shore-birds prefer to hunt among the roots of the manglier and the gasse often builds its nest in the upper limbs. Many birds, especially the martin (Indian mynah), come at night to roost in the limbs of the manglier because they are safe from predators there.

2.624 Unfortunately, the coastal marshes of Mauritius have suffered much damage as a result of man's activities. The manglier makes good firewood and as a result, most of the trees have been cut. Some of the best remaining examples of indigenous coastal marsh can be seen around Poste de Flacq and just north of Mahebourg.

2.625 The vegetation on the beaches of Mauritius has been changed dramatically by man. Today, the most conspicuous seaside plant is the filao (Casuarina equisetifolia) which is not native to Mauritius but was introduced from Malaysia. However, scattered among the filaos and in a few out-of-the-way places it is still possible to find beaches that retain their natural vegetation. In these undisturbed areas, just behind the open wave-washed beach you will find carpets of liane de gondelouror or batafran (Ipomaea pes-caprae) and chiendent bourrique (Stenotaphrum dimidiatum, only doubtfully native) growing on the sand. These low, creeping plants are important because they act to hold the loose, shifting sand. Behind this zone of ground level plants, where the soil is stabilized, grow the larger shrubs and trees characteristic of the beach habitat. The most common species are the veloutier manioc (Scaevola), veloutier blanc (Tournefortia) and the coqueluche (Pongamia). These small trees rarely reach a height of over 3 m (about 10 ft) and are able to withstand the constant sand and salt spray that are blown on them. One of the best places on Mauritius to see undisturbed beach vegetation is on Ile aux Aigrettes Nature Reserve, protected because of its unique vegetation which includes several endemic species. Small areas around Le Chaland, Pointe des Roches Noires and Pointe Sud-Ouest are also fairly typical.

2.63 Indigenous palm savannas

2.631 When man first arrived in Mauritius, one of the striking features of the coastal plains must have been the extensive palm savannas. This type of habitat existed in those regions of the island that received less than 1000 mm (about 40 in) of rain a year. At one time the palm savannas must have covered a coastal strip about 2 km (1-2 miles) wide all the way from Le Morne to Cap Malheureux and along much of the north-east coast. The trees that characterized this habitat were the latanier (Latania commersonii), the palmiste blanc (Dictyosperma alba), the palmiste gargoulette (Hyophorbe indica) and the vacoas (Pandanus spp). Beneath these scattered, tall palms, were smaller shrubs such as socotrine du pays (Lomatophyllum macrum) and bois de chandelle (Dracaena spp). The ground was probably covered with grasses such as citronelle (Andropogon sp).

2.632 This habitat was probably one of the places where the dodo and the large broad-billed parrot (Lophopsittacus mauritianus) were most common. Here they could find an abundant supply of the latanier fruits. The early settlers quickly destroyed the palms for food and building material and converted the land into pastures for their animals. Today not one example of the palm savanna habitat can be found on Mauritius.

2.633 Fortunately, remnants of the indigenous palm savanna still survive on several of the northern islands such as Gunners' Quoin, Round Island and Gabriel Island. On these islands one can still find most of the plants that were characteristic of the palm savannas on Mauritius, but the overall character of the habitat has been greatly altered. Rabbits and goats were introduced on to Round Island and have now destroyed most of the island's remnant native vegetation. Hares were introduced on to Gunners' Quoin with a similar result.

2.634 It would be unfortunate if these last remnants of indigenous palm savannas were completely destroyed by these introduced pests. Already the palmiste gargoulette of Round Island is nearly extinct; less than 20 individual plants survive there. The palmiste blanc is likewise almost extinct and only a very few old plants survive. All of the young plants are eaten by rabbits and goats. The latanier, vacoa and socotrine du pays are still found in some numbers.

2.635 It is hoped that in the near future it will be possible to exterminate the introduced pests on the northern islands so that the indigenous vegetation will

have a chance to recover. Round Island is already a Nature Reserve, in part, because of its unique vegetation. Every effort should be made to protect the indigenous palm savannas on all the other northern islands as well.

2.64 Indigenous lowland forests

2.641 The indigenous lowland forests of Mauritius were one of the primary reasons for the original settlement of the island by the Dutch. They were said to contain huge trees growing so close together that it was difficult to walk through them. The Dutch East India Company was so impressed with reports of the forests that it sent the first colonists out to begin exploiting the valuable tropical hardwoods such as the famous Mauritian ebony.

2.642 These lowland forests were originally quite widely distributed over the island at elevations below about 220 m (750 ft) where the yearly rainfall was between 1000 and 2500 mm (40-100 in). The forests attained their most impressive development on the plains of the Flacq district. The most common tree species were the bois d'ebene (Diospyros tessellaria), bois d'olive (Elaeodendron orientale) bois de fer (Stadtmannia sideroxylon) and bois puant (Foetidia mauritiana). Beneath these large trees there was a layer of smaller trees such as bois lousteau (Antirrhoea verticillata) and bois cerf odorant or bois carotte (Pittosporum senacia). The forest floor was probably covered with a dense carpet of ferns.

2.643 The lowland forests of Mauritius are nearly extinct. Only a few examples of this habitat type remain and the species of trees that were formerly common are now becoming very rare. Today the indigenous lowland forest exists only on the western slopes of the mountains between Mt du Rempart and Chamarel. In a few places in this region it is still possible to find some large trees, but for the most part all that remains is a sadly depleted remnant. The very best examples of forest are found at the base of Trois Mammalles and Mt Brise Fer and at the mouth of the Tamarin Gorge.

2.644 In this forest such endemic birds as the merle and coq des bois can be found. The chauve-souris frugivore is also found here because the fruits of the ebony are a favourite food. Unfortunately, the few hundred hectares of indigenous lowland forest that survive today do not have a very good future. Besides the problem of cutting, many exotic plants such as aloe (Furcraea), bois noir (Albizia lebbek) and l'acacie or cassie blanc (Lucaena glauca) are invading

the forest and replacing the native species. Much of the remaining lowland forest is included in the proposed National Park which would protect the forest and allow for the removal of some of the exotic plants. The indigenous lowland forests have played such an important role in the history of Mauritius that an effort should be made to preserve some examples for future generations to see.

2.65 Indigenous dwarf forest

2.651 One of the more interesting indigenous habitats on Mauritius is the upland dwarf forest. From the point of view of both the native plants and animals, this scrub habitat has a great deal of variety to offer. It is characterized by the fact that the plants rarely grow to more than 3 or 4 m (10-12 ft) in height, even though many of them are capable of growing much taller under more favourable conditions. The soil conditions and exposure to harsh weather do not permit the plants to reach great height.

2.652 Two plant species stand out as being typical of the dwarf forest; the manglier des hauts or bois cendre (Sideroxylon) and the immortelle (Helichrysum). The manglier des hauts is one of the tallest plants in the type, usually standing well above the others. A great variety of other trees also grow here but they all remain stunted. Some of the more common species are the bois clou (Eugenia), fandame (Aphloia), bois de riviere (Gaertnera), bois ronde (Erythroxylon) and the vacoas (Pandanus spp). In the more open patches where the trees are scarce, the immortelle is the prominent plant. Usually the ground is covered with a variety of mosses and petite menage (Lycopodium cernuum). The lower trunks of the trees have a great number of small orchids growing on them and are usually covered with moss and lichens.

2.653 Unfortunately, a number of exotic plant species are now quite common in the upland dwarf forest, and these often compete with and eliminate the native Mauritian species. Guava (Psidium), framboise marron (Rubus), privet (Ligustrum walkeri) and a long list of other plants introduced by man are now threatening to take over the areas that were once indigenous vegetation.

2.654 One interesting characteristic of the indigenous dwarf forest is that it contains some of the most beautiful of the native flowers of Mauritius. Some of the more striking species are the white-flowered boucle d'oreille (Ochna), the pink-flowered Trochetia, the bois de riviere, bouquet banane, bois corail,

bois banane and many orchids.

2.655 The animal life in the dwarf forest is also interesting. The oiseau a lunettes and the oiseau banane are perhaps the most typical birds. Both of these species prefer the scrub habitat to any other and it is here that they nest. Both species also feed on the nectar of flowers, so the abundance of flowering plants is attractive to them. The pigeon des mares spends much of its time feeding on fruits and flowers of the dwarf forest plants. Even the hirondelle often hunts for insects above the scrub vegetation. Although they are difficult to see in the scrub, the endemic lezard banane or gecko verte (Phelsuma) is also found here.

2.656 The upland dwarf forest habitat once covered large areas of the higher elevations of Mauritius wherever soil and climatic conditions would not permit high forest to develop. Today the upland dwarf forest has been almost completely destroyed and only a few examples still remain intact, mostly on the south-west corner of the island. Perhaps the best and most extensive remaining area is found on Plaine Champagne. Several smaller patches still exist elsewhere, such as Petrin, on Corps de Garde, Trou Kanaka and Perrier. Perrier is already a Nature Reserve because of the dwarf forest vegetation that exists there. In addition, a programme of removing exotic plant species has resulted in this small area retaining its true character. Perhaps one of the more urgent conservation measures needed on Mauritius is the protection of Plaine Champagne and its unique vegetation. If this fine area of indigenous upland dwarf forest should be destroyed, Mauritius will have lost an important piece of its natural heritage.

2.66 Indigenous upland marshes

2.661 The upland marsh habitat of Mauritius was at one time characteristic of wet, poorly drained soils throughout the upland plateau. Today only a very small portion of this area is still marsh habitat. Some of the largest areas of marshland have been turned into reservoirs (Mare aux Vacoas, Mare Longue, Tamarin Falls). Another very important area where upland marshes occurred was at Les Mares which has recently been cleared to make way for exotic forest plantations. Today only a very few scattered examples of the indigenous marshland remain around the fringes of Les Mares, on Plaine Champagne and at Petrin. In these places the total area of marshland probably does not exceed 12 ha (30 ac).

2.662 Perhaps the most typical tree was the vacoa, which lent its name to the marsh which formerly occurred at Mare aux Vacoas. Nine endemic species of vacoa were known to exist in the upland marshes; many were found nowhere else. These marshland vacoas often grew in dense clumps and were not uniformly distributed around the marsh. Dense clumps still occur on Plaine Champagne and at Petrin.

2.663 Two other species of small trees that were characteristic of the marshes were fangame (Stillingia lineata) and croton (Croton spp). Both of these small trees grew in dense clusters and were probably the most numerous plants of the marsh, but grew almost nowhere else. Beneath these larger plants there was a lower stratum of small plants such as Du Petit Thouars (Carpaea sp) in the drier places and mosses (Sphagnum) in the wet places.

2.664 The upland marshes were the home of many endemic Mauritian animals. Perhaps the most important was the pigeon des mares which has taken its name from the fact that it was so closely associated with the areas around Les Mares and Mare aux Vacoas. It was in the upland marshes that the pigeon found its favourite foods such as the fangame. Both the oiseau banane or colin and the oiseau a lunettes or pitpit were common in the marshes. Because of the abundance of vacoa trees the endemic lezard banane or gecko verte (Phelsuma sp) were also common here. Even today it is possible to see large numbers of these beautiful geckos on the vacoa trees that survive on Plaine Champagne.

2.665 With the clearing of Les Mares over the past three years, Mauritius has lost the best remaining example of the upland marsh habitat. The few scattered examples at Petrin are protected as a Nature Reserve but these areas are so small and untypical that they may soon disappear as the land is dried out by the increased drainage resulting from the creation of the reservoirs and afforestation. If Plaine Champagne were protected as a Nature Reserve or National Park there is a chance that some of the upland marsh habitat might survive.

2.67 Indigenous heath

2.671 One of the most unusual habitats on Mauritius is the indigenous heath, which is now quite rare and can be found only in a very few places on the south-western plateau. Special soil and climatic conditions are necessary for the development of the heath vegetation. The soil is always of extremely poor quality, usually

a recent unweathered lava flow where there is little or no real soil but only coarse gravel. Because of the high elevations (over 600 m or about 2000 ft) at which the heath grows, rainfall is about 4400 mm (about 175 in) a year and the humidity is always high.

2.672 The sparse vegetation of the heath is very characteristic. The dominant plants are the bruyere des montagnes (Philippia abietina), Phyllica mauritiana and the immortelle (Helichrysum yuccaefolium), all of which are endemic. Beneath these small shrubs that rarely reach a height of more than 2 m, there are only a few other plants growing. Usually there are only lichens (Cladonia), mosses (Campylopus introflexus) or gatte menage (Lycopodium cernuum). These plants form a low spongy mat of soft grey and yellow colours that is very typical of the heath. Epiphytes such as small orchids and certain mosses are fairly common on the lower limbs of the bruyere des montagnes and the upper branches are usually festooned with hanging mosses and lichens.

2.673 Very few animals spend much time in the heath habitat because there is not much food or shelter for them there. One of the few birds that visits the heath regularly is the oiseau banane (Foudia rubra) which comes to hunt for insects on the limbs of the bruyere des montagnes.

2.674 Today there are only about 40 ha (100 ac) of true indigenous heath still remaining on Mauritius. The very best examples are found at Petrin, not far from the point where the road turns to Grand Bassin. This area has been declared a Nature Reserve because of the unique vegetation. Unfortunately, because the road passes so near the heath many people walk into the area and pick plants, such as the gatte menage, which take a very long time to regenerate.

2.68 Upland forests

2.681 The indigenous forests of Mauritius are the most impressive of the remaining vegetation types on the island. At one time these forests covered most of the fertile uplands of the Plaine Wilhelms and the south. At these higher elevations the rainfall is heavy (about 3800 mm or 150 in a year) so that plant growth is luxuriant. The soils are often quite poor, rocky and shallow. Today the upland forests are restricted in area and only about 1600 ha (4000 ac) still exist in the south-west around the Black River Gorges.

2.682 The upland forests reach the greatest height of any of the remaining vegetation types; some trees exceed 20 m in height, but most are about 17 m high. The trees are arranged in distinct layers or strata. The uppermost consists of bois de natte (Mimusops maxima), macaque (Mimusops petiolaris), ebene (Diospyros), tatamaka (Calophyllum), colophane (Canarium) and tambalocoque (Calvaria). These huge trees usually have a very characteristic shape. The upper limbs are spreading and are carried on a long straight trunk. Often the trunks have strong buttresses to support the trees, which in a cyclone are fully exposed to the wind. The roots cannot penetrate deeply into the rocky soil so they spread out over the ground and cover a large area. Usually the roots of adjacent trees intertwine so that each tree is braced by its neighbours.

2.683 Beneath these tallest trees is a layer of trees about 15 m (50 ft) tall. Many species of plants are found in this stratum. Some of the more common ones are bois de lait (Tabernaemontana), fandame (Aphloia), bois clou (Eugenia), bois tambour (Tambourissa), bois manioc (Erythrospermum), bois lousteau (Antirrhoea) and bois maigre (Nuxia). These trees also tend to have a characteristic shape which is quite different from the trees of the upper stratum. They tend to have many more branches and the trunks are often twisted and branched. The limbs of adjacent trees usually intertwine and the foliage is dense. Many lianes reach up into this layer of trees. Some of these are the patte de poule à piquants (Toddalia), liane rousseau (Rousseau), liane jaune (Danaïa) and liane à crochet (Hugonia). These lianes use the trees for support and contribute to the physical stability of this layer.

2.684 The next layer of plants is about 5 m (16 ft) in height and once again a great variety of species are found here. Usually the plants in this stratum have a very thin straight trunk with a small bushy crown. Some of the more characteristic species are the bois margoze (Colea), bois cassant (Psathura) and fandia (Cyathea).

2.685 The lowest layer of plants is rather less crowded than the upper layers, because little light reaches the forest floor. Bois cassant and bois queue de rat are two common species.

2.686 Most of the trees in the forest have epiphytes growing on them. Many species of orchids and ferns grow on the trunks of taller trees, especially those in the second stratum.

2.687 The animal life of the upland forest is the most diverse on the island. Several of the endemic birds are found only in this habitat. The gros cateau vert is restricted to these forests where it feeds on fruits and nests in hollow limbs of the trees in the uppermost stratum, usually bois de natte. The mangeur des poules is also confined to these forests and like the parrot nests in hollow limbs of the tallest trees. The merle cuisinier is a typical forest bird and spends most of its time in the lower layers of plants searching for insects. The pigeon des mares visits the forests to feed on fruits and flowers. The merle is found in the trees of the lower strata. The paille en queue (Phaethon lepturus, the only sea-bird which nests far inland) nests in hollow limbs in the tall trees. The upland forest is by far the most important wildlife habitat on the island.

2.688 The best examples of upland forest are around the Black River Gorges. Macchabe and Bel Ombre are already Nature Reserves because of the fine forests that grow there. Smaller areas of forest exist elsewhere on the island, such as along the ridges of the Bamboo Mountains.

2.689 Apart from direct damage by cutting, these forests are gradually being invaded by exotic plants such as the guava (Psidium) and the privet (Ligustrum walkeri). These exotics compete with the seedlings of the native species and interfere with their regeneration. The oldest trees in the forest are often blown down by cyclones. If there are no younger trees coming up to replace these cyclone victims, the cycle repeats itself until the last of the large trees are gone. This is happening in the Black River Gorge where the bleached skeletons of cyclone-killed trees are still standing without any trees to take their place. It is important that the magnificent upland forests of Mauritius be protected fully and that some removal of exotic plants be done so that the native species can regenerate. These forests are the finest examples of the wild, natural Mauritius that existed before man arrived.



Rare plants : Coffea sp. Scientists are already investigating the possibility of cross-breeding this rare wild coffee with existing strains, in the search for improved flavour and blending qualities.

Rare plants : Upland heath is one of the most specialized of the native plant communities of Mauritius - and one of the most restricted in area. The pale green fine-leaved shrubs are Philippia; the junction with dwarf forest can be seen on the right.



2.7 RARE SPECIES, GENETIC RESOURCES AND INVADERS

2.71 General

2.711 Mauritius was once one of the richest oceanic islands in terms of the numbers of plant and animal species which were confined to it. Many of these are now extinct - the story of the dodo does not need to be told again: a living dodo has not been seen by man for nearly three hundred years. It is not intended to elaborate here the arguments for the preservation of individual species or the communities in which they live. Some of these arguments were discussed by Verdcourt (1968). The following principles are taken as axiomatic.

1. Whatever technology man develops, he is still bound by the natural laws.
2. Man's survival will depend in a large measure on his increased understanding of natural laws, the operation of which can best be studied in wild species living in natural conditions.
3. The extinction of any species or the destruction of any biotope (or habitat) will result in an impoverishment of the field available for study. Man may be jeopardising his own and other future systems by allowing gene-groupings, or species, to become extinct.
4. Man must take care not to destroy what he does not yet understand - or what he is not yet able to utilize.
5. In any society there is a need for environmental diversity.

2.712 Thus 'scientific', 'cultural' and 'economic' reasons for the retention of diverse natural ecosystems blend into each other. The dodo is extinct, so we can never know the composition of its blood proteins, the thrill of photographing it in the wild or its potential for domestication as a food source. The ring-necked parakeet survives - just. Will it one day be the basis for a thriving export trade in cage-birds, based on a healthy and viable wild population? Will the genetic properties of the rare wild coffees of the Mauritius forests be used to blend subtle flavours into our jars of instant coffee? (Already there is interest in them, shown by research scientists in France.) How long since a shipment of ebony logs left Port Louis harbour to command a high price in Europe?

2.713 All these possibilities depend on maintaining the integrity of natural ecosystems and on our management and guardianship of them. It is hard to justify action whose aims are long-term and not susceptible of concise quantification, in the face of short-term economic needs, but in the end only failure can result from acting tactically and without a strategy - or confusing the means with the end.

2.72 Birds

The ecological requirements of the remaining endemic birds are now well enough known for realistic recommendations to be made on their management (cf Appendix 6), but the risk to the tiny remaining populations of some species from accidental, wanton or thoughtless killing is still too great for comfort.

2.73 Reptiles

2.731 The lizards of Mauritius have been well documented by Vinson and Vinson (1969) who give excellent accounts of the ecology and status of the species. Probably populations of all species are still large enough to survive in the wild state, provided the habitat destruction on Round Island is arrested and reversed.

2.732 Little is known of the biology and ecology of the two unique snakes of Round Island. One, indeed, may already be extinct. They are the two sole representatives of a unique sub-family of boas, once perhaps, widely distributed around the Indian Ocean. One lives in the crowns of the palms, the other on the ground, but both feed on lizards. The delicate chain: palms - insects - lizards - snakes: is on the verge of breaking. Probably not enough is known about these snakes to attempt a captive breeding programme.

2.74 Round Island

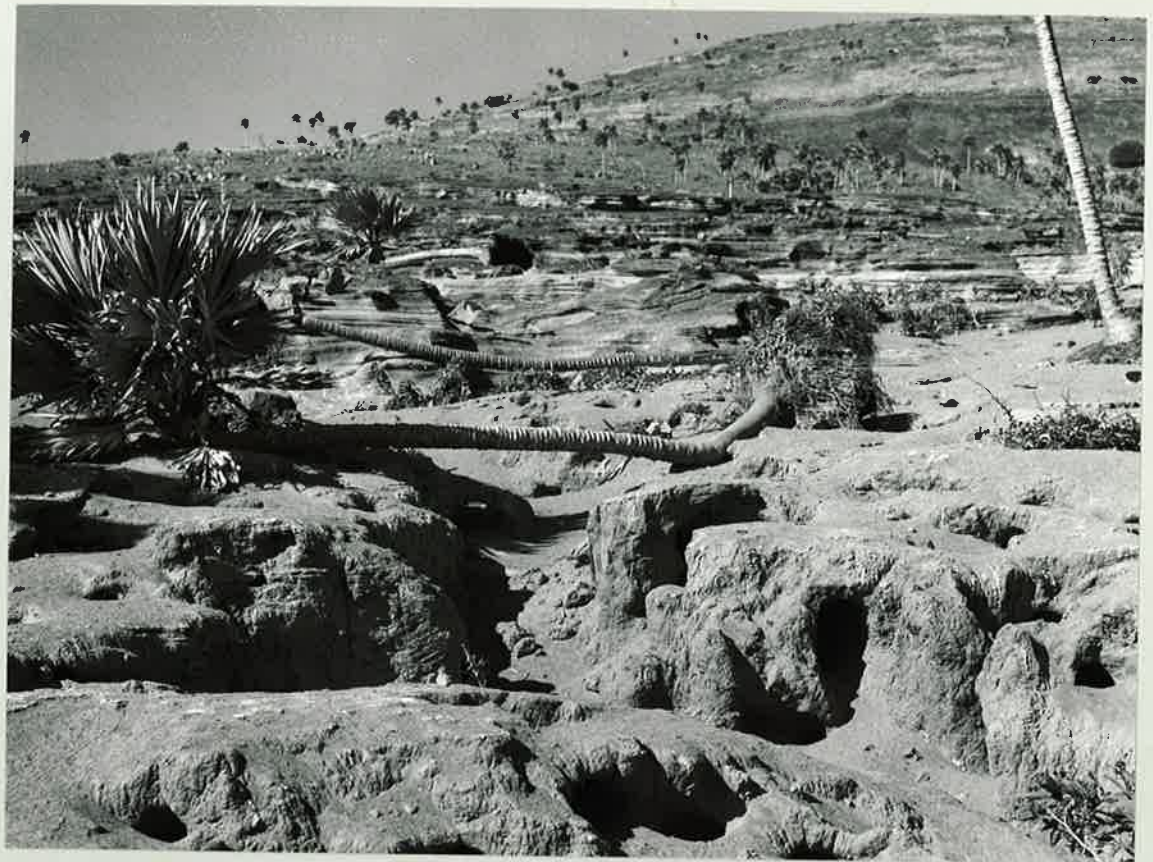
2.741 The biological history of Round Island is well known, but the Round Island endemics are so important that it is impossible to overstate the case for an attempt to rehabilitate the island's ecosystems. Before the introduction of rabbits and goats about 130 years ago, the island vegetation was palm savanna and low closed evergreen forest. Soil of varying depth must have covered most of the island. Much of this soil was highly susceptible to degradation and erosion but a fragile balance was maintained by the plant and animal communities which lived on it. Visiting sea-birds, shearwaters and petrels, burrowed into the soil to find secure nesting places.



Inhospitable Serpent Island, guano-covered and treeless, is framed by the eroded western slopes of Round Island, with the palm Latania loddigesii maintaining a precarious hold in rock crevices.

The summit of Round Island was once covered with forest of broad-leaved trees and shrubs. Rabbits and goats have destroyed the vegetation : wind, rain and cyclones have removed the soil.





Between ten and twenty percent of Round Island still carries some soil. This soil is honeycombed by the burrows of rabbits and shearwaters. Rabbits and goats have destroyed the vegetation and it is only a matter of time before the wind and rain remove the remaining soil, unless urgent action is taken to eliminate the rabbits and rehabilitate the vegetation.





White-tailed tropic-bird and chick. Most sea-birds on Indian Ocean islands have not yet learned to flee from man's presence. So far these birds have escaped the notice of fishermen landing on Round Island.

Between 40 and 50 red-tailed tropic-birds - killed, presumably by fishermen, either for food or for sale. No breeding sea-bird population can long survive such slaughter. This picture, taken on Round Island, a proclaimed Nature Reserve, underlines the need for a resident scientist/warden.



2.742 The rabbits and goats destroyed the vegetation. Wind and rain removed the soil. I estimate that now, between 80 and 90% of the island surface is bare rock. Petrels nest under rock ledges. Shearwaters compete with rabbits for burrowing space in the remaining 10 to 20% of soil, leaving it bare and unstable. Many shearwaters, unable to find burrowing space, lay their eggs on bare rock. There, they are baked by the sun when heat drives the adults to fly out to sea. I found about 100 eggs abandoned in this way. No woody broad-leaved plant now grows on Round Island; only one species of palm still regenerates freely; the only low-growing plants are a small number of species that are unpalatable to rabbits.

2.743 Round Island is a proclaimed Nature Reserve, yet fishermen land at will and kill sea-birds, particularly the beautiful red-tailed tropic-bird, for a change of diet, or, it is said, to sell to certain citizens of Port Louis.

2.744 The reefs around Round Island are not well developed and they show many signs of damage which could be attributed to the deposition of silt eroded from the island. Thus corals are few and weakly developed and reef-dependent fish are few.

2.75 Invading Species

2.751 Hawaii is famous for the number of its original endemic species, the number which have become extinct and the number of invaders which have colonised the islands, but Mauritius certainly holds the record for the Indian Ocean. Plants and animals that have been deliberately introduced have almost always been brought to serve some useful human purpose - for food, to control pests, for ornament or as pets, but around the world, it is rare for such species to be neutral in their effects, once they have become naturalised. Almost without exception, any benefits they have brought have been cancelled by their harmful effects. This is especially true of oceanic islands.

2.752 In Mauritius it is of course too late to reverse this situation. But there are some cases where introduced species, now fully naturalised in the wild, are seriously threatening the survival of some of the rare endemic plants and animals. Some of the more important of these are -

1. The rabbits and goats of Round Island.

2. Hares on Gunners' Quoin and Ilet Gabriel - erosion still at a moderate level, but increasing.

3. Santalum album, Wikstroemia viridiflora and Flacourtia indica forming extensive thickets on Gunners' Quoin.

4. Flacourtia indica, Lantana camara, Leucaena glauca on Ile aux Aigrettes.

5. Rats and/or mice on Ile aux Aigrettes, Flat Island, Ilot Gabriel, Gunners' Quoin.

6. Guava, privet, Hiptage, and Rubus roridus have invaded all forests where uncontrolled cutting or cyclone damage has allowed light to penetrate the forest canopy. In these situations they are suppressing the regeneration of native species.

7. Macaque monkeys destroy the nests and young of rare endemic birds.

Sometimes the rate of predation is very high - approaching 80%.

8. Macaque monkeys destroy the fruits of some endemic trees before they are ripe, thus preventing the development of seed.

2.753 It would be possible to control these plant and animal pests in at least some of the more important areas to be set aside as Strict Natural Reserves. That it is practicable has been demonstrated by the excellent start that has been made in Perrier Nature Reserve and in the Macchabe Forest, with removal of plant pests.

2.754 An example of an introduced naturalised species which is not itself harmful, is the deer. Although deer may damage a certain amount of regeneration of native trees, this damage is negligible by comparison with the effect of introduced plants. Only some of the management practices associated with deer ranching may have to be modified slightly as understanding develops of the interrelationships of the deer with their forest and forest glade habitat.

2.8 RESEARCH, EDUCATION AND PUBLIC RELATIONS

2.81 Research

2.811 The natural resources of Mauritius are possibly as well studied and documented as in any comparable area in the tropics. The activities of the Mauritius Sugar Industry Research Institute, while concentrating on sugar cane and other



Mascarenha revaughanii (left); one of the half-dozen remaining on Round Island. It grows wild nowhere else. The constrictions on the stem may represent past cyclones, when most of the leaves would have been stripped from the crown. This old tree may not survive another cyclone. The other palms are Latania loddigesii and in the foreground are two plants, a grass and an asclepiad climber, which are unpalatable to rabbits.

Because of its bizarre shape when young, Mascarenha revaughanii (right) has been widely planted as an ornamental. Thus, although almost extinct on Round Island, it survives genetically elsewhere and could provide seed for a re-planting programme in its native home.



agricultural crops, have resulted in excellent studies of background ecological data - geology, soil, climate, agricultural suitability etc.

2.812 The organised introduction of plants has a long history. Pierre Poivre, following the start made by Governor Labourdonnais, seems to have set himself the task of introducing the largest possible number of species from all over the world, in the middle years of the 18th century. He was responsible for developing the famous Botanic Gardens at Pamplemousse, started by Labourdonnais, once among the finest in the world but now, regrettably, a monument to past, rather than present endeavour. The Pamplemousse gardens are complemented by the Curepipe Botanic Gardens, on the high-rainfall central plateau. These two fine botanic gardens together offer an excellent opportunity for the establishment of cultivated populations of the endangered endemic plants. Many of the palms are already in cultivation.

2.813 Botanical collecting, started by Bojer and other famous botanists of the 18th and 19th centuries, was given a new impetus when Vaughan reorganised the Herbarium which is now housed at the Mauritius Sugar Industry Research Institute. In collaboration with Kew and the French botanists, a Flora of the Mascarenes is being prepared to replace Baker's Flora of Mauritius and the Seychelles (1877), long out of date.

2.814 Marine life has also received considerable attention and the literature has recently been reviewed by Michel (1974).

2.815 Surprisingly, the vertebrate land animals have received rather little attention. Vinson and Vinson (1969) have recently worked on the saurians, but there are no recent comparable accounts of mammals or birds.

2.816 Invertebrate land animals have been studied for their potential importance as pests or disease vectors, but there are some major gaps.

2.817 Up to the present time, there has been virtually no research directed towards the general field of monitoring man's effect on the Mauritian environment. Chemicals are widely used in the sugar industry and other sectors of agriculture, as fertilizers and as pesticides. Recently, research has begun in the School of Agriculture on pesticide and fertilizer residues. Malarial mosquitoes were eliminated about 25 years ago by blanket insecticide application. Industry is

developing and waste of many kinds is being produced, which must be disposed of. A spring which rises on Le Pouce Mountain is said to yield the purest water in Mauritius: it was praised by Darwin when he climbed Le Pouce in 1836. Today the spring still provides a refreshing drink, but later it is unrecognisable in the squalid ditch in which it runs through Port Louis - laden with all kinds of garbage. There is a clear need for a greater awareness by Mauritians, whether as private citizens or officials, of the health of their environment. (cf Sir Peter Scott's report para 3.4.)

2.82 Education and Public Relations

2.821 Mauritius has a rich cultural heritage and a tradition of cultural activity centering in the Mauritius Institute, the Royal Society of Arts and Science and other cultural organisations. Formal learning has found expression in the Agricultural College which within the last decade has evolved to become the University of Mauritius. Currently, a major U N D P project to set up an Institute of Education has as its long term objective 'to act as a catalyst in the education system and guide it to meet the needs of the country', focussing particularly on the development of curricula.

2.822 Mauritians in all walks of life - not only among the better-educated - show a lively intellectual awareness. They are eager to supplement their personal experience by reading and eager to give their theoretical knowledge meaning by practical experience. This situation offers a challenge which has been accepted by such organisations as the Mauritius College of the Air and to some extent by the Television service and Government Information Office.

2.823 Mauritius has a large number of newspapers of varying size and readership. The initiative shown by some of these newspapers in presenting news items and features about the environment and the natural heritage of the country is warmly commended.

2.824 Discussion at various levels suggested that the best place to establish a focal point for organised effort in conservation and environmental education would be the Institute of Education.

PART 3

3. OBJECTIVES

3.1 It has been stated that many of the options which historically were available in Mauritius are no longer open. It is therefore unrealistic to set objectives which are unattainable for the positive reason that over 60% of the land of Mauritius is under an intensive, productive and conservative form of use, but a use in which diversity is at a minimum. The attainable objectives of conservation (as defined in Section 1.31) must therefore relate to the coral reefs and to the approximately 30% of the land area classified in Table 1 (Section 2.2) as natural forest, plantation forest, scrub, rock, swamps, savanna, reservoirs and ponds. They must also relate specifically to the remaining endemic species of plants and animals, the preservation of their genetic make-up and their potential for evolution.

3.2 There remain the wider objectives of the management of the total human environment. These are not within the immediate terms of reference of this report, but many aspects of environmental management are inextricably linked with conservation as defined in Section 1.31 and our terms of reference. Among the most important may be mentioned the question of the modification of the chemical composition of river waters not only by noxious pollutants but by the fertilization of other chemical regimes practised on neighbouring agricultural lands. Others were mentioned by Sir Peter Scott, for example, population control (his Recommendation 3.3.1) and automobiles (his Recommendation 3.9.1).

3.3 Conservation in its wide sense reaches into the lives of every member of the community. Public understanding and support is necessary for the successful implementation of any government policy, especially one which deals with a dispersed resource. But in the case of environmental conservation it is absolutely necessary to educate the public at all levels to a fuller understanding of the interdependence of man and nature.

3.4 An essential concomitant of the decision to plan is the necessity to control and monitor the effects of the planned actions. Because of the density of population and the intensity of land use, it is becoming increasingly important to work towards a national plan for the environment and natural resources.

3.5 The objectives of a strategy for the management or conservation of the natural resources are therefore as follows:

- 1 To demarcate in perpetuity, for the present and future inhabitants of Mauritius, the remaining areas of land carrying natural or near-natural ecosystems and representative areas of coral reefs.
- 2 To manage such areas so that -
 - i The ecosystems and species which they contain shall be able to develop and live naturally.
 - ii They shall continue to be a source of cultural enjoyment and of opportunities for recreation and scientific study for the Mauritian people and for the rest of the world.
- 3 To study the existing species and ecosystems and to monitor the results of management so that the greatest long-term benefits may accrue.
- 4 To seek to educate the Mauritian people to a fuller understanding of the interdependence of man and nature.
- 5 To present Government Conservation Policy in a positive way to the Mauritian people and to the outside world.
- 6 Recognising the potential value of the genetic resources of the endemic species of Mauritius, to seek by all means possible, including aid from international sources, to prevent their extermination by positive breeding programmes and the rehabilitation of their native habitats.
- 7 Recognising the limits on development imposed by the constraints of land area and natural resources, to intensify the monitoring of the human environment.

PART 4

PROPOSALS FOR ACTION

4.1 INTRODUCTION

4.11 As was stated in the opening section (1.11) of this report, one of the main principles underlying our survey was to relate it as far as possible to work which had gone before, within the context and framework of Government policy statements. We tried to maintain close and frequent contact with the Ministries and technical Departments concerned with our work, in order that there might be a free exchange of ideas. We have tried to incorporate previous recommendations as far as possible, either specifically or as part of our general pattern of proposals.

4.12 The prime need is for practical proposals which are capable of achievement not only technically, but within the political and social framework of government and national life. The development of any programme inevitably passes through a number of phases. The general course of development needs no elaboration - problem identification - planned build-up - continuing management based on research and development. Natural resource management in Mauritius is at present at a late stage in the first phase - of problem identification. The next stage is one of planned build-up and development.

4.13 There is, however, need for immediate action in certain cases. These must be treated ad hoc, without waiting for the achievement of the main programme. The proposals are therefore divided into three groups of phases. The first contains proposals for immediate action. The second phase, or main group of proposals, comprises the logical and planned attack on the central problems of conservation. This attack should be three-pronged -

- 1 The development of a conservation organisation, with its governmental links, its legislative background and technical structure.
- 2 The conservation of genetic resources.
- 3 The development of conservation education at all levels.

The third phase should at this stage be indicated only in outline. It will consist of the development and continuing management of National Parks and the continuing development of the national awareness of the environment, in the era after the establishment and consolidation of the conservation organisation.

4.14 It is desirable to set a tentative time-scale to the three phases, or at least to set a target date for their start. Action on the small group of immediate objectives should start at once. Likewise the first steps towards the establishment of a conservation organisation can be taken without delay. The completion of the initial legislative, fiscal, organisational and administrative measures required, need not take longer than about two years. It should certainly be possible for a conservation organisation in Mauritius to be a going concern by 1977, or about halfway through the successor to the current Four-Year Plan.

4.15 Phasing and priorities

Although it would be premature to attempt to write a formal Development Plan at this stage, Table 5 indicates the logical relationships of the proposed development phases and the main recommendations in the sections which follow.

TABLE 5

RELATIONSHIP OF MAIN PHASES OF NATIONAL PARK DEVELOPMENT

Main Proposals	Remarks
<u>Phase 1</u>	
Initiation of principal legislation	Must precede - Declaration of National Parks Appointment of Board of Trustees
Announcement of name of future Chairman of Board of Trustees	
Appointment of Conservation Officer	Until this is done, execution of proposals will fall on the already heavily-burdened shoulders of existing Government officers in the Forestry Service etc.
Round Island Project	Elimination of goats and rabbits must precede - Application for Project funds Appointment of scientist/warden Initiation of rehabilitation measures.
<u>Phase 2</u>	
Appointment of Board of Trustees	
Declare first two National Parks	Baie de l'Arsenal Black River Gorges
Initiate Round Island Project	
Recruitment of first staff	
<u>Phase 3</u>	
Production of Development Plan	Should contain a broad-based financial forecast
Production of Management Plans	Generalized at first for the main areas; later in more detail for Nature Reserves etc. Good management plans are the basis for detailed financial forecasting and the efficient use of funds.
Initiation of staff training	Liaison with University of Mauritius, FAO/UNDP, African Wildlife Leadership Foundation etc.
Declaration of other National Parks	As resources permit, within Development Plan.
Initiation of organized Nature Reserve and National Park management.	

4.2 IMMEDIATE ACTION

4.21 Summary of proposals in this section

4.211 Round Island Nature Reserve

- 1 Elimination of goats and rabbits.
- 2 Establishment of a scientist/warden on the island.
- 3 Infrastructure
- 4 Implementation of Management Plan to be supported by IUCN/WWF.

Île aux Aigrettes Nature Reserve

- 1 Appointment of guardian.
- 2 Funds for repair of guardian's house.

Appointment of Conservation Officer

Conservation Coinage Funds: planned expenditure.

Conservation and hotels: advantages of integrated planning.

Captive breeding programme for critically endangered birds: endorsement of programme proposed by Dr Temple.

Endemic plant species: list to be produced.

Afforestation policy

- 1 Need for continued liaison between all parties concerned.
- 2 Survey of woodfuel demand and supply.

4.22 Round Island Nature Reserve

2.221 The urgency of action on Round Island was stressed by Sir Peter Scott (Para 4.1 and Recommendations 4.1.2 and 4.1.3 of his Report). Legislation is dealt with in Section 4.33 below and inevitably will take time to enact. The following practical measures, which can be put into effect immediately, are therefore proposed.

4.222 Recommendation The first step in any plan to rehabilitate the vegetation and hence the ecosystems of Round Island must be to eliminate the rabbits and remaining goats. Practical techniques for this have already been established and should be put into execution by the Government as soon as weather permits and the logistics can be worked out. The Conservator of Forests, with responsibility for Nature Reserves, has played a leading part in planning the operation so far, and it is suggested that he should continue to organise it, through the Ministry of Agriculture, Natural Resources and the Environment, who should be responsible for ensuring the cooperation of other Government agencies.

4.223 Recommendation The second step must be to establish a scientist/warden on Round Island. Only a resident warden will be able to control unauthorised landing on the island and therefore the slaughter of birds. The alternative which has been proposed, of basing a warden on Flat Island, could be considered only as a temporary expedient, if only because any person doing anything illegal on Round Island would have ample time to embark and sail away, before even a fast boat could cover the distance from Flat Island.

4.224 Recommendation A warden established on Round Island would need the following support or infrastructure.

- 1 An improved landing such as a mast with a derrick acting as a jetty, perhaps with a pontoon at the end.
- 2 A storm/cyclone-proof house and store, incorporating rain-water catchment areas and water-storage.
- 3 A water-distillation system for sea water.
- 4 A wind-driven generator for electricity.
- 5 Radio contact with Mauritius.
- 6 Boat contact with Mauritius.

This infrastructure implies the establishment of a base on Mauritius for boat and radio contact.

4.225 It was not possible to produce estimates for the construction of such a base on Round Island, and inevitably, construction would take time. Provided the rabbits are successfully eliminated, provided this recommendation is accepted in principle by the Mauritius Government, and provided a suitable scientist warden can be found, he could make a start from a base on Flat Island. Frequent visits to

Frequent visits to Round Island might reduce the bird slaughter and would enable work to start on erosion control and the rehabilitation of vegetation.

4.226 An outline Management Plan for Round Island is given at Appendix 8.

4.227 Recommendation The implementation of the Management Plan, the recruitment and support of a scientist/warden, and the capital cost of establishing a base on Round Island, should be the subject of an application to IUCN/WWF. When a conservation organisation is established in Mauritius, the Round Island Project should be integrated into it for administrative purposes.

4.23 Ile aux Agrettes Nature Reserve

4.231 Recommendation A guardian should be recruited immediately and stationed on the island. A good house exists and a small capital sum should suffice to put it and its water-storage system into good repair. For the time being the guardian should be recruited and paid by the Forestry Service.

4.232 Recommendation If there is difficulty in finding quickly, through Government sources, the small sum required for repairing the house, an approach should be made to the Mauritius Rotary Club or the World Wildlife Fund.

4.24 Appointment of a Conservation Officer

4.241 Recommendation Formal application should be made to the UNDP Country Representative for the release of the funds earmarked in the current Country Programme for an ecologist. These funds should be used to recruit an officer with experience in wildlife management and administration, if possible for two years. His main responsibilities would be -

- 1 To supervise where necessary the 'Immediate action' proposals in this section.
- 2 To pilot the setting up of the main conservation programme outlined in section 4.3.
- 3 To assist in planning the allocation of funds derived from the Conservation Coinage issue.

4.25 Conservation Coinage funds

4.251 Recommendation That an advance plan be prepared for the allocation of funds derived from the Conservation Coinage issue (of Sir Peter Scott's Report Para 9.3). The rate at which funds will accrue is not known precisely, but it is understood that a total of \$500,000 is likely to become available. The following broad heads are suggested for expenditure.

- 1 Capital costs of the Round Island Project.
- 2 Costs of rehabilitation of other Nature Reserves in the Northern Islands group, namely Flat Island, Ilet Gabriel, Gunners' Quoin.
- 3 Cost of rehabilitation of Ile aux Aigrettes.
- 4 Publications and interpretation.

4.26 Conservation and hotels

4.261 It was not possible to investigate this in depth. However, it is understood that a proposal exists to build a major tourist hotel at Arsenal, immediately adjacent to the area which we have selected as the premier Marine National Park site.

4.262 Recommendation That the hotel developers be invited to consider the advantages to be gained by integrating the planning of the hotel and the proposed Marine National Park. (cf Recommendation 3.465).

4.27 Captive breeding programme for critically endangered birds

4.271 Recommendation The current programme, under the direction of Dr Stanley Temple, sponsored by the International Council for Bird Preservation, the New York Zoological Society and the World Wildlife Fund, has already achieved excellent results. Appendix 6, written by Dr Temple, contains recommendations for conservation programmes for all of the endemic land birds. These recommendations are strongly endorsed. The following Resolution of the 16th ICBP World Conference is also strongly endorsed.

"Resolution 26 RECOGNISING the precarious state of some bird species unique to Mauritius, especially the Kestrel Falco punctatus; Pink Pigeon Nesoenas mayeri; Ring-necked parakeet Psittacula torquata; Olive White-eye Zosterops olivacea chloronothus and Mauritius Fody Foudia rubra, and the special plant communities on which they depend;

RECOGNISING the Mauritius Government's support of captive breeding of endangered species:

URGES the Mauritius Government to take rigorous protective action to ensure their survival, including the establishment of suitable areas as National Parks; particularly the Black River Gorges/Macchabe Forest area on Mauritius; and Round Island."

4.272 Recommendation Government should give all possible support to the continuation of this programme.

4.28 Endemic plant species

4.281 Recommendation The Herbarium of the Mauritius Sugar Industry Research Institute, in collaboration with Kew and the appropriate authorities in La Reunion, should produce, as a matter of urgency, a list of Mauritian/Mascarene endemic vascular plants, with an indication of their status. The material for such a list, which need not be the last word in nomenclature or taxonomy, already exists. It would be of the greatest value as a tool for practical conservation measures.

4.29 Afforestation policy

4.291 This is discussed in more detail in section 4.42.

4.292 Recommendation The formal and informal contacts established during November and December 1974, between those responsible for afforestation in the Development Works Corporation, the Ministry of Agriculture, Natural Resources and the Environment, the Forestry Service and wildlife conservation interests, should be maintained. Frequent informal contact at all levels is one of the best ways of avoiding misunderstanding.

4.293 Recommendation As a matter of urgency, the Forestry Service, in collaboration with the Development Works Corporation, should carry out a survey of the demand and supply of woodfuel, and an assessment of marginal land which might be suitable for woodfuel production.

4.3 THE MAIN CONSERVATION PROGRAMME

Page 4/8

4.31 Summary of proposals in this section

Policy

White Paper on Conservation Policy.

Legislation

An Act to provide for the creation of National Parks and related matters.

Review of conservation legislation.

Administration and executive

Board of Trustees.

Responsibility and membership of Board.

Function of Board.

National Parks and Wildlife Service.

Finance

Guidelines.

National Parks and Reserves

Priorities and phasing.

Ownership of National Parks and Nature Reserves.

Management Plans.

The Black River National Park.

Priority.

Management Plan guidelines.

Future extension.

The Baie de l'Arsenal marine National Park.

Priority.

Coordination of National Park and hotel development.

The Northern Islands National Park.

Priority

Serpent Island Nature Reserve declaration.

Flat Island/Gabriel marine National Park.

The Blue Bay marine National Park.

Future land National Parks.

4.32 Policy

4.321 Mauritius at present lacks legislation through which a formal comprehensive conservation programme can be implemented. Although several general statements of policy have been made in various contexts, a full and clear policy statement by Government is the foundation on which all future work must be built.

4.322 Recommendation A White Paper on Conservation Policy should be produced. Experience in other countries has shown that the announcement by Government of a long-term policy has the effect of pulling together many activities and shades of opinion which previously were uncertain of their direction or objectives. The effect often far surpasses the effort put into the formulation of the policy.

4.33 Legislation

4.331 The research into legislation proposed by Sir Peter Scott (his Recommendations 6.3.1 and 9.1.1) is certainly desirable. If it can precede the next recommendation, so much the better. An enabling Act which will permit the creation of National Parks and an organisation for their management is, however, an urgent necessity and is a prerequisite of further progress.

4.332 Recommendation An Act to provide for the creation of National Parks, a Board of Trustees and related matters, should be passed as soon as possible. A suggested draft forms Appendix 1.

4.333 Recommendation The research recommended by Sir Peter Scott should be combined with a study of existing conservation and related legislation in Mauritius, with a view to producing subsidiary legislation as required and a review of the Principal Acts in about five years' time.

4.34 Administration and execution

4.341 Recommendation A Board of Trustees should be set up under the Act (cf Recommendation 4.322). Mauritius is fortunate that Dr Robert Antoine, presently Director of the Mauritius Sugar Industry Research Institute, has volunteered to act as the first Chairman of the Board.

4.342 Recommendation The Board should be responsible to the Minister of Agriculture, Natural Resources and the Environment. Membership should where possible be

on a personal basis, not ex officio, and should be for a stated term (three years is suggested), with the possibility of re-appointment. Membership should include at least the following.

A representative of the Ministry of Agriculture, Natural Resources and the Environment, also representing the UNESCO - MAB Committee.

A representative of the Ministry of Fisheries..

A representative of the Ministry of Tourism.

A representative of the Ministry of Development Planning.

A representative of the deer-ranching community.

The Mauritius representative of the International Council for Bird Preservation, Dr France Staub.

A nominee of the International Union for the Conservation of Nature and Natural Resources.

The Director of the Mauritius Institute, Mr Claude Michel.

4.343 Recommendation The function of the Board should be to advise Government on matters of policy and legislation. Its executive responsibilities should be carried out by a National Parks and Wildlife Service. The Board should have powers to hold and administer funds from sources outside the Government budget.

4.344 Recommendation A National Parks and Wildlife Service should be set up. Its primary function would be the execution of Government Policy as set out in the White Paper (Recommendation 4.311) and in particular to manage the National Parks and Nature Reserves. It is premature at this stage to prescribe in detail the structure of this Service, but a suggested outline is given in Appendix 2. The details should be worked out by the officer appointed under Recommendation 4.241, in consultation with the Chairman of the Board and the Ministry of Agriculture, Natural Resources and the Environment.

4.35 Finance

4.351 Recommendation It is premature to attempt to forecast in detail the pattern of revenue and expenditure of the Board of Trustees. This should be worked out by the Conservation Officer (Recommendation 4.241) in consultation with the Chairman, the Ministry and other interested agencies. Guidelines are suggested in section 4.83 below.

4.36 National Parks and reserves

4.361 Recommendation The effort required to set up a National Park is very considerable and the initial burden of administration and legislation falling on the Conservation Officer's shoulders will be a heavy one. It is therefore unrealistic to suggest initiating the creation of several National Parks immediately and simultaneously.. It is therefore recommended that work should start, as soon as legislation has been enacted, on the creation of one land National Park and one marine National Park.

4.362 Recommendation Ideally, it is preferable for National Parks and Nature Reserves to be wholly state-owned. However, in a few cases, some areas of privately-owned land should be included. Formal agreements should be negotiated with the land-owners concerned, who may wish to retain certain rights, to ensure that the management objectives of the National Parks are fulfilled. Such areas are likely to be in Mountain or River Reserves, over which the Government already has a large measure of control.

4.363 Recommendation All National Parks and Nature Reserves should be managed according to Management Plans, which should be drawn up by the National Parks and Wildlife Service (Recommendation 4.344) and approved formally by the Board of Trustees. Such plans should not be varied within a five-year revision period except with the approval of the Board.

4.364 The Black River National Park (cf Sir Peter Scott's Recommendations 4.2.1 and 4.2.2).

Recommendation Priority should be given to proclaiming this Park (cf Recommendation 4.361 above). The proposed boundary is indicated on Map 1.

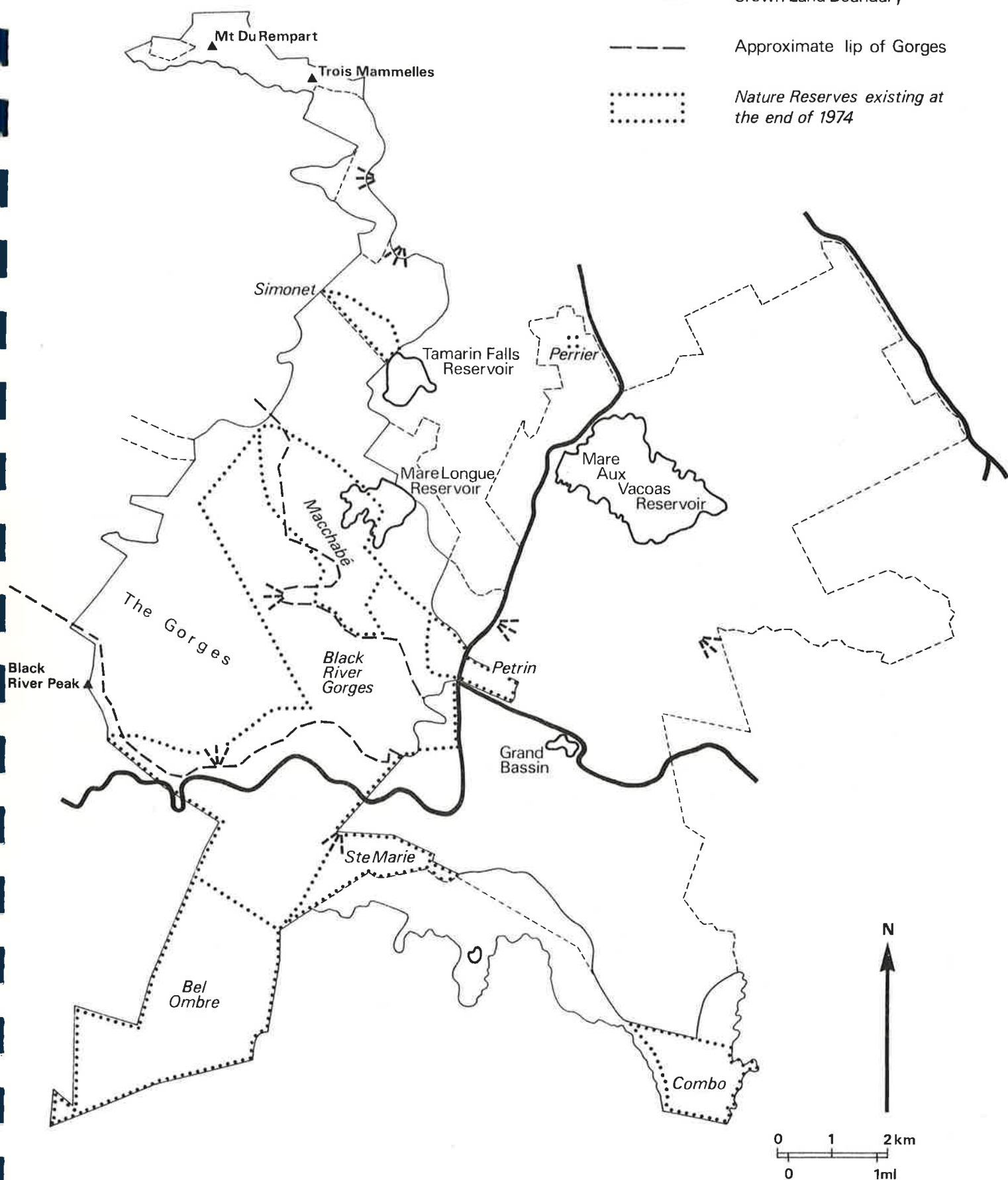
Recommendation The Management Plan for this Park should aim at a zonation of use, with development for visitors at one extreme and Strict Natural Reserves at the other. The multiple use concept would then enable certain blocks to be used for growing wood and others for deer ranching, while the overall requirement of maintaining the largest possible area of natural or near-natural ecosystems would be maintained. It may be found that the present aggregate area of Nature Reserves is too large (interpreting 'Nature Reserve' to mean 'Strict Natural Reserve').

Recommendation When the status of land which has been cleared and planted with tea

MAP 1

BLACK RIVER NATIONAL PARK

-  Main Access Roads
-  Lookouts and Viewpoints
-  Proposed National Park Boundary
-  Crown Land Boundary
-  Approximate lip of Gorges
-  Nature Reserves existing at the end of 1974



eucalyptus and pine during the past decade, especially the past five years, becomes clearer, the Park should be extended substantially eastwards, to include most of the afforestation area and the remaining blocks of natural or near-natural vegetation. Grand Bassin, Kanaka Crater and Montagne Perruche should be included.

4.365 The Baie de l' Arsenal Marine National Park

Recommendation Priority should be given to proclaiming this Park (of Recommendation 4.361 above). The proposed boundary is indicated on Map 3. A description of the proposed Park, with an outline Management Plan, is given in Appendix 4 and 5.

Recommendation The coordination of tourist hotel and marine Park development in this area should be given urgent consideration. (cf Recommendation 4.262).

4.366 The Northern Islands National Park (cf Sir Peter Scott's Report section 4.1).

Recommendation The northern islands should in due course be created a National Park. All of the islands are already Nature Reserves, with the exception of Serpent Island and Pigeon Rock. This fact, and the proposed Round Island Project (Recommendations 4.222 to 4.227) should ensure a reasonable degree of protection for this area, until priorities admit of its being given full National Park status.

Recommendation Serpent Island and Pigeon Rock should be declared Nature Reserves.

4.367 Flat Island/Gabriel

Recommendation The reefs between these two islands, both Nature Reserves, should be proclaimed a marine National Park, as an interim measure before the whole Northern Islands group is proclaimed. The proposed boundary is indicated on Map 5. A description of the proposed Park is given in Appendix 4.

4.368 Blue Bay

Recommendation This area should be given a lower priority than Baie de l'Arsenal for the reasons given in Recommendation 4.361. It should, however, be proclaimed as soon as resources and manpower are available. A description of the proposed Park is given in Appendix 4.

4.369 Future land National Parks

Recommendation - The following areas should be considered for future National Parks.

- 1 La Nicollière.
- 2 Bamboo Mountains.
- 3 The south coast between Le Gris-gris and Pmt Naturel.
- 4 The Moka Range - Le Pouce to Pieter Both.

4.4 CONSERVATION OF GENETIC RESOURCES

4.41 This is the second of the three prongs of the attack (cf section 3.5, Objective 6, and section 4.13). Its importance is no less than the management of the share of Mauritius in the world's gene-pool. As such it is of world concern, and Mauritius and the rest of the world have a two-way responsibility. The ideal to be aimed at is the maintenance of intact ecosystems with their component species. The programme for the creation of Nature Reserves and National Parks is designed with this objective in mind.

4.42 There are, however, a number of species of both plant and animal, which are currently in danger. It would be unrealistic to suppose that the management of Nature Reserves or the control of introduced pest species will reach a sufficient level of sophistication and effectiveness soon enough to ensure the survival of these endangered species. In the short term, the survival of many of them can probably be ensured only by programmes of cultivation or captive breeding, followed by attempts to re-establish populations in the wild.

4.43 Recommendation Management Plans for Strict Natural Reserves and natural areas in National Parks should have as a major objective the maintenance of viable populations of endangered species.

4.44 Recommendation Captive breeding programmes for endangered birds should be continued and expanded. (cf Recommendation 4.271 and 4.272.)

4.45 Recommendation As soon as the status of the endemic Mascarene vascular plants has been established (cf Recommendation 4.281), a programme of cultivation should be started. (It is appreciated that many of the rare endemics, particularly the palms, are already in cultivation.) The initiative currently being taken by the Royal Botanic Gardens, Kew, in collaboration with I U C N, to establish cultivated populations of endangered species, is strongly endorsed. The Mauritius Sugar Industry Research Institute Herbarium, the Forestry Service and those responsible for the Botanic Gardens at Pamplémousse and Curepipe, should collaborate with the National Parks and Wildlife Service in this programme. (cf Recommendation .) (cf Sir Peter Scott's Recommendation 3.5.4).

4.46 Recommendation Attention should be given to the possibility of captive breeding programmes for the endangered endemic reptiles, with priority for the Round Island endemics.

4.5 RESEARCH

4.51 The National Parks and Wildlife Service will be a management rather than a research organisation. It follows that it should not undertake pure or academic research. It will, however, have a duty to organise research directed towards the management objectives of the areas under its control. It will also have a duty to monitor the results of its own management practices and to guide the general monitoring of the effects of man's actions on his environment.

4.52 Recommendation The National Parks and Wildlife Service should undertake the collection of basic biological information and should invite the participation of other organisations in carrying out research which will help to define and achieve the objects of management of National Parks and Nature Reserves.

4.53 Recommendation The Botanic Gardens of Pamplemousse and Curepipe should be used as locations for establishing populations of endangered species of plants.

4.54 Recommendation The ecological requirements of endangered species should be studied both in nature and in cultivated or captive populations.

4.55 Recommendation The ecology of coral reefs should be studied with special reference to their resilience against utilization, the occurrence of large populations of certain organisms such as echinoderms, and successional processes, including recovery from cyclone damage.

4.56 Recommendation The levels of pesticide and other residues should be investigated in a selected range of indicator organisms in the coral reef communities, with special reference to the concentration of residues in river outflows, and with special reference to the fate and side effects of the insecticides used to control malarial mosquitoes about 30 years ago.

4.57 Recommendation The work on the ecology of rare birds begun under the sponsorship of ICBP, BOU and other organisations, should be continued and expanded.

4.58 Recommendation Work currently under way on the flora of Mauritius should be expanded where possible to cover the precise mapping of the distribution of rare endemic plants, with special reference to 'refuges' such as mountain and

and river reserves which have not yet been proclaimed as Nature Reserves.

4.59 Recommendation The above Recommendations should be considered against the background of the recommendations of the Mauritius UNESCO/MAB Committee. (See Appendix 3.)

4.60 The basis of the following recommendations was established in discussion with Dr. H. Davis of the Institute of Botany, who is a specialist in the field of the Ministry of Education, and Dr. H. Davis of the Ministry of Education, who is a specialist in the field of the Ministry of Education.

4.61 The basis of the following recommendations was established in discussion with Dr. H. Davis of the Institute of Botany, who is a specialist in the field of the Ministry of Education, and Dr. H. Davis of the Ministry of Education, who is a specialist in the field of the Ministry of Education.

4.62 The basis of the following recommendations was established in discussion with Dr. H. Davis of the Institute of Botany, who is a specialist in the field of the Ministry of Education, and Dr. H. Davis of the Ministry of Education, who is a specialist in the field of the Ministry of Education.

4.63 The basis of the following recommendations was established in discussion with Dr. H. Davis of the Institute of Botany, who is a specialist in the field of the Ministry of Education, and Dr. H. Davis of the Ministry of Education, who is a specialist in the field of the Ministry of Education.

4.64 The basis of the following recommendations was established in discussion with Dr. H. Davis of the Institute of Botany, who is a specialist in the field of the Ministry of Education, and Dr. H. Davis of the Ministry of Education, who is a specialist in the field of the Ministry of Education.

4.6 EDUCATION AND PUBLIC RELATIONS

4.61 Any programme concerned with land or renewable natural resources stands a much greater chance of success if it has the understanding and support of the people. In Mauritius, however, it is doubly important to educate the people to an understanding that the programme is for the benefit of them and their descendants.

4.62 Without such understanding, the chances of success in a major conservation programme are small. Education and public relations, or 'Interpretation' thus comprise the third prong of the attack and in some ways the most important.

4.63 The basis of the following recommendations was established in discussion with Dr R Davis of the Institute of Education, with Mr M Vasudevan, UNESCO Expert in the Ministry of Education, and Messrs G van den Enden, UNESCO Expert in Agricultural Education and M Chadwick, Bilateral (ACTS) Science Adviser.

4.64 Recommendation That a specialist in Environmental Education be attached to the Institute of Education.

4.65 Recommendation Recognising that the current UNDP/UNESCO project funds are fully committed until the end of 1975, application should be made to USAID for support for the Specialist.

4.66 A job specification and details of a possible candidate have already been sent to Mr Vasudevan.

4.7 MISCELLANEOUS PROPOSALS

4.71 Recommendation Any Crown land currently under tea, which is to be abandoned, should be allocated to forestry or national parks, if this is compatible with the general pattern of land use in the area and with the classification of Arlidge's Land Use and Agricultural Suitability map.

4.72 Recommendation The Perrier Nature Reserve should be maintained as a research area.

4.73 Recommendation The Organisation of African Unity Convention on the Conservation of Nature and Natural Resources should be supported by appropriate legislation as soon as possible.

4.74 Recommendation The Forestry Service should make every effort to find any existing records of the research plots established during the 30's in Bel Ombre and Belloguet. In any case these plots should be re-measured and re-described as a basis for future work on the regeneration of these forest types.

4.75 Recommendation Casual access by picnickers and others to Nature Reserve areas is having an adverse effect on the vegetation in some areas, notably along the road through Plaine Champagne. Management plans for National Parks should take into account the need to channel visitor use to areas where it is not harmful to the natural life.

4.76 Recommendation The Black River Gorges lookout should be developed as the first land National Park visitor centre.

4.77 Recommendation Brouard's excellent 'History of the Woods and Forests of Mauritius' is now out of print. A second edition, incorporating a division into chapters, an index, maps and illustrations, would be a major contribution to the literature on the natural resources of Mauritius and should sell readily to visitors.

4.78 Recommendations A set of stamps based on the endemic plants of Mauritius, would be a worthy addition to the notable philately of Mauritius and would serve also to emphasise current work on the Mauritius and Mascarene Flora.

4.8 FUTURE PROGRESS

4.81 Organisation

4.811 The emphasis throughout our survey and throughout this report has been on practicality. Our aim has been, not to describe heaven, but to point out the first rungs of the long, steep ladder which leads there. Our Immediate Action proposals are confined strictly to urgent essentials, attainable through the use of existing manpower, resources or opportunities. Our Mainstream proposals are designed to take wildlife management a few steps further on the path to a formal organisation. The very creation of such an organisation will mean that thought and planning will be consciously directed towards the next stages of development and consolidation. Therefore it would be pointless for us to attempt, now, to prescribe in detail the course of such stages.

4.812 In working out our Mainstream proposals we constantly bore in mind the existing Ministerial and Departmental structures, with their range of responsibilities and logistical capabilities. In spite of the acknowledged drawbacks of proposing a proliferation of organisations, it was decided to recommend the establishment of a new National Parks and Wildlife Service for the following reasons.

(1) While the Forestry Service has been the main agency for carrying out Government conservation policy up to the present time, at its present strength it is fully occupied in executing Government forest policy and in collaboration with the Development Works Corporation, the execution of the national afforestation programme.

(2) The future burden of plantation management will be a heavy one for the Forestry Service, which will almost certainly require to be strengthened if management is to continue at its present high standard.

(3) We believe that it would be wrong to expect the Forestry Service, even with expanded staff cadres, to shoulder the heavy burden of creating a wildlife management organisation including the administration of marine parks.

(4) The proposed National Parks Board of Trustees, with a degree of autonomy, would require a reasonably self-contained executive arm which should not have divided loyalties.

4.813 It is suggested that in the future there might be a case for merging the Forestry and Wildlife Services. This would be an evolutionary process and would depend on a number of factors. In any case the two organisations would have certain common objectives and the Wildlife Service would initially need to draw heavily on the experience and records of the Forestry Service.

4.82 Forestry

4.821 Although forestry as such does not fall within our terms of reference, some current forest operations impinge so strongly on certain concepts of nature conservation that it is impossible not to take forest policy and practice into consideration. Furthermore, the Forestry Service's present responsibility for Nature Reserve and general Crown Land management gives it a strong position as a base for any work in this field. Aspects of forest policy and practice have been discussed in Sections 2.11, 2.2, 2.3 and Recommendations 4.292, 4.293, 4.364 have already been made. Sir Peter Scott's remarks and recommendations in paragraph 3.6 of his report are also relevant.

4.822 The following remarks are therefore intended, not as firm recommendations, but as guiding principles for the evolution of both forestry and nature conservation. They have their basis in the history of land use and in the dominant features of the economy.

4.823 The available area of land which is not under sugar and which is capable of producing a crop of utility timber with economic efficiency is strictly limited. It almost certainly will not produce enough timber to satisfy the current and future demand. The components of this equation are probably quantifiable from existing knowledge and assessment of the proportion of the demand which should be satisfied from local sources is an essential prerequisite of future planting policy decisions.

4.824 The excess demand must therefore be met in other ways - by importation, or by the local manufacture or importation of substitutes. The ultimate, if indirect source of finance for this must of course be the main land-using industry, sugar.

4.825 The large and unsatisfied demand for woodfuel has been discussed above. At many stages of its production, woodfuel requires a lower capital input and less technological sophistication than the production of utility timber. It

cannot be produced efficiently on very poor sites but it is amenable to labour-intensive methods on some land which is now considered marginal to agriculture.

4.826 One of the main goals of the Development Works Corporation is to utilise the large pool of labour at present available in Mauritius. Provided the objectives of afforestation are clearly identified in terms of forest and land-use economics, there is an excellent opportunity for using the DWC as a contracting agent in carrying them out. Analogous arrangements have proved successful in other countries such as India.

4.827 There is a similar but perhaps more limited opportunity for developing cooperation in the field of wildlife management. Wildlife management is not, as a rule, amenable to labour-intensive methods, though the development of National Park infrastructure such as road-making, building etc, offers some opportunities.

4.828 It is suggested therefore that the situation should evolve towards a balance between import of timber, home production of timber, organised production of woodfuel, the need to find employment for labour and the need to reduce pressure on the remaining natural ecosystems.

4.829 We believe that such a balance can be struck.

4.83 Finance

4.831 It has been recommended (4.343) that the Board of Trustees should have powers to hold and administer funds from outside the Government budget. This is especially significant in view of the growing international concern to conserve the resources of the world as the common responsibility of all nations. Certain responsibilities, however, are by their very nature, vested in the state (cf Appendix 2, para 1.1). These include legislation and decisions on land-allocation.

4.832 The costs of running a wildlife management organisation can be divided into administrative costs and costs related to specific projects. The former are open-ended; the latter may be open-ended or they may be capital costs which would not be repeated. It is suggested that in addition to responsibility for legislation, policy-making and land-allocation, Government should accept

responsibility for the administrative costs of the Board of Trustees and that funds for specific conservation projects should be sought from one or both of the following types of source.

(a) Sources generated from within Mauritius with the assistance of outside agencies; such as the Development Works Corporation and the Conservation Coinage Issue.

(b) Direct aid funds from international organisations or bilateral agreements.

REFERENCES

- ALLEN, G R 1972 Anemone fishes Jersey City.
- ANON 1971-75 Four-Year Plan for social and economic development. Govt. of Mauritius.
- ARLIDGE E Z 1973 Land resources and agricultural suitability map of Mauritius FAO/MSIRI.
- AXELROD, H R and EMMENS, C W 1969 Exotic marine fishes. Jersey City.
- BAISSAC, J de B (in press) Poissons de mer des eaux de L'Ile Maurice.
- BAISSAC, J de B, LUBET P and MICHEL, C 1962. Les biocoenoses benthiques littorales de L'Ile Maurice. Rec. Trav. St. Mar. End. 25 (39): 253-291.
- BAKER J G 1877 Flora of Mauritius and the Seychelles. London.
- BARNES, J H 1966. The crown of thorns as a destroyer of coral. Aust. Nat. Hist. 15: 257-61.
- BARNWELL, P J 1948. Visits and despatches (Mauritius 1598 - 1948). Mauritius.
- BALINSKY, B I 1969 The echinoderms. In MACNAE, W and KALK, M (Eds.) A natural history of Inhaca Island, Mocambique. Johannesburg.
- BOSHOF, P H 1969 Development and constitution of coral reefs. In MACNAE, W and KALK, M (Eds.) A natural history of Inhaca Island, Mocambique. Johannesburg.
- BROUARD, N R 1963 A history of the woods and forests in Mauritius. Mauritius. 86 pp.
- CHESHER, R H 1969 Destruction of Pacific corals by the seastar Acanthaster planci. Science. 165: 280 - 3.
- CLARK, H L 1946 The echinoderm fauna of Australia. Washington.
- CURRY-LINDAHL, K 1971 Comments on the conservation, management, utilization of the renewable natural resources of Mauritius. UNESCO typescript, 9 August, 1971, 6pp.
- CURRY-LINDAHL, K 1974 Conservation problems and progress in northern and southern Africa. Environmental Conservation 1 (4): 263 - 270.
- DARWIN, C 1870 Journal of researches during the voyage of HMS Beagle around the world. London.

- DASMAN, R F, MILTON, J P and FREEMAN, P H 1973 Ecological principles for economic development. John Wiley/IUCN and Conservation Foundation. 262 pp.
- DAWSON, E Y. 1959 Changes in Palmyra Atoll and its vegetation through the activities of man 1913 - 1958. Pacif. Nat. 1 (2): 1 - 51.
- DAWSON, E Y, ALEEM, A A and HALSTEAD, B W 1955. Marine algae from Palmyra with special reference to the feeding habits and toxicology of reef fishes. Occas. Pap. Allan Hancock Found. 17: 1 - 39.
- DAY J H 1969 A guide to marine life on South African Shores. Capetown.
- DOUGLAS, M J W 1967 FAO/UNDP report on deer management. FAO/UNDP Mauritius milk and meat project. AGA: DP/MAR/67/504 Technical Report No.3.
- GRUNDLEY, J R and GRICE, C D 1969 A redescription of Pseudodiaptomus marinus Sato (Copepoda Calanoidea) and its occurrence at the island of Mauritius. Crustacea, 16 (2): 125 - 134.
- HARRINGTON, R W and BIDLINGMAYER, W L 1958 Effects of dieldrin on fishes and invertebrates of a salt marsh. J Wildlife Management, 22 (1): 76 - 82.
- HERBERT T 1663 Relation du voyage de Perse et Indes Orientes Tr. Vuicquefort, Paris.
- HODGKIN, E P and MICHEL C 1963 Zonation of plants and animals on the rocky shores of Mauritius. Proc. R Soc. Arts. Sci. Mauritius, 2 (2): 121 - 145.
- JOHANNES, R E 1972 Coral reefs and pollution. In RUIVO, M (Ed.) Marine pollution and sea life. London.
- JOHNSTON, D R, GRAYSON, A J and BRADLEY, R T 1967. Forest planning. London. 541pp.
- KALK, M 1969 The general ecology of the shores of Inhaca Island. In MACNAE, W and KALK, M (Eds.) A natural history of Inhaca Island, Mocambique. Johannesburg.
- LAXTON, J H 1974 Aspects of the ecology of the coral-eating Starfish, Acanthaster planci. Biol. J. Linn. Soc., 6: 19 - 45.
- MACNAE, W 1969 Sea grasses. In MACNAE, W and KALK, M (Eds.) A natural history of Inhaca Island, Mocambique. Johannesburg.
- MICHEL, C 1974 Notes on marine biological studies made in Mauritius. Bull. Mauritius Inst. VII (2) : 284 pp.
- MCHARG, I L 1969 Design with nature. New York.

- MILBERT, J 1812 Voyage pittoresque à l'île de France en Cap de Bonne Espérance et à l'île de Tenériffe. Paris.
- MOORHEAD, S 1974 Fathom five underwater park. Landscape Architecture, 64 (4) : 264 - 269.
- MUNDY, P 1914-1919 The travels of Peter Mundy in Europe and Asia 1608 - 1667. The Hakluyt Society (Ed.) London.
- OWADALLY, A W 1973 Les forêts naturelles de l'île Maurice. Bull. Soc. Protectrice Reunionaise et Etude de la Nature. (SPREN). Special issue: la Forêt: 88 - 94.
- OWADALLY, A W and BUTZLER, W 1972 The deer in Mauritius. Mauritius. 32pp.
- PICHON, M 1967 Caractères généraux des peuplements benthiques des récifs et lagons de l'île Maurice. Cah. ORSTOM. (Océanographie) 5 (4) : 31 - 45.
- PICHON, M 1971 Comparative study of the main features of some coral reefs of Madagascar, La Réunion and Mauritius. Symp. Zool. Soc. Lond. 28: 185 - 216.
- PITOT, A 1905 T' Eylandt Mauritius. Port Louis.
- POPPER, F E 1972 Preface to Marine pollution and sea life. London. 648 pp.
- PROCTER, J 1971 Conservation in the Seychelles. Seychelles. 37pp.
- RAINFORD, E H 1925 Destruction of the Whitsunday Group fringing reefs. Anst. Mus. Mag. 2 : 175 - 177.
- RANDALL, J E 1958 A review of ciguatera, with a tentative explanation for its cause. Bull. Mar. Sci. Gulf Caribb. 8 (3) : 236 - 267.
- RAY, C 1969 Marine parks and inshore conservation in Kenya. Report to the Director of National Parks, Nairobi, Kenya.
- ROBERTSON, I J B 1972 Seychelles marine parks. Report to the government of the Seychelles.
- ROBERTSON, I J B 1974 A draft report on the Mauritius marine parks. Report to FAO, Rome.
- RUSSELL, R J 1962 Origin of beach rock. Z. Geomorph. N. F. 6 : 1 - 16.
- SALM, R V 1974 Dynamics and management of the Ponta Terres coral reef, Inhaca Island. Report to the Institut de Investigacao Cientifica de Mocambique.
- SCOTT, A 1955 Natural resources : the economics of conservation. Toronto.

- SCOTT, P 1973 Conservation in Mauritius. ~~21pp~~ 21pp, a report to the Prime Minister of Mauritius.
- SMITH, J L B and SMITH, M M 1969 The fishes of Seychelles. Grahamstown.
- SPRINGER, P F and WEBSTER, J R 1949 Effects of DDT on Salt-marsh wildlife. Fish and Wildlife Service, Special Sci. Rep. Wildlife, 10.
- STEPHENSON, T A, STEPHENSON, A, TANDY, G and SPENDER, M A 1931. The structure and ecology of Low Isles and other reefs. Scientific Rep. Great Barrier Reef Expedition 3 : 17 - 112.
- STODDART, D R 1969 Ecology and morphology of recent coral reefs. Biol. Rev. 44 : 433 - 498.
- TEMPLE, S A, STAUB, J J F and ANTOINE, R 1974 Some background information and recommendations on the preservation of the native flora and fauna of Mauritius. Cyclostyled. 37pp.
- VAUGHAN, R E 1968 Mauritius and Rodriguez. In Hedberg, O. and Hedberg, I. Conservation of vegetation in Africa South of the Sahara. Acta Phytogeographica Snecica 54 : 265 - 272.
- VAUGHAN, R E and WIEHE, P O 1937 Studies on the vegetation of Mauritius, I. A preliminary Survey of the plant communities. J. Ecol. 25 : 289 - 343.
- VAUGHAN, R E and WIEHE, P O 1941 Studies on the vegetation of Mauritius, III. The structure and development of the upland-climax forest. J. Ecol. 29 : 127 - 160.
- VERDCOURT, B 1968 Why conserve natural vegetation? In Hedberg, O. and Hedberg, I. Conservation of vegetation in Africa South of the Sahara. Acta Phytogeographica Snecica 54 : 1 - 9.
- VINSON, J and VINSON, J.-M. 1969 The saurian fauna of the Mascarene Islands. Bull. Mauritius Inst. 6 (4) : 203 - 320.
- WALKER, H J 1962 Coral and the lime industry of Mauritius. Geographical Review, 52 : 325 - 36.

APPENDIX 1

AN OUTLINE FOR A NATIONAL PARKS ACT

Suggested outline for an Act to provide for the setting up of a Board of Trustees for National Parks, for the creation of National Parks and Reserves, and other matters related and incidental thereto.

Title National Parks and Nature Conservation Act.

1. Interpretation

Inter alia, the following terms should have the meanings indicated, unless the context should require otherwise.

Area of Outstanding Natural Beauty means an area set aside by reason of its natural beauty or other special characteristics for its preservation and maintenance for the benefit, advantage and enjoyment of the general public.

National Park means an area set aside for the propagation, protection and preservation of wildlife or the preservation of places or objects of aesthetic, geological, prehistoric, historical, archaeological or other scientific interest for the benefit, advantage and enjoyment of the general public and includes in the case of a marine National Park an area of shore, sea or sea-bed together with coral reef and other marine features so set aside.

Special Reserve means an area set aside in which characteristic wildlife requires protection and in which all other interests and activities are subordinated to this end.

Wildlife means all animals and plants whether on land or in the sea, including coral, together with the biotopes necessary for their survival.

2. Establishment of a Board of Trustees

- (a) Constitution and modus operandi to be outlined in Schedule 1.
- (b) Board to be a body corporate, to be capable of suing and being sued, of purchasing, holding and alienating land, or receiving, holding or disposing of moneys paid to them by grant or otherwise for the purpose of defraying

expenses incurred in carrying out the objects and provisions of this Act, and generally of doing and performing all such acts and things as a body corporate may do and perform, subject to the provisions of this Act and of any law for the time being in force.

3. Creation of Reserves etc

Power to create: Areas of Outstanding Natural Beauty

National Parks

Special Reserves

Strict Natural Reserves

Procedure for the designation of areas given in Schedule 2.

4. Agreements

Power to conclude agreements with the owners of land for the purposes of carrying out the provisions of this Act.

5. Compulsory purchase

Power to acquire land compulsorily for the purposes of carrying out the provisions of this Act.

6. Facilities in National Parks and Areas of Outstanding Natural Beauty

Power to provide facilities in National Parks or Areas of Outstanding Natural Beauty, including :

- (a) Provision of shelters, viewing lodges and refreshments.
- (b) Provision of vehicle parking places.
- (c) Provision of camp sites.
- (d) Provision of means of access.
- (e) Establishment of research stations.
- (f) Setting aside areas and carrying out works for the protection or display of any wildlife.
- (g) Promotion of the general purposes of the Act.

7. Regulations

Power to make regulations.

Model National Park or Nature Reserve Regulations in Schedule 3.

8. Reserve powers

9. Creation of offences and penalties

SCHEDULE 1

Constitution and modus operandi of Board of Trustees

1. The Board shall be composed of such members, not less than five, as the Governor-General may from time to time appoint.

2. The Chairman of the Board shall be nominated by the Governor-General from among its members.

3. A member of the Board shall, excepting as provided in Section 4 of this Schedule, retire after serving for three years, but shall not, for this reason be debarred from reappointment for a further term.

4. The Governor-General may revoke the appointment of a member at any time. Such member shall not be eligible for reappointment.

5. In the case of death, absence from Mauritius, resignation, revocation of appointment or incapacity to act of the Chairman or of any member of the Board or when a vacancy arises from any other cause, the Governor-General may make the necessary appointment to fill the vacancy either temporarily or permanently; provided that when the Chairman is absent from any meeting or a vacancy arises in the Chairmanship and no new appointment has been made, the members of the Board may choose one of their number to preside at the meeting.

6. Three members of the Board shall form a quorum.

7. The Board shall meet at least six times in any one calendar year.

8. A decision of the Board shall be taken on a majority of the members present and voting, but on any matter in which the votes are equally divided, the Chairman, or in his absence, the member of the Board presiding at the meeting, shall have a second, or casting vote.

9. The Board may appoint a Secretary and such number of other officers and servants as the Governor-General may determine, who may receive such fees, salaries or other remuneration from public funds or other funds held by the Board as shall be determined by the Governor-General.

10. A decision of the Board shall be authenticated under the hand of the Secretary to the Board.

11. Not less than once a year the Board shall render a full report to
of all action taken for the purposes of this Act.

SCHEDULE 2

Procedure for the designation of areas

1. Where the Board proposes to designate any area as an Area of Outstanding Natural Beauty, a National Park, a Special Reserve or a Strict Natural Reserve, it shall cause to be prepared a map showing the location of the said area and the boundaries thereof and shall publish in the Government Gazette and in at least one Newspaper in each of three successive weeks a notice which shall contain the information specified in Section 2 of this Schedule.

2. The said notice shall:

- (a) describe the area;
- (b) name a place or places where a copy of the map relating to the said area may be inspected without payment of a fee and notify the times during which such inspection may be made;
- (c) state that the Board proposes to submit for the approval of the
an Order designating the said area as an Area of Outstanding Natural Beauty, a National Park, a Special Reserve, or a Strict Natural Reserve, as the case may be;

- (d) state that owners or other persons having an interest in the said area who wish to make representations with regard to the proposals may do so by forwarding their representations in writing to the authority specified in the notice before a date specified therein, which date shall not be earlier than twenty-eight days after the date when the notice is first published in accordance with Section 1 of this Schedule.

3. For the purposes of Section 2(b) the map shall be available for inspection throughout the period mentioned in Section 2(d) during the normal working hours of Government departments.

4. (1) After considering all representations duly made and not withdrawn, the Board may make an Order under Section 3 of the Act, which Order shall be submitted to the for approval together with a copy of all representations duly made and not withdrawn.

(2) The said Order shall define the area to be designated as an Area of Outstanding Natural Beauty, National Park, Special Reserve or Strict Natural Reserve, as the case may be, by reference to a map which shall specify the location of the area and the boundaries thereof.

5. The area designated in an Order published under Section 3 of the Act may differ from the area specified in the notice published under Section 1 of this Schedule so, however, that it shall not include any land not included in the area specified in the notice.

SCHEDULE 3

Model Regulations for National Parks, Special Reserves or Strict Natural Reserves

In exercise of the powers conferred by section of the National Parks and Nature Conservation Act, hereinafter referred to as the principal Act, His Excellency the Governor-General has made the following regulations:-

PART I

Short title 1. (1) These regulations may be cited as the

Commencement (2) Subject to any express provision to the contrary, these regulations shall come into operation on such day as the Minister may, by notice in the Gazette, appoint, and different days may be appointed for different provisions of these regulations or for the same provision in relation to different cases or classes of case.

Interpretation

2. In these regulations, unless the context otherwise requires - "Minister" means the Minister of Agriculture, Natural Resources and the Environment;

"Board" shall have the meaning assigned to it in the principal Act, and shall include its appointed servants and agents;

"Warden" means the person appointed by the Board, to be in charge of the Reserve/National Park;

"Reserve"/National Park" means (name of Reserve/National Park) as defined by Gazette Notice No. of

"Spear-gun" shall have the meaning assigned to it in the Act;

"Anchor" means any moveable device or combination of such devices used or which may be used for securing a craft in a fixed position in relation to the sea-bed;

"Mooring" means any fixed device or combination of such devices used or which may be used for securing a craft in a fixed position in relation to the sea-bed;

"Pleasure-boat" includes any type of craft used for pleasure, however propelled, but does not include an inflatable craft which is not propelled by an internal combustion engine or a pleasure boat while engaged in the saving of life or proceeding to or coming from anywhere for the purpose of saving life;

"Casier" means a bamboo wicker-work fish-trap whose construction is in accordance with the provisions of the Fisheries Act.

PART II

No restriction on lawful acts.

3. (1) Nothing in these regulations shall prevent or interfere with -

(a) The use of the sea around Island by craft in lawful navigation.

(b) The Port Authority performing any act which it considers necessary to public safety, provided that such act is not performed without prior consultation with the Warden and the Board.

(2) These regulations shall be in addition to and not in derogation of any regulations in force relating to territorial waters or air navigation.

Water-skis not to be used.

4. Any person who uses or causes or permits to be used in the Reserve/National Park any surf-board or water-ski shall be guilty of an offence and shall be liable to a fine not exceeding 1,000 rupees.

Pleasure boat not to be used dangerously.

5. Any person who drives, sails or otherwise uses a pleasure boat or any other craft in the Reserve/National Park recklessly, or at a speed or in a manner which is dangerous to the public or without due care and attention, shall be guilty of an offence and shall be liable to a fine not exceeding 1,000 rupees.

Unlawful to damage property of Board

6. Any person who, except as provided in Regulation 16, removes, defaces, damages or obscures any buoy, marker, notice, structure, vessel or equipment belonging to or placed by the Board shall be guilty of an offence and shall be liable to a fine not exceeding 2,000 rupees or to imprisonment for a term not exceeding three months or to both such fine and imprisonment.

Unlawful to kill or disturb living things or their habitats. 7. Any person who, within the Reserve/National Park, except as provided in Regulation 16 -

(a) Injures, disturbs or damages any sandbank or reef or area of the sea-floor; or

(b) kills, captures, takes or wilfully injures, disturbs or destroys by any means whatsoever any plant or animal whether marine or terrestrial and whether vertebrate or invertebrate and whether living or dead and including their nests, eggs, spawn or shells; or

(c) removes any humus, soil, sand, mud, gravel, rock, pebble, coral or reef debris for any purpose whatsoever from any part of the Reserve/National Park -

shall be guilty of an offence and shall be liable to a fine not exceeding 2,000 rupees or to imprisonment for a term not exceeding three months or to both such fine and imprisonment.

Anchoring of boats.

8. Notwithstanding the provisions of Regulation 7(a) it shall be lawful to secure a boat by an anchor on the sea floor, provided that the Warden may specify areas where anchors may be used or may provide moorings.

Use of casiers.

9. Notwithstanding the provisions of Regulation 7(b), the Warden may, in his discretion, authorise the taking of fish in casiers by employees of the Board resident within the Reserve/National Park.

Introduction of plants or animals unlawful.

10. Any person who, except as provided in Regulation 16, wilfully introduces or permits to be introduced into the Reserve/National Park any living creature, or any plant, or any seed or other part of any plant, shall be guilty of an offence and shall be liable to a fine not exceeding 1,000 rupees.

Unlawful to
possess turtles,
wild birds or
eggs.

11. Any person who, except as provided in Regulation 16, has in his possession in the Reserve/National Park any green or hawksbill turtle or part thereof or any wild bird or any egg or young of a wild bird whether living or dead shall be guilty of an offence and shall be liable to a fine not exceeding 1,000 rupees.

Pollution and
other acts
unlawful.

12. Any person who, except as provided in Regulation 16, -

(a) beaches, carcens, scrapes or paints any craft;
or

(b) other than in receptacles provided for that purpose, throws down, drops, leaves or otherwise deposits in any part of the Reserve or on any part of the sea-bed or in any part of the sea, anything whatsoever in such circumstances as to cause, contribute to or tend to lead to the defacement by litter or the pollution by chemicals or other noxious substances or domestic effluent of any part of the Reserve/National Park -

shall be guilty of an offence and shall be liable to a fine not exceeding 2,000 rupees or to imprisonment for a term not exceeding three months or to both such fine and imprisonment.

Possession of
spear-guns
unlawful.

13. Any person who, except as provided in Regulations 16, introduces into or has in his possession in the Reserve/National Park any spear-gun, harpoon or other device described in section of the Fisheries Act shall be guilty of an offence and shall be liable to a fine of 1,000 rupees.

Possession of
weapons unlawful.

14. Any person who, except as provided in Regulation 16, introduces into or has in his possession in the Reserve/National Park any firearm, bow, crossbow, sling, catapult or any other weapon or any explosive, explosive device or firework shall be guilty of an offence and shall be liable to a fine of 1,000 rupees.

Lighting of
fires unlawful.

15. Any person who, except as provided in Regulation 16, lights a fire or does anything likely to cause a fire in the Reserve/National Park shall be guilty of an offence and shall be liable to a fine of 1,000 rupees.

Authorisation of
certain acts for
Reserve/Park
management.

16. It shall be lawful for the Board, to authorise in writing any act which in the absence of such authorisation would contravene the provisions of Regulations 6, 7, 8, 10, 12, 13, 14, 15; provided that such authorisation shall be confined to lawful acts which are related to the management of the Reserve/National Park and to securing the provisions of these regulations or of the principal Act.

Restrictions
on access.

17. The Board may -

- (a) close any part or parts of the Reserve/National Park to public access;
- (b) indicate days or times when the public may land on or enter the Reserve/National Park;
- (c) in its discretion, impose such other restrictions on public access as may be in the interests of good wildlife management.

Collection of
fees.

18. It shall be lawful for the Board to make such provision as it thinks fit, for the collection of fees for entry into or the performance of acts within the Reserve.

Made by the

on the

day of

APPENDIX 2

FRAMEWORK FOR A STRUCTURE FOR A NATIONAL PARKS AND WILDLIFE SERVICE FOR MAURITIUS

1. Introduction

1.1 The pattern of development of wildlife conservation services have varied widely around the world, in response to the needs of different countries. Because wildlife conservation is a long-term national responsibility involving legislation and the allocation of state-owned land, it is usual for the central authority to be vested in the national government. (Though some countries with large and powerful component provinces or states, have successful provincial conservation departments.) It is rare for the mainstream of conservation activity to be managed by private enterprise, though in some countries voluntary bodies are active and important in moulding public opinion. Because a paper return on investment in conservation is often extremely difficult to demonstrate, much of the capital investment, at least for specific conservation projects, is often derived from sources, outside national budgets, which are non-profit-making.

1.2 Mauritius has experience of para-statal organisations, supported on the one hand by Government policy decisions and legislation, and on the other by funds derived from external sources of various kinds. Such a system allows considerable flexibility in managerial decision-making. It is suggested that wildlife conservation should be organized in this way.

2. Proposed Structure

Minister of Agriculture, Natural Resources and the Environment

National Parks Board of Trustees

Director; National Parks and Wildlife Service

(Qualification: experience of forest or wildlife administration and management in the tropics.)

Divisions

Land Parks Division

Senior Park Warden (Senior Professional Officer: qualification - degree or equivalent in a biological subject plus experience of park management.)

Park Wardens (Professional Officers: qualification - degree or equivalent)

Senior Rangers (qualification - 1 or 2 years technical training plus experience)

Rangers (qualification - basic educational qualifications to a standard which will allow for further training; on-the-job training)

Marine Parks Division

Senior Park Warden (Senior Professional Officer: qualification - degree or equivalent in marine biology plus experience of park management)

Park Wardens

Senior Rangers

Rangers

} qualifications as for Land Parks Division

Research Division

As regards staff, a division in name only, but it will be necessary to plan and budget for a research and monitoring programme. Specific research projects to be carried out by outside agencies, within the general framework of a research plan to be prepared by the Director.

Education and Interpretive Division

A division in name only, but see the Recommendations in section 4.6 of the main report. This token Division will be the link with the effort being put into the national education and public information programmes.

Administrative Division

Office superintendent
Accountant
Clerical staff
Mapping staff
Library staff

3. Finance

3.1 The Board of Trustees should be empowered to hold and administer funds, subject to the usual provision for accounting and audit.

3.2 The basic costs of administration, salaries, administrative buildings and the like, should be borne by Government through a subvention to the Board of Trustees. (It would of course be open to Government to seek support for this programme from external sources, but the acceptance of the basic administrative costs implies the acceptance by Government of the responsibility for the wise management of the nation's natural resources.)

3.3 The funds for individual specific projects including the cost of manpower, such as the capital investment for setting up a National Park, the rehabilitation and management of a particular ecosystem, or even a relatively long-term research project, should be sought from external sources. Provision of such funds would be a measure of the world's concern for the natural resources of Mauritius.

3.4 Mauritius already has another parastatal body, the Development Works Corporation, which is geared to carrying out labour-intensive projects on a contract basis, in the national interest. There would be scope here for a well-planned operation, in National Park development and management, but close managerial and technical control would be vital.

APPENDIX 3

RESUME OF COMMENTS AND RECOMMENDATIONS MADE BY THE MAN AND
BIOSPHERE SUB-COMMITTEE OF U.N.E.S.C.O. IN 1973

The working party has divided the resume of comments and recommendations into three sections:-

I Aims of the Man and Biosphere sub-committee.

II Present and future threats to the Environment.

III Measures to be taken to counteract threats to the environment and improve it.

I Aims

The aims of the sub-committee are, inter alia:

- (a) To draw the attention of Government, private bodies and the public to the value of our environment.
- (b) To point out to the relevant bodies specific threats to the surroundings owing to harmful human interference.
- (c) To make the public aware of what it can do to preserve and improve the environment.
- (d) To recommend measures for maintaining or improving the quality of the relevant aspects of the environment.

II Specific Threats to the Environment

These threats can be listed under two main headings:

- (1) Pollution
- (2) Damages and risks

1. Pollution

The pollution of:-

- (a) the atmosphere by:
 - (i) Lead content of car exhausts,
 - (ii) smoke from badly set diesel engines,
 - (iii) smell from tanneries,
 - (iv) noise due to motorcycles running without silencers and to parties held at late hours,
- (b) freshwater bodies by:
 - (i) Pesticides and excess fertilizers leached land,
 - (ii) effluent from factories e.g. beer, detergent, sugar, paint aloe mill and contemplated paper and textile mills,
 - (iii) sewage,
- (c) the sea and beaches by:
 - (i) Pesticides brought down by rivers,
 - (ii) oil slicks from tankers and pleasure craft,
 - (iii) sewage,
- (d) the soil by pesticides

2. Damages and Risks

The damages and risks are listed below according to areas threatened.

(a) To land, sea and beach: (i) Land erosion due to wrong methods of land management e.g. removal of vegetation on steep slopes.

(ii) Removal of geologically important coral blocks e.g. in the Salle d'Armes area.

(iii) Uncontrolled sand dredging in lagoons.

(b) To the country side: (i) Deterioration of public beaches consequent upon excessive use due to the shortage of easily accessible public beaches.

(ii) Dumping of domestic refuse on beaches, streets or wasteland.

(iii) Indiscriminate use of good agricultural land for building purposes.

(iv) Unaesthetic siting of posts, electric lines, posters etc., and inconsiderate lopping of trees.

(c) To plant life: (i) Excessive reduction in forest areas.

(ii) Invasion of indigenous forests by exotic plant species.

(iii) Deterioration of Round Island and Ile-aux-Aigrettes.

(d) To animal life: (i) Reduction in numbers of endemic birds due mainly to lack of adequate forests.

(ii) Reduction in numbers of marine turtles due to over exploitation.

(iii) Collection of live coral for lime.

- (iv) Sale to tourists of live coral, of molluscs and of fish at a rate higher than that of natural regeneration.

III. Measures to be Taken

1. Legislation

(a) Ministry of Health: Prepare laws controlling:

- (i) Amount of lead in petrol. (Recently European Laws have been passed which reduce lead to less than 0.15 gm per litre.
- (ii) Exhaust from diesel engines.
- (iii) Use of pesticides.
- (iv) Content of pesticides/toxins in food offered for sale.
- (v) Level of noise.
- (vi) Air pollution.

(b) Ministry of Fisheries: Prepare laws if none exist to:

- (i) Regulate the collection of live fishes, live molluscs and live coral.
- (ii) Regulate the capture of turtles.

(c) Ministry of Agriculture, Natural Resources and Environment:

Prepare laws if none exist to:

- (i) Control the collection of various plants.
(A list of endangered plant species should be incorporated in the law).

(ii) Proclaim adequate Marine Parks.

(iii) Increase present Nature Reserves.

(iv) Create National Parks.

(d) Ministry of Housing, Pass Laws:
Lands, Town and C.P.

(i) To control exploitation of fossil reefs.

(ii) To control sand dredging.

(iii) To provide access to the public by foot-
paths to places of outstanding beauty.

(e) Central Water Pass laws preventing pollution of water bodies.

Authority:

2. Enforcement, Inspection and Maintenance

(a) Ministry of Health: (i) Analysis of pesticides and other
contaminants of food and water.

(ii) Reinforce the authority of inspectors
for the control of contamination of food
e.g. by pesticides.

(b) Ministry of Agriculture
Natural Resources and
Environment:

(i) Carry out conservation measures on Round
Island, Ile-aux-Aigrettes and in the
Reserves on the Mainland.

(ii) Take steps to rear endemic birds in
aviaries.

(c) Central Water

Authority:

Survey water bodies control contamination of water bodies and take necessary action.

(d) Police:

(i) Reinforce control on existing laws concerning noise and exhaust gases from motor vehicles.

(ii) Stock appropriate substance to combat oil slicks for use whenever necessary.

(iii) Take steps against persons offering protected birds for sale.

(e) Urban Authorities:

Study possibility of composting domestic refuse.

(f) Customs:

Efficient control of exports and checking illegal export of animals or animal remains.

(g) Customs and/or Civil
Aviation and/or
Harbour Authorities

Affixing notices at exit and entry points telling passengers what they are not allowed to take out of the country.

and/or Tourist Office:

3. Publicity and Education

(a) Ministry of Informa-
tion and/or Local
Government and/or
Education and/or
Tourism.

(i) Make films and slides of local plant and animal life for show on television in schools and in cinema halls.

(ii) Prepare for schools and general public posters depicting endangered plant and animal species and publish conservation slogans.

(iii) Induce teachers to make their pupils conservation minded and run courses on Environmental Studies.

(iv) Persuade hotels to give information to their clients (by posters or leaflets) on protective measures and/or need for protection.

(v) Campaign for planting more trees.

4. Research and Development

(a) Ministry of Agriculture, Natural Resources and the Environment. Establish an Aquatic Research Station and study aquatic flora and fauna particularly in areas where changes are contemplated.

APPENDIX 4

DESCRIPTION OF THREE PROPOSED MARINE NATIONAL PARKS

A BAIE DE L'ARSENAL

Introduction to the geology of Baie de l'Arsenal

The bay is lined, both north and south, along most of its length by smoothly rounded boulders of basalt cemented basally by beach rock. The beach on the southern shore is small. It is a gravel beach composed of coral fragments. North of the brackish water lagoon is a fine grey sandy beach. Running north of Pointe aux Piments is a continuous coarse sandy beach composed of shell and coral grains.

There are several ledges of beach rock off Pointe aux Piments forming a more or less continuous series of arcs parallel to the shore. Some are partially covered by sand and others are in the lagoon well forward of the beach. There are three shelves of beach rock along the southern shore. Two are close to the shore while the third is 30 metres from the beach at its furthest point.

On the shore behind this second shelf of beach rock are two blocks of raised beach now one metre above sea level. To the east of these are several such blocks behind the beach. Continuing east towards the brackish lagoon is a rocky outcrop the structure of which is interesting. The prominent rocks are large slabs of compacted back-reef now exposed 2 metres above sea level and deeply undercut at their seaward faces. These rocks are studded with small colonies of boulder corals (*Porites*, *Astreopora*) firmly embedded in a matrix of shell fragments and sand grains. An intertidal area of small basalt rocks cemented by beach rock separates the raised reef from the shore which is composed of weathered basalt. Backing the shore is another bank of raised reef which is as much as 3 metres above sea level.

The southern point of the bay has large basalt boulders and south below the earthen fort several fractured spurs of basalt impinge into the sea creating a series of shallow pools. The boulders along the shore are cemented basally by beach rock.

North across the bay is a 3-4 metre high headland of Weathered basalt.

Sand has been mined from the limited dunes of the south and is currently being mined from both the beach and dunes of Pointe aux Piments.

The Coral Reefs

Surf breaks over the peripheral fringing reefs north and south of Baie de l'Arsenal. These reefs curve into the quieter water and continue all the way to the head of the bay. The grooved fore-reef structure with scattered coral colonies characteristic of peripheral fringing reefs is replaced in the bay by a solid tiered bank of coral colonies.

The corals of these sheltered fringing reefs are remarkably intact, large and varied. Slender stagshorn, enormous plates of tabular Acropora, and the delicate whorls of foliaceous Montipora are the most conspicuous corals. The great diversity of species and growth form, and the extreme fragility and bright colours of the colonies combine to give the reef the look of a well kept garden in full bloom. There are huge boulders of Porites scattered throughout these reefs several of which exceed 3 metres in diameter and at least one that is more than 4 metres across - a size that corresponds to an age of 400 or more years.

There is no surf or current in the bay and the sheltered reef is close to shore and easy to reach. Informed local sources claim that conditions are seldom, if ever, rough in the bay even during the worst of storms. The size of many of the coral colonies confirms this. Water clarity is good at times but averages about 10 metres. Conditions in the bay seem to favour coral growth; there are overturned colonies that have reversed their direction of growth and continued living. Broken pieces also have continued growing and are fused with the corals on which they landed.

The patches of lagoon corals are better north of the bay opposite Pointe aux Piments. These are composed of thickets of stagshorn, often tipped with bright blue, harbouring the black and white humbug, Dascyllus aruanus, and clouds of Chromis caeruleus. This lagoon is readily accessible and periodically fished (in one morning seven Mauritian spearfishermen were seen operating along a 100 metre stretch in the Pointe aux Piments lagoon). There are three pirogues based in the bay, but the fishermen operate over

the deeper fore-reef slope. The intactness of the corals, the lack of abandoned casiers entangled in the reef, and the relative absence of anchor damage confirm that fisherman seldom visit the reefs in the bay. In all 137 species of conspicuous reef fishes and more than 48 coral species were recorded from Baie de l'Arsenal.

The Habitats

Coral (Dealt with in previous section).

1. Peripheral fringing reef north and south.
2. Sheltered fringing reef inside the bay north and south (Acropora assemblage).
3. Boulder reef - Porites assemblage characteristic of areas of erratic salinity, turbidity and temperature - towards the mouth of the brackish lagoon.
4. Lagoonal coral patches between the shore and the fringing reef off Pointe aux Piments.

Plant-based

5. Algal beds behind the surf zone south of the bay. Sargassum and Turbinaria are abundant in this region which is the habitat of innumerable wrasses and parrotfishes, notably Halichoeres kawarin, Thalassurus chlorurus, Leptoscarus vaigiensis and Xanodon marmoratus.
6. Seagrasses: beds of Syringodium iscaetifolium and Halodule uninervis. Living in these beds are many molluscs including Pinna kraussi, Cassia cornuta, and Dolabella, the shame-faced crab, Calappa hepatica, various annelids, and the juveniles of some important food fishes such as Lethrinus harak and Siganus spp. Donax faba is relatively abundant inshore from the H. uninervis beds.

Sand-based

7. Sandflats. These are important habitats for Synapta, the sinuous sea

- cucumber, other holothurians, numerous molluscs, crustaceans, sand gobies, and the commercially important goat fishes (Mullidae) and mullets (Mugilidae).
8. Bay floor sediments. Colonised by burrowing invertebrates and fishes.
 9. Sandy beaches. Previously used by nesting turtles. The hawksbill turtle or caret, Eretmochelys imoricata, was seen around the mouth of the bay. It is possible that turtles left unmolested would resume nesting on these beaches. The beaches support a population of ghost crabs, Ocypode sp.

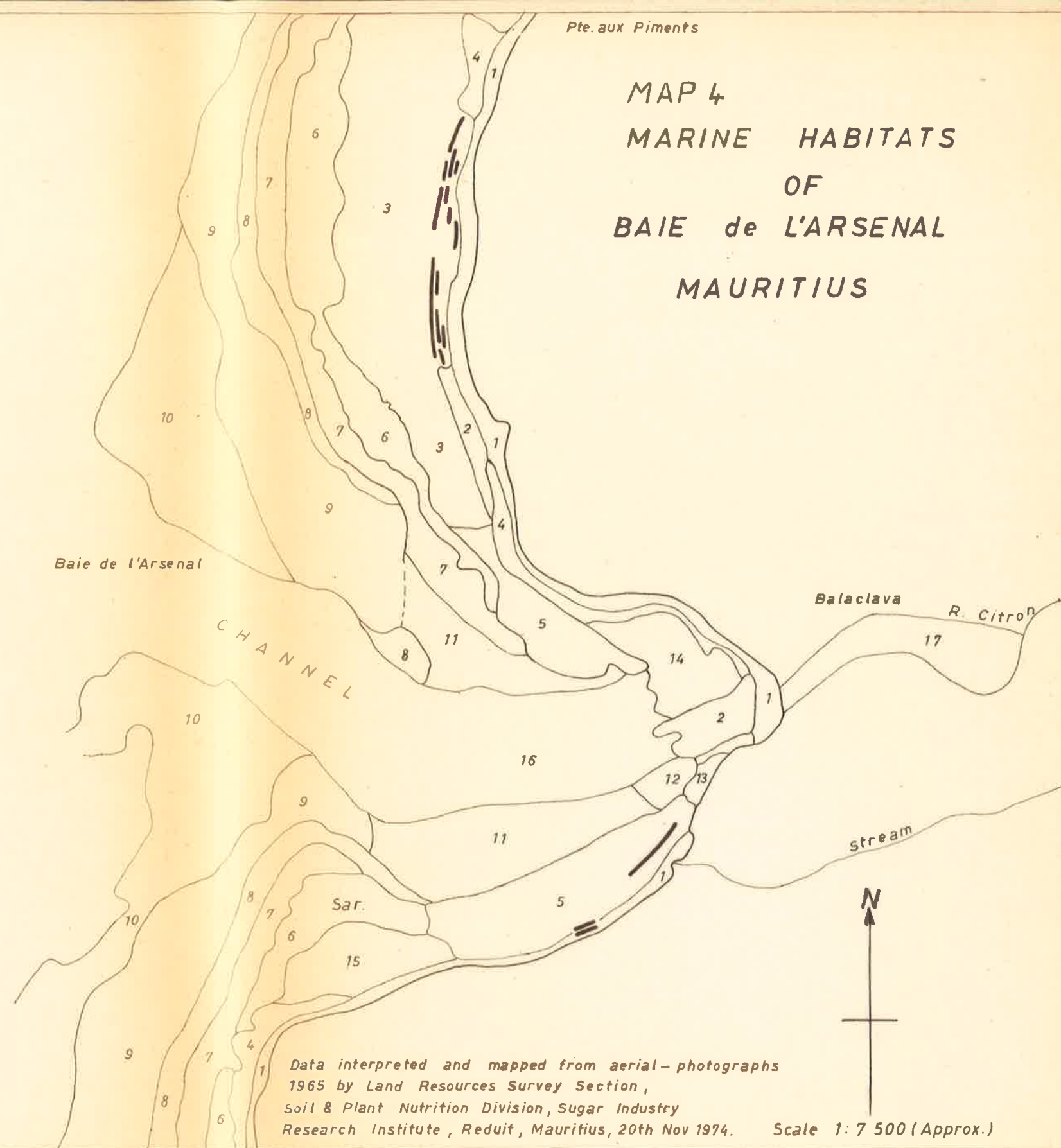
Rock-based

10. Shore-line basalt boulders. Important habitat for Salariaid blennies, brittle stars (Ophiuroids), the gastropod snails Littorina mauritiana, Nerita spp., Planaxis sulcatus and Siphonaria ferruginea, the barnacles Tetraclita squamosa and Tetrachthamalus oblitteratus, and the Sally lightfoot crab, Grapsus tenuicrustatus.
11. Intertidal beach rock. Important substrate for Septifer sp., Siphonaria ferruginea, Tetraclita squamosa, Echinometra mathaei, Halmablennius spp.
12. Base of raised reef rock. This is a remarkable echinoid dominated community. Lithothamnion carpets the submerged rock. Above the level of MHWS and in the upper intertidal range one finds Tetrachthamalus oblitteratus, Salariaid blennies, Grapsus, Nerita spp., Littorina mauritiana, and below these Tetraclita squamosa, and the following incredible array of echinoids, Echinometra mathaei, Heterocentrotus mammillatus, H. trigonarius, Echinostrephus molaris, Tripneustes gratilla, Stomopneustes variolaris, Diadema setosum and Echinothrix diadema.
13. Brackish water basalt rocks. There is a cluster of basalt rocks close to the mouth of the estuary which have typical brackish water fauna such as Crassostrea culcullata and Isagomon ephippium.

LEGEND

- 1 Sand beach
- 2 Sand flat with coral rubble
- 3 Lagoonal coral patches
- 4 Shore-line basaltic rocks
- 5 Colonised sand habitat
- 6 Back-reef corals
- 7 Reef flat
- 8 Reef front
- 9 Fore-reef slope
- 10 Reef-edge terrace
- 11 Sheltered fringing reef
- 12 Porites assemblage
- 13 Raised reef
- 14 Sea-grass beds
- 15 Sand-flat covered with stones
- 16 Bay floor sediment
- 17 Brackish water lagoon
- Sar. Sargassum beds
-  Beach rock

Note:- Habitats situation as at November 1974.
Details confirmed in the field.



The Suitability

The proposed construction of an hotel at Balaclava does not impose a threat to the marine park. On the contrary, it enhances the recreational value of the park, but does introduce an element of urgency into the establishment of this park.

Baie de l'Arsenal is unique in Mauritius for its remarkable diversity of habitats and species - and their unusual intactness - within such a confined area. There is no other area with as easily definable boundaries or which could be as easily policed. The bay is safe. There are no currents and no surf during most of the year (there can be a slight surf occasionally during the NW monsoon). The reef is only 30 to 60 metres offshore. The area is readily accessible by road and by virtue of its position is close to the heavily populated central and northern areas of the island. The Pointe aux Piments beaches are suitable for swimming, but the Balaclava beach is built of coral gravel overlying boulders of basalt and has little value to bathers. Attempts to build artificial beaches by seeding the existing beaches with fine grain sand would be disastrous to the exceptionally fine reefs and, financially, to the parties concerned. The shelves of beach rock offshore are mute evidence of erosional processes already at work. Fine grain sand would be removed as has been the phenomenon through innumerable past decades leaving the coarser gravel behind, filling the interstices of the reef and excluding any life settled or sheltering there, and squandering the money invested.

Declaring the area a National Park would not in any way inconvenience swimmers or, more importantly, reef-dependent fishermen. The three pirogues based in the bay are used to lay casiers in about 15 metres of water outside the bay over the fore-reef slope. These three fishermen could be allowed to continue fishing outside the bay but they should be encouraged to stop fishing and take interested tourists to dive over the reef.

Baie de l'Arsenal has much of geological interest including its different rock formations (basalt, beach rock, raised beach and raised reef), its three types of beaches, and the dunes at Pointe aux Piments.

The bay derives its current name - the previous name, Baie aux Tortues, having died with the turtles - from the arsenal built there by the French.

Also, there is a well preserved earthen fort on the southern point of the bay.

Surely this blend of biological, geological and historical interest coupled with the safety, accessibility and lack of dependence by subsistence fishermen is unparalleled anywhere in Mauritius and demands that Baie de l'Arsenal be declared a National Park.

B. FLAT ISLAND/GABRIEL

There is a continuous peripheral fringing reef joining the northern points of both islands. Surf piles in over this reef building up the level of lagoon water which pours out through a channel in the south. This is the pass used by boats. The lagoon floor is almost entirely covered by coral. Acropora species, exhibiting digitate, tabular and stagshorn growth forms, are the dominant corals over most of lagoon. The uppermost tips of all the corals nearest the water surface are dead. Many stagshorn colonies have the top 10 centimetres dead while the lower part remains alive. The depressions, furrows and deeper gullies through the dead areas all contain living corals. This phenomenon reflects the cyclic procedure of reef growth initiated by a period of rapid coral growth and followed by catastrophic death of the shallowest corals. Death here is probably caused by heavy rainfall at a low tide or by the surface layers of lagoon water warming above the coral's lethal limit during hot calm weather.

The reef flat exhibits three seral stages of formation: a young zone of dead stagshorn, as described above, on the lagoon side, a zone of loose coral rubble with small coral colonies outside the stagshorn, and the outer algal zone of coral rubble consolidated by calcareous algae and brown algae.

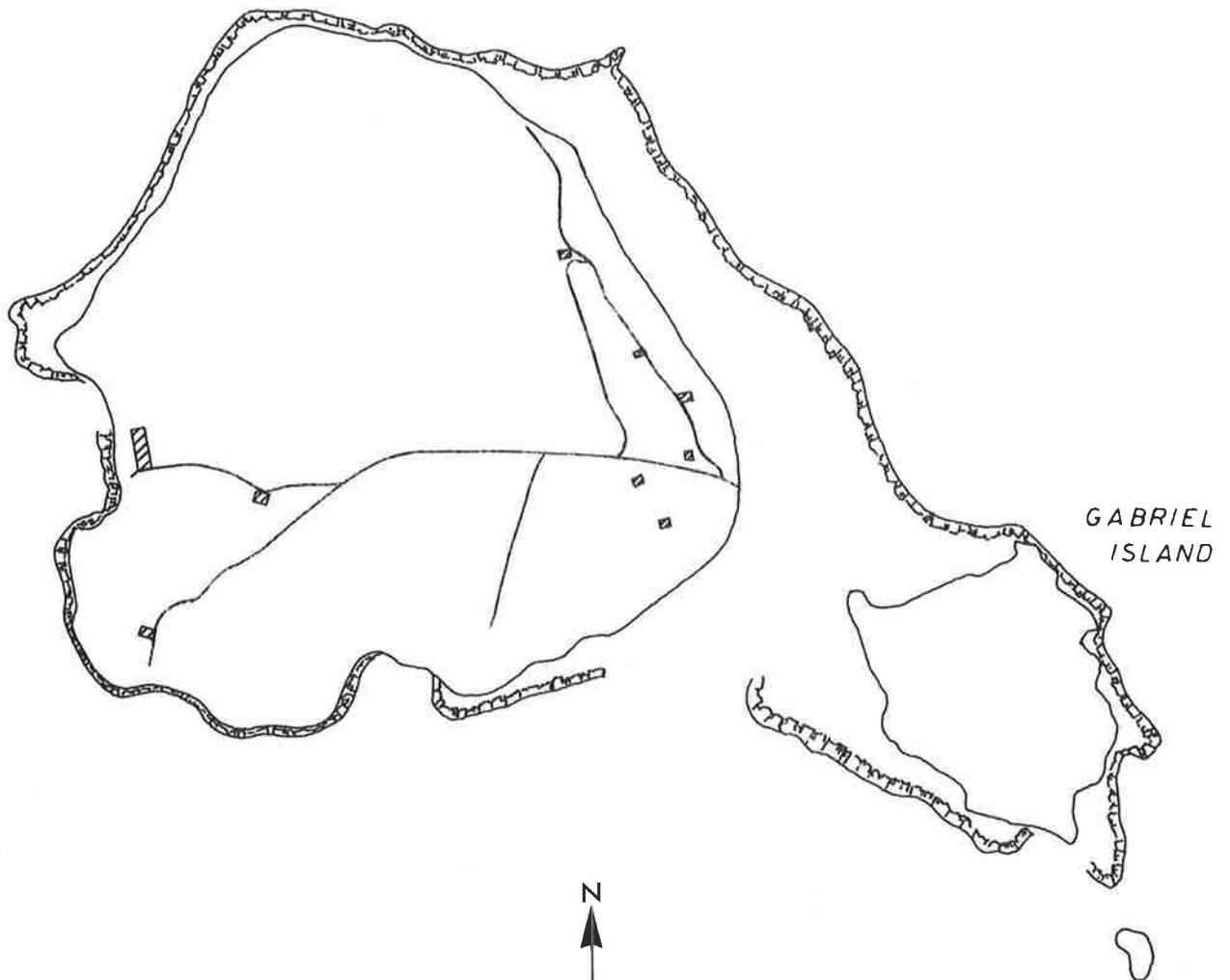
In the lagoon the patches of coral vary in structure with the depth of the water. Some patches are built of large tabular colonies of Acropora and covered by stands of foliaceous Montipora. Unfortunately, much of the lagoon coral is destroyed - the evidence of dynamiting, grounding pirogues, casiers and anchors. Overturned and broken pieces of coral die.

Nine large Cypraea tigris, the tiger cowrie, and several C. lynx were counted during a one hour period. It is rare to see many shells anywhere around Mauritius. The fishes were abundant and approachable, also rare for

Pigeon
Rock



FLAT ISLAND



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1 mile

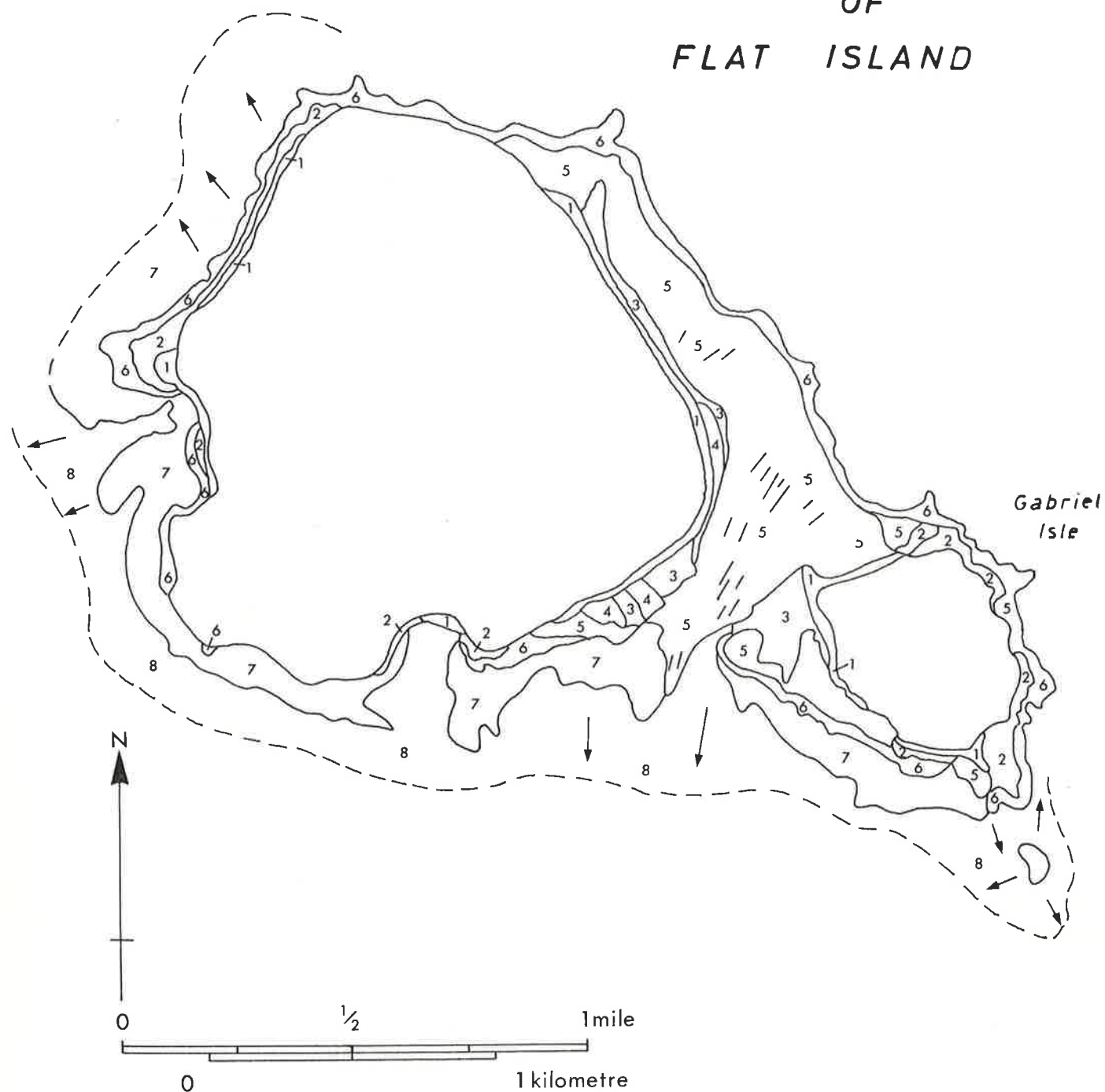
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1 kilometre

Data interpreted and mapped from aerial-
photographs 1949 by Land Resources Survey Section,
Soil & Plant Nutrition Division, Sugar Industry
Research Institute; Reduit, Mauritius, 20th Nov. 1974.

Pigeon
Rock

MARINE HABITATS OF FLAT ISLAND



LEGEND

- | | | |
|----------------------|-----------------------------|--|
| 1. beach. | 4. colonised sand habitats. | 7. grooved fore-reef slope. |
| 2. shore-line rocks. | 5. lagoonal corals. | 8. fore-reef shelf (mixed algae and corals). |
| 3. sand flats. | 6. reef-flat | → steep slopes. |
| | | /// direction of grooves. |

(Details confirmed in the field)

Data interpreted and mapped from aerial photographs 1949 by Land Resources Survey Section, Soil & Plant Nutrition Division, Sugar Industry Research Institute, Reduit, Mauritius 20th Nov 1974

Mauritius, and would mill around very close to one underwater. A remarkable sight was a school of hundreds of the surgeon fish, Acanthurus nigroris. A feature of the reef unique, among Mauritian reefs, to this area is the abundant and beautiful blue coral, Heliopora caerulea especially in the northwest arm of the lagoon.

The entire northwest arm is a series of quiet calm pools with patches of corals, large blue coral colonies, dense cover of green, red and brown seaweeds (at its northern limit), and numerous fishes. The algal fields house many nudibranchs and Aplysiids, and blue-spotted boxfishes, Ostracion cuscus, and blue-green sea cucumbers, Stichopus chloronotus, occur in great numbers.

The fore-reef slope of the southern reef has elements of spur and groove structure, but the reef is poorly developed. The reef is particularly interesting for the populations of large fishes (Carengids, Lutjanids, Nasinids, Scarids) which it supports.

Altogether 150 species of conspicuous fishes were recorded from the Flat Island reefs.

C LE CHALAND/BAY

There is a shallow bank of coral on the west, or Le Chaland side of the bay. The coral bank and much of the rocky shore to the west is fringed by slender stagshorn. North of the bank, i.e. deeper into the cove, and towards Pointe Corps de Garde the bay is deeper and there are isolated patches of coral. The reef-flat is planed level and exposed at lowest tides. The reef-front is undulating with shallow plateaus, deep valleys and sandy gullies. It is not easy to define the limits of the reef-front because of the proximity of coral patches some of which are margining with the coral bank. Further from the bank the mounds of coral become more and more isolated.

Boulder corals such as Goniopora and Porites are the colonisers of the sandy substrate. They in turn are settled by other corals notably Acropora and Pavona. Tabular Acropora is an important component of reef construction; broken or dead plates offer a substrate for settlement of other corals unable to settle directly on the shifting sand. The boulder corals act as nuclei from which stagshorn corals and to a lesser extent other coral genera

spread over the sand. In this way adjacent mounds of coral fuse to form large patches which fuse to the coral bank expanding it. The underlying structure of the coral bank is probably one of boulder corals masked by layers of stagshorn.

The overall impression of the reef is one of little coral diversity, few and timid fishes. There is broken coral over the reef-flat due to wading, boats and poles. In some places the corals over the reef edge are extensively damaged by anchors and casiers many of which lie broken, abandoned and entangled in the reef. Accumulation of litter are scattered around the reef. However, conditions seem to favour rapid coral growth and many upturned colonies have simply reversed their direction of growth and continued to live. Once the litter is removed and the area properly managed the reefs will recover substantially.

Altogether 91 species of conspicuous reef fishes were recorded and 28 coral species. This is the total of an exhaustive search continued during three days and illustrates one important fact - lack of habitat diversity. The peripheral fringing reefs were not visited. They are unapproachable during most of the year because of the large SE swell which piles a vast volume of water over the reefs. The accumulated water flows with dangerous velocity through the pass between Le Chaland and Ile des Deux Cocos.

While the section of reef fringing the coral bank off Le Chaland is the most intact and least littered, the greatest coral diversity is found off the rocky point which is the eastern border of Blue Bay. Most interesting here are the enormous colonies or hillocks of several Pavona species and the unusual foliaceous coral, Mycodium tenuicostatum.

There is a large sandy beach, popular with Mauritians, and the Blue Bay side and a smaller beach in the west in front of the Le Chaland hotel. The shore line is principally constructed of basalt boulders cemented basally by beach rock. This boulder border is the habitat of Ulva and Enteromorpha (during October/November), the barnacle Tetrachthamalus oblitteratus, the pulmonate Siphonaria ferruginea, and the mussel Septifer sp.

The Bras de Mer du Chaland, especially along the southern border, has a fringe of mangrove plants rooted among the basalt boulders. Rhizophora

mucronata is abundant, but at the points of entry of the three fresh water streams Bruguiera gymnorhiza dominates. Behind the edging of mangrove trees are scattered a mixture of the mangrove fern Acrostichum aureum, which forms dense patches, Hibicus tiliaceus, Pemphis, Scaevola, Tournefortia, Ipomoea tuba and other species, often tangled with Cassytha. At the head of the bay at least two Barringtonia speciosa have started growing.

Schools of small fishes resembling juvenile mullet (Mugil sp) whirled through the rocky pools and between the prop roots of Rhizophora. The submerged rock was covered by Ulva, Enteromorpha and the gastropod Neritina mauritiae. Along the northern shore of the Bras de Mer du Chaland there is no mangrove and the rocks are carpetted by the snail Planaxis sulcatus.

APPENDIX 5

OUTLINE DEVELOPMENT AND MANAGEMENT PLAN FOR BAIE DE L'ARSENAL NATIONAL PARK

The development of the park structure should be phased according to the following plan. At this stage it is not possible to make precise estimates of costs.

Part 1 Management Prescriptions

Phase 1

Prescription 1 Declare and gazette Baie de l'Arsenal Marine National Park.
The boundaries are shown on map 3 .

Prescription 2 Appoint Senior Park Warden to supervise the Marine Parks programme. (cf Appendix 2.)

Prescription 3 Declare and gazette the areas shown on map as Special Reserves. These Reserves should include the reef-flat, the lagoon, the beach and the dunes to a distance of 30 m above MHWS. The Reserves should extend from the northern park boundary to the rocky point below the fish landing station and from the park's southern boundary to Batterie d'Artois. Fishing, collection of any plant or animal, coral or sand mining should be forbidden within the Reserve boundaries. Fishing should be permitted over the fore-reef slope.

Prescription 4 Park and Reserve boundaries must be clearly marked with beacons constructed of basalt and cement at the points marked on map 3 .

Prescription 5 Legislation based on the recommendations in the section on management of habitats must be promulgated.

Phase 2

Prescription 6 Establish the Park Headquarters on the north side of the bay (see map 3).

Prescription 7 Improve access road to Pointe aux Piments. (map 3).

Prescription 8 Build car park. (see map 3).

Prescription 9 Recruit two Rangers and initiate training programme.

Phase 3

Prescription 10 Advertise for concessionaires to handle catering, hire of glass-bottom and other boats, and hire of snorkelling diving equipment.

Prescription 11 Build change rooms, open air (fresh water showers and toilets (see map 3)).

Prescription 12 Build a raised rock path from the mouth of R. Citron south around the headland and behind the raised reef outcrops to the sandy beach (see map 3).

Prescription 13 Build bridge across mouth of R. Citron to connect with the rock path. (see map 3).

Prescription 14 Employ watchman for the car park.

Prescription 15 Lay out channel markers and mooring buoys for visiting boats. These should be small to offer as little as possible resistance to waves in stormy weather. (see appendix 2).

Prescription 16 Lay out underwater trail and establish a fish feeding station.

Phase 4

Prescription 17 Investigate the different underwater observation chambers in operation around the world. Design, build and instal a chamber in a suitable site within the park boundaries of Baie de l'Arsenal.

MAP 3

PROPOSED STRUCTURE OF THE BAIE DE L'ARSENAL MARINE PARK MAURITIUS

LEGEND

--- boundary of proposed marine park

 proposed marine reserve

 mooring buoys

 beacon

 channel markers

 proposed car park

 access roads

 proposed park headquarters and building.

--- tracks

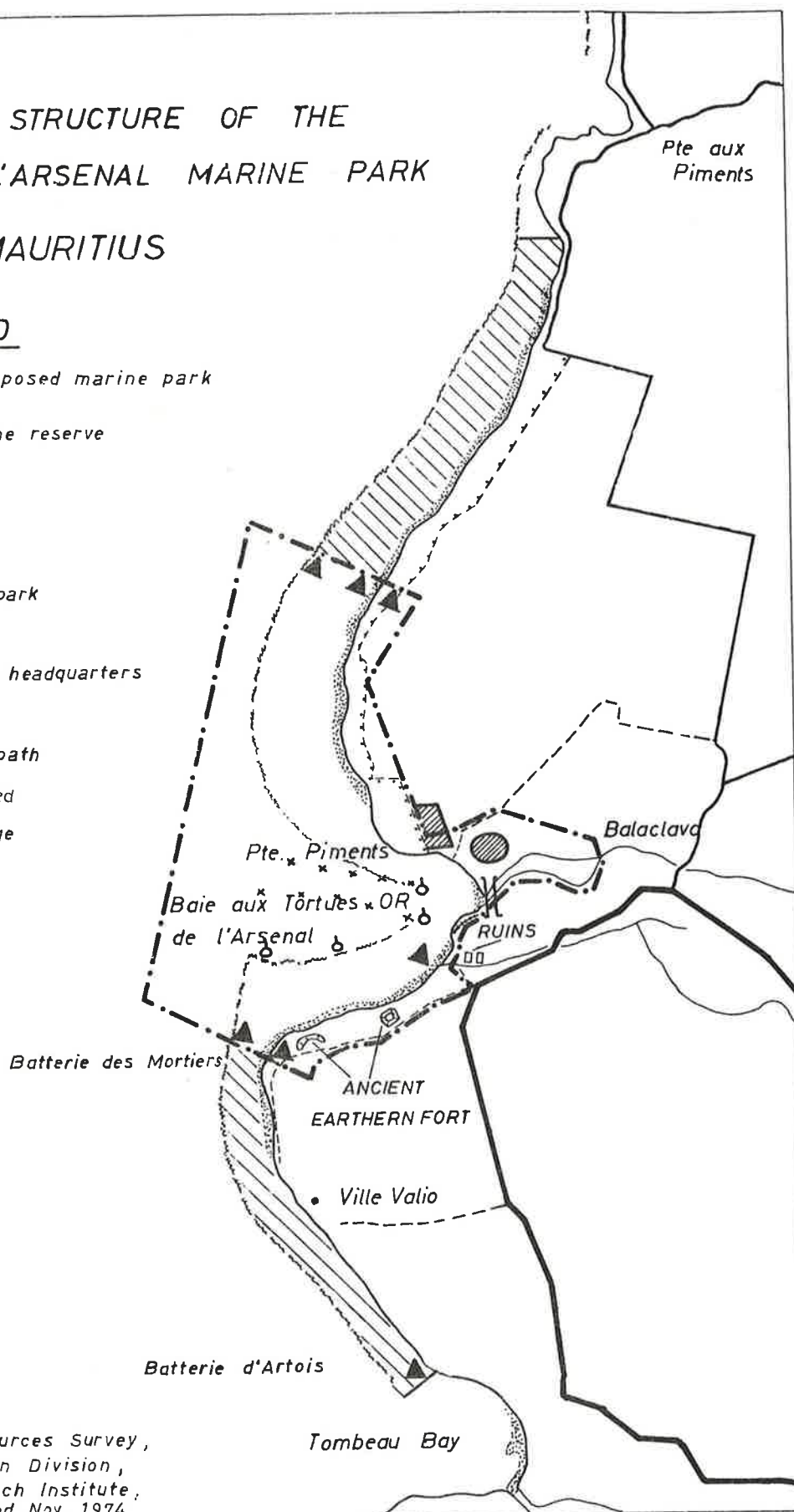
 raised rocky path

--- track to be improved

 proposed bridge



1 : 25,000



Drawn by Land Resources Survey,
Soil & Plant Nutrition Division,
Sugar Industry Research Institute,
Reduit, Mauritius, 22nd Nov., 1974

Phase 5

Prescription 18 Build an exhibition hall in the grounds of Baie de l'Arsenal marine park to house displays of some common reef specimens and so illustrate the life history of corals, the process of reef development and the interactions between certain reef organisms by using underwater photography and actual prepared specimens.

Part 2 Management of the Marine Habitats in the Baie de l'Arsenal National Park

Natural phenomena such as storms, cyclones, heavy rainfall at low tides, and overheating of surface waters can cause drastic destruction of reef corals. The Mauritian reefs have developed despite these setbacks. In places where conditions favour coral growth reef development is fairly extensive and, given time, the reefs recover from damage. Were cyclones to occur annually the reefs would never have attained their present structure or proportion. They must have a period of respite in which to recover. Any factor that retards the rate of growth and damage repair of the corals on a reef will at the same time weaken the reef's defences against such forces as cyclones and prevent the reef recovering between recurrences. The implications are obvious.

The following management suggestions for Baie de l'Arsenal follow an attempt to identify all the vulnerable points of the reefs. Their implementation will assist the numerous reef populations to attain and retain their original pristine condition.

Wave action, silting, emersion, salinity, water-depth, substrate, currents, temperature and temperature fluctuation are natural influences which limit coral growth and determine the morphology of reefs. There are certain man-induced phenomena which go further than limiting coral growth - they kill corals. These are listed below.

Mechanical Destruction

Fishing: casiers, lines, nets, anchors tangle in the reef. Dynamite, poles and grounding boats smash corals.

Prescription 19 That the use of boats be restricted to a buoyed channel
(see map 3).

Prescription 20 That visiting boats be obliged to tie up to a mooring buoy
or alongside other boats moored to a buoy.

Prescription 21 That no form of fishing be allowed inside the park boundary.

Tourism: carelessness, souvenir collection, spearfishing and shelling all cause
coral breakage and depletion of the fauna.

Prescription 22 That nothing dead or alive in the sea be handled or removed
with the exception of the crown-of-thorns starfish,
Acanthaster planci.

Prescription 23 That standing on corals to rest be forbidden.

Coral mining for lime: covered by Prescription 22.

Siltation

Inland erosion: silt brought downstream and deposited in the bay could smother
corals. This is not a danger yet and seems unlikely to arise.
Nevertheless, the Senior Park Warden should be aware of the
possibility.

Dune and Beach Erosion: dunes and beaches are fragile areas of loose sand held
by specialised vegetation. Trampling of these sand-binding plants
causes collapse of the dune ridge, erosion, siltation of the lagoon
and death of corals.

Prescription 24 That sufficient stairs or ramps for visitor use be built
through the dune ridge.

Water Quality The solution to pollution is not dilution.

Sewage and Fertilisers: These cause explosive growth of phytoplankton which
increases turbidity or causes mass mortality of marine creatures

through the release of toxic substances. They also cause increased growth of algae which smother corals and others which are precursors to ciguatera poisoning in fishes.

Pesticides: These are used in certain streams during dry seasons to poison fishes and on sugar cane fields flanking the streams which empty into Baie de l'Arsenal. Their effect on marine life can be catastrophic. Crustaceans in particular are highly susceptible.

Garbage Disposal: Accumulations of litter on the reefs ruin their aesthetic appeal and plastics and some kinds of paper wrap around coral colonies, smothering them.

Prescription 25 That dumping of anything be prohibited within the park boundary.

Prescription 26 That dumping of anything, including washing soaps, be prohibited in both the fresh water sources flowing into the bay.

Prescription 27 That the Senior Park Warden be required to monitor the quality of the freshwater streams flowing into the bay, to assess any effects of chemicals from agricultural or domestic sources on the marine communities in the bay, and, if necessary, to control the use of deleterious substances where these may be conducted into the drainage streams.

Annexe

The recommended buoys are available from Messrs Bridport Grundy, U.K. agents for Polyform all-plastic inflatable buoys. The headquarters address is: Polyform Ltd, Aalasund, Norway.

Ten Polyform Mini-floats, Code U-3, colour Polyform Redeye IV (fluorescent), are required to mark the boat access channel. The unit price is US\$ 0.7.

The following model is recommended as mooring buoys. Ten Polyform Pick-up Floats, code HA-8, colour Polyform white 11, unit price US\$ 2.80.

APPENDIX 6

THE NATIVE FAUNA OF MAURITIUS: 1, THE LAND BIRDS

by Dr Stanley A Temple

MAURITIUS KESTREL or MANGEUR DES POULES

Falco punctatus

Distribution and habitat requirements:

The Mauritius kestrel is found only on the island of Mauritius. It has never been known to occur in any other place. On Mauritius it is restricted to the mature evergreen forests that survive in the uplands of the southwest around the Black River Gorges. It requires this forest habitat in order to hunt successfully for its prey and to find suitable nesting sites in large forest trees. Each pair of kestrels requires an area of slightly over one square mile of forest habitat in order to survive.

Status and estimated numbers:

The kestrel is no doubt the rarest bird in the world and it is certainly the most severely threatened with extinction. Field research carried out during 1973-74 has shown that at present there are only six individual kestrels surviving. The Mauritius kestrel is so dangerously close to extinction that a single natural disaster, such as a bad cyclone, could completely wipe out the species.

Current threats to the population:

At present there are three main threats to the kestrel population:

- (1) Reduction in the area of mature evergreen forest habitat required by the birds.
- (2) Nest predation by the introduced Macaque monkeys that annually destroy the eggs and young of kestrels. Only one young kestrel has been raised in the last three years because of monkey disturbance.
- (3) Shooting by careless or uninformed hunters. During the past three years at least three kestrels are known to have been shot.

Conservation programmes proposed:

- (1) Captive propagation. Under the sponsorship of the International Council for Bird Preservation, the World Wildlife Fund and the New York Zoological Society, an intensive programme of captive breeding has been initiated for

the kestrel. If this programme succeeds it should be possible to begin releasing captive-reared kestrels back into the forests of Mauritius in about five years. This programme may offer the only hope for saving the kestrel from extinction. The sponsoring organizations have guaranteed continued personnel and financial support for this programme. The Government of Mauritius should cooperate fully in this on-going programme.

- (2) Habitat preservation. The proposed National Park would contain within its boundaries the entire world's population of the kestrel. The park should under ideal conditions provide sufficient forest habitat for a viable population of 20-30 kestrels.
- (3) Predator Control. Even within a well-managed National Park the kestrel will not thrive unless the threat of predation by monkeys is reduced. A reduction in the number of monkeys may be necessary within the park boundaries to ensure the kestrels safety.

PINK PIGEON or PIGEON DES MARES

Nesoenas mayeri

Distribution and habitat requirements:

The pink pigeon is found only on the island of Mauritius and has never been known to occur elsewhere. On Mauritius it requires indigenous evergreen forest and scrubland habitat in order to survive. It requires this native habitat in order to find the types of fruits and flowers on which it feeds. At present, the pink pigeon is restricted to the remnant native forests that exist in the southwestern region of the island. Each pigeon ranges over an area of forest habitat nearly 2-3 square miles in extent.

Status and estimated numbers:

The pink pigeon is one of the rarest birds in the world. Field research during 1973-74 has shown that only 25-30 individual pigeons survive in Mauritius. These few birds are severely threatened with extinction and their numbers are slowly dwindling. Unless this trend is halted the pink pigeon will soon be in a precarious state like the kestrel.

Current threats to the population:

There are three main threats to the pink pigeon:

- (1) Reduction of habitat area. During the past ten years hundreds of acres of the best habitat for the pink pigeon have been destroyed. The remaining areas of suitable pigeon habitat are barely sufficient for a viable population to maintain itself.
- (2) Predation. Each year many nests of the pigeon are destroyed by introduced Macaque monkeys with the result that very few young are raised. During 1973-74 perhaps as few as four young pigeons were raised.
- (3) Shooting. Unfortunately hunters still shoot the pigeon when they encounter it in the forest. During 1973-74 at least five pink pigeons were known to have been shot by hunters. This mortality cancels out the pigeons poor reproductive output over the period.

Proposed conservation programmes:

- (1) Captive propagation. Under the sponsorship of the ICBP, WWF and NYZS, work has begun on a programme to breed pink pigeons in captivity so that their numbers can be increased. If this programme is successful it should be possible to repopulate the forests of Mauritius with captive-reared pigeons. The sponsoring organizations have guaranteed continued personnel and financial support for this programme and the government of Mauritius should cooperate fully with this on-going programme.
- (2) Habitat preservation: The proposed National Park will include within its boundaries virtually the entire world's population of pink pigeons. Pigeons do, however, at present feed in several areas outside the park boundary. Ideally, the proposed park protects an area of forest habitat sufficient for the preservation of a viable population of nearly 75 pink pigeons.
- (3) Predator control: Within the boundaries of the proposed park some form of monkey control will be necessary if the pink pigeon is to thrive. Special emphasis should be placed on the prevention of pigeon shooting as this is a serious threat.

MAURITIUS PARAKEET or GROSSE CATEAU

Psittacula echo

Distribution and habitat requirements:

The Mauritius parakeet is found only on the island of Mauritius and has never been known to occur elsewhere. On Mauritius it is restricted in distribution to the mature evergreen forests that surround the Black River Gorges. The parakeets are confined to this habitat because they feed only on the fruits of native forest trees and require very large old trees in which to nest.

Status and estimated numbers:

The parakeet is one of the rarest birds in the world. Field research during 1973-74 has shown that the total population of this species does not exceed 60 individuals. The parakeet is now threatened with extinction because its population numbers are continuing to decline steadily.

Current threats to the population:

At present, there are three major threats to the parakeet.

- (1) Reduction in the area of forest habitat required by the birds.
- (2) Nest predation by introduced Macaque monkeys that annually destroy many eggs and young of the parakeet.
- (3) Competition for nesting sites. Now that the forest habitat has been reduced in area, the aggressive introduced ring-necked parakeet (petite cateau) and the Indian mynah (Martin) are invading the native forests. They use the same type of nesting hole as the Mauritius parakeet and often take over nesting sites of the endemic parakeet with the result that the parakeet cannot raise young.

Conservation programmes proposed:

- (1) Captive propagation. Under the sponsorship of the ICBP, WWF and NYZS, work has begun on a programme of breeding the parakeet in captivity. If this programme succeeds it should be possible to repopulate the native forests of Mauritius with captive-reared birds. The sponsoring organizations have guaranteed continued personnel and financial support for this programme. The government of Mauritius should cooperate fully with this on-going programme to preserve the parakeet.

- (2) Habitat preservation: The proposed National Park would contain within its boundaries the entire world's population of Mauritius parakeets. The park would provide an area of suitable forest habitat sufficient to maintain a viable population of over 100 parakeets.
- (3) Control of predators and competitors: Within the boundaries of the proposed park some control of monkeys and competing species of exotic birds may be necessary if the parakeet is to thrive.

MAURITIUS CUCKOO-SHRIKE or MERLE CUISINIER

Coracina typica

Distribution and habitat requirements:

The cuckoo-shrike is found only on the island of Mauritius and has never been known to occur elsewhere. On Mauritius it is restricted to the mature evergreen forest habitat that exists in the south-western region of the island around the Black River Gorges. It requires this native forest habitat in order to successfully find the leaf-dwelling insects upon which it feeds. Each pair of cuckoo-shrikes needs an area of about 15-20 acres of forest habitat in which to live.

Status and estimated numbers:

The cuckoo-shrike is one of the rarer birds in the world. Field research carried out during 1973-74 has shown that between 100-200 individual cuckoo-shrikes survive in the forests of Mauritius. At present these birds are doing fairly well and seem to be maintaining their numbers or decreasing only slightly in abundance.

Current threats to the population:

At present there may be only two threats to the cuckoo-shrike:

- (1) Reduction in the area of mature evergreen forest habitat that the cuckoo-shrike requires.
- (2) Nest predation by introduced Macaque monkeys and rats. There is evidence that each year the eggs and young of many cuckoo-shrikes are destroyed by these predators.

Conservation programmes proposed:

- (1) Habitat preservation: The cuckoo-shrike requires relatively undisturbed indigenous forest to survive. The proposed National Park would include within its boundaries nearly the entire world's population of Mauritius cuckoo-shrikes. A small percentage of the population does exist in forests immediately adjacent to the park.
- (2) Control of predators: Within the boundaries of the proposed park some form of monkey control would benefit the cuckoo-shrike. If this threat to the birds reproductive output was eliminated, the birds could no doubt maintain a stable population.

MAURITIUS BULBUL or MERLE

Hypsipetes olivacea

Distribution and habitat requirements:

The Mauritius Bulbul is found only on the island of Mauritius and has never been known to occur elsewhere. It is restricted to the indigenous evergreen forests that exist in various places around the island. It is confined to this habitat because it requires the fruits and flowers of native plants for food. Each pair of bulbuls forage for food over an area of nearly 30 acres but several pairs can coexist in overlapping areas.

Status and estimated numbers:

The Mauritius Bulbul is one of the more common endemic birds even though it is confined to the native forest habitat. Field research during 1973-74 has shown that the total population of this species is well over 1000 individuals. Although still fairly common in the proper habitat, its numbers have been decreasing steadily in recent years. Unless this downward trend is halted the bulbul could eventually be threatened with extinction.

Current threats to the population:

At present there are two main threats to the Mauritius Bulbul.

- (1) Reduction in the area of indigenous evergreen forest that the bird requires.
- (2) Nest predation and competition with exotic birds. The Macaque monkeys destroy many nests of the bulbul and the introduced red-whiskered bulbul (Conde) and mynah (Martin) compete for some of the same fruits and seeds that the Mauritius bulbul eats.

Conservation measures proposed:

- (1) Habitat preservation. The Mauritius bulbul requires indigenous evergreen forest habitat in order to survive. The proposed National Park would contain within its boundaries nearly half of the total bulbul population. The remaining portion of the population is found in areas of forest adjacent to the park and in areas of native forest that exist on mountain slopes in other regions of the island. Although the proposed park probably contains enough forest habitat for a viable bulbul population to survive in, the areas of native forest that exist outside the boundaries should also be maintained in their present natural condition if at all possible.
- (2) Control of introduced predators and competitors. Within the boundaries of the proposed National Park some control of monkeys and exotic birds would greatly benefit the endemic bulbuls by allowing them to breed undisturbed and to feed without competition.

MASCARENE PARADISE FLYCATCHER or COQ DE BOIS

Terpsiphone bourbonniensis desolata

Distribution and habitat requirements:

The flycatcher is found on the island of Reunion as well as on Mauritius. Each island does, however have a distinct subspecies. On Mauritius the flycatcher is found in several widely scattered localities and is not restricted solely to indigenous vegetation. Although the majority of the population is found in areas of mature evergreen forest and scrub, the birds can exist equally well in exotic second growth forests, certain forestry plantations and fruit orchards. The main requirement seems to be that the habitat provide a good supply of flying insects and an understorey plant species suitable for the birds to nest in.

Status and estimated numbers:

Although the flycatcher is not yet seriously threatened with extinction, its numbers have apparently decreased sharply in recent times. Today the flycatcher population on Mauritius probably numbers somewhat over 1000 individuals but an exact count is not yet possible.

Current threats to the population:

- (1) Reduction in wooded areas. As more and more land in Mauritius is placed under cultivation the wooded areas required by the flycatcher have

disappeared. This includes not only areas of native vegetation but also areas of exotic second growth vegetation.

- (2) Disturbance by man. The flycatcher is an extremely tame bird and as a result it is often shot by thoughtless persons when it occurs close to man's activities. The flycatchers that used to be found in the Pamplemousses Gardens, for example, were destroyed by persistent disturbance and shooting.

Conservation measures proposed:

- (1) Habitat preservation. The proposed National Park would provide a refuge for only a portion of the total flycatcher population. Although a viable population of flycatchers could survive solely within the proposed park, it seems important also to protect those flycatchers that live outside the park. The forests that exist on mountain slopes outside the National Park should, of course, be maintained. Also forestry plantations and orchards could easily be managed in such a way as to encourage the flycatchers to live there.
- (2) Prevention of unnecessary disturbance. One result of an effective nature education programme might be to allow the flycatcher to survive in suitable habitats that are close to human activities. If people were encouraged to protect the flycatcher, it might possibly become a familiar garden bird as it was in former times.
- (3) Translocation of birds. When an area, such as a forestry plantation, that contains flycatchers is scheduled to be cut, it would be possible to capture the resident flycatchers and move them to a safe location elsewhere. This could, for example, be done with the flycatchers that live in the woods being cleared for the building of the new airport. A request from the Mauritius government to organizations such as the ICBP or WWF would certainly result in the required technical assistance to accomplish such a programme.

GREY WHITE-EYE or OISEAU MANIOC

Zosterops borbonica mauritiana

Distribution and habitat requirements:

The grey white-eye is found on both Mauritius and Réunion but each island has a distinct subspecies. On Mauritius the grey white-eye is found in nearly every

part of the island and in a great variety of different habitats, both indigenous and exotic. Because it is an adaptable species, the grey white-eye can survive in close contact with man. Although the population density of grey white-eyes is greatest in native vegetation, the majority of the island's population lives in other habitats.

Status and estimated numbers:

The grey white-eye is perhaps the only endemic Mauritian bird that is in no way threatened with extinction. It is a fairly common bird everywhere on the island and its total population surely numbers many thousands.

Current threats to the population:

At present there are no serious widespread threats to the grey white-eye. On the local level there may be certain situations where birds are harmed by the use of pesticides or clearing of trees, but these are not important to the total population.

Conservation measures proposed:

Because the grey white-eye is so successful and widespread, there is little, if anything, that needs to be done in the way of conservation work.

OLIVE WHITE-EYE or OISEAU PIT-PIT

Zosterops chloronothos

Distribution and habitat requirements:

The olive white-eye is found only on the island of Mauritius and has never been known to occur elsewhere. On Mauritius it is found mainly in areas of indigenous evergreen forest and scrub although it will occasionally go into exotic vegetation and even gardens to feed. Most of the population lives in the indigenous scrub and forest around Plaine Champagne in the southwest. The most important habitat requirement for the white-eye is a good supply of nectar-producing flowers on which to feed. Thus it can only be found in the indigenous scrublands.

Status and estimated numbers:

The olive white-eye is now seriously threatened. Its numbers have decreased markedly in recent years and there is no evidence that this trend is not to continue. Today the total population of this species is estimated at less than 1000 individuals.

Current threats to the population:

- (1) Reduction of indigenous forest and scrub habitat. During the past 10 years hundreds of acres of the white-eyes' preferred habitat have been cleared for cultivation. This habitat reduction seems to be far and away the most serious threat to the population. Should any further destruction of indigenous scrub habitat take place, the white-eye may be placed dangerously close to extinction.

Conservation measures proposed:

- (1) Habitat preservation. Unless suitable areas of white-eye habitat are preserved, this species will soon become extinct. The proposed National Park would contain within its boundaries the largest remaining portion of the white-eyes' habitat, the regions around Plaine Champagne. Probably more than half of the total white-eye population resides within the proposed park. The remaining portion of the population is found in areas adjacent to or near to the park. The areas outside the proposed park are a difficult problem as many of these areas are under immediate threat. Hopefully, small patches of indigenous vegetation can be allowed to remain outside the park in areas being cultivated for tea or forest products as this would be a great benefit to the white-eye. Probably the areas of habitat protected within the park would be barely adequate to maintain a viable population of white eyes.
- (2) Planting of nectar-producing flowers. The Forestry Service has already started a programme of planting road sides with decorative trees and flowers. If these plants could be selected for their nectar-producing ability, they could provide the white-eyes with an important food supply in regions near the proposed park. This additional food source would be a great benefit to the white-eyes and would fit in well with a pre-existing planting programme.

MAURITIUS FODY or OISEAU BANANE

Foudia rubra

Distribution and habitat requirements:

The fody is found only on the island of Mauritius and has never been known to occur elsewhere. On Mauritius it is restricted to the indigenous evergreen forests and scrubland of the southwest in the regions around the Black River

Gorges. The preferred habitat of the fody is indigenous scrub with scattered large trees, but the fody will also live in mature forest. The fody requires this type of habitat to find the insects and flower nectar upon which it feeds.

Status and estimated numbers:

The fody is now seriously threatened with extinction. Its population numbers have been so reduced that now only about 150-200 individuals survive. The fody population is continuing to decline due to habitat destruction and will soon be pushed very close to extinction.

Current threats to the population:

- (1) Reduction in indigenous forest and scrub habitat. The recent clearing of hundreds of acres of the fody's preferred habitat and the threat to the fody population. The fodys have been forced to move into marginal areas when their preferred habitat is cleared and in these regions their chances of survival are much reduced.
- (2) Nest predation. The introduced Macaque monkeys frequently destroy the eggs and young of the fody. During 1973-74 very few pairs of fodies managed to rear young successfully.

Conservation measures proposed:

- (1) Habitat preservation. It is essential that as much as possible of the remaining indigenous scrub habitat be preserved if the fody is to survive. The proposed National Park would include within its boundaries a large portion of what remains of this habitat. The park would provide a refuge for a majority of the fodies but a large segment of the population still resides in marginal areas outside the proposed park.
- (2) Translocation of Fodies to Réunion. A plan to transfer some Mauritius Fodies to Réunion has been proposed by the British Ornithologists Union. This plan is based on the assumption that the fodies could establish themselves in the large areas of suitable habitat that exist on Réunion, where presently there is no endemic fody. Should this scheme be undertaken and succeed, it could be an important way to save the Mauritian Fody from extinction, even if it should eventually disappear from Mauritius. The Government of Mauritius should cooperate with this scheme if international conservation groups decide that it is an acceptable course of action.

APPENDIX 7

THE NATIVE FAUNA OF MAURITIUS: 2, SEABIRDS, REPTILES AND MAMMALS

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The Trinidad Petrel

Round Island is not only the home of unique snakes and lizards, it is also the home of a very unusual seabird named the Trinidad Petrel (Pterodroma arminjoniana). This very rare bird is found on only two small islands on opposite sides of the world: South Trinidad Island in the tropical Atlantic Ocean off the coast of Brazil and Round Island near Mauritius. The Petrel has never been seen in any place other than these two islands where the birds come to breed.

The Petrel is a large seabird slightly larger than the Fouquet. It is dark on the back and some birds have a dark belly while other individuals have a white belly. The call of the Petrel which is often heard on Round Island is a loud series of notes sounding like "gong, gong ..." that lasts for nearly 15 seconds. Usually a pair give this call when they are courting.

It is interesting to note that the Petrel was only recently discovered on Round Island (in 1948). Before this date, the species was only known from South Trinidad Island. On Round Island about 100 pairs of Petrels come to nest each year. Each bird lays one large white egg on the ground beneath a rock or in a crevice. It seems that some Petrels nest almost the year round, but most of the birds lay their eggs in the early summer. It takes a young Petrel about 2½ months to grow and leave the island.

The Petrels on Round Island may be in serious trouble as an indirect result of the activities of man. In 1973, it was noted that many Petrels were breaking their eggs in the nests. This is a serious problem as it is essential that a species be able to reproduce if it is to survive. It is well known that one factor which can cause birds to break their eggs is poisoning with pesticides like DDT. The DDT upsets the female bird's reproductive system so that she lays eggs that are very thin-shelled. These, of course, are more easily broken.

Eight eggs from the Round Island Petrels were sent for analysis, and every single one of them had DDT present in the egg contents. In addition, measurements of the shells of these eggs showed that they were indeed thinner than normal. It appears that the Round Island Petrels are suffering from the classic DDT syndrome that has been seen in many other species of birds.

The Petrels feed mostly on squids and other swimming crustaceans, and they, no doubt, capture their food in the ocean near to Mauritius. The birds acquire the DDT through their food, so it is significant that they become poisoned near Mauritius. Probably the source of the DDT was water flowing from Mauritius. Once the DDT reached the ocean, it was absorbed by the animals on which the Petrels feed, and thus passed on to the Petrel. DDT is very stable and lasts for dozens of years. The DDT in the Petrels on Round Island may have come from the extensive spraying that was carried out to eradicate malaria on Mauritius.

In any event, the Petrels are now being affected by the DDT, and only time will tell whether they will be able to survive on Round Island or whether they will eventually disappear from their only home in the Indian Ocean.

Other seabirds

Because Mauritius is surrounded by the sea, it is only natural that many seabirds should be found on or near Mauritius. These seabirds spend most of their life out over the open ocean and return to land only to breed and nest. In all over 20 species of seabirds have been recorded in the sea near Mauritius. Some of these are fairly common, well-known species that nest either on Mauritius or nearby smaller islets. Others do not breed here but are more or less regularly seen each year as they wander about the open seas. Finally, there are a few birds that occur only rarely in the waters around Mauritius, usually when a severe storm has blown them from their usual haunts in the Indian Ocean.

The frequently seen seabirds that breed on or near Mauritius are as follows:

Fouquet (Puffinus pacificus): The Fouquet breeds by the thousands on Round Island with smaller nesting colonies on Gunner's Quoin and Isle de Passe. This grey bird with pink feet is well known to anyone who has been to sea around Mauritius. It nests in burrows and returns to the nesting islands only after dark. Its call is an eerie wail that sounds like a ghost!

Paille-en-Queue à brins rouge (Phaeton rubricauda): This well-known seabird nests on the cliffs of Gunner's Quoin, and in smaller numbers on Round Island and Serpent Island. Its distinctive long red tail and red beak make it readily identifiable. It is unfortunate that this once common bird is now becoming quite rare on Mauritius. Fishermen kill hundreds of the birds each year when they return to the islands to nest. Being quite tame, the birds sit tightly on their nest when man approaches and, consequently, are easily killed.

Paille-en-Queue à brins blanc (Phaeton lepturus): The second Paille-en-Queue found in Mauritius is far more common. It nests by the hundreds on Mauritius itself and on nearly all of the northern islets. On Mauritius, the birds nest on cliffs such as Corps de Garde or Le Morne and in holes in large trees in the forests of the Black River Gorges. On a fine day, it is possible to see hundreds of Paille-en-Queue flying lazily about the gorges on their way between their nests and the sea. The Paille-en-Queue is found the world over in tropical ocean regions.

Fou or Boeuf (Sula dactylatra): A colony of a few dozen pairs still nest on Serpent Island, and these large white birds can occasionally be seen flying over the sea to the north of Mauritius. The Boeuf is found on many islands of the Indian Ocean, but it is becoming increasingly rare near Mauritius probably due to depredations by fishermen.

Yeye (Sterna fuscata): The Yeye is one of the most commonly encountered birds in the sea around Mauritius. It nests by the thousands on Serpent Island where it is, fortunately, not disturbed often. The fishermen know well that the Yeye can lead them to good fishing grounds. The distinctly marked black and white adult Yeye differs from the young birds which are black with small white spots.

Cordonnier and Marianne (Anous stolidus and Anous tenuirostris): These two closely related birds nest commonly on Serpent Island, and, like the Yeye, are quite well known to the Mauritian fishermen. The dark grey birds with a whitish head can be seen fishing all around Mauritius about 1-2 miles off shore. The two birds are difficult to tell apart, but the Marianne is smaller with a longer beak. They often fly together in flocks while fishing.

The seabirds which visit Mauritius quite regularly but do not breed here are usually seen only by those who venture outside the reefs into the open seas.

These birds have no reason to come in too close to shore and, in fact, seem to avoid land. The Goelette Blanche (Gygis alba) is one of the best known visitors. These pure white birds breed in St. Brandon and Rodrigues and come to Mauritius in small numbers. The Martin Pêcheur (Sterna dougalli) is frequently seen in the summer. This white bird with a black head even comes ashore occasionally to rest on undisturbed beaches and rocks. It breeds far to the north and only comes to Mauritius after the nesting season is complete.

A few seabirds are rather unwelcome visitors to Mauritius because their occurrence here usually means that the severe storms are approaching. The Fregate (Fregata ariel) is perhaps the best known species, and it visits almost every year coming from St. Brandon and the islands to the north. The large black bird is a graceful and beautiful aerial acrobat and often robs fish from other seabirds. The albatross (Diomedea chlororhynchus), Petrel Géant (Macronectes giganteus) and Pigeon du Cap (Daption capensis) come from the southern Indian Ocean where they nest on Amsterdam-St. Paul. Usually they stay far to the south not far from the Antarctic ice.

Round Island Reptiles

The reptile fauna of Round Island is one of the most extraordinary in the world. On this tiny island of only 374 acres are found no less than six endemic lizards and two endemic snakes. There are, in fact, more endemic lizards on tiny Round Island than exist on the whole island of Mauritius. These six lizards include 3 skinks and three geckos.

The three skinks are: Ablepharus boutonii, Gongylomorphus bojerii and Leiolopisma telfairii. The first two species are indigenous to the island, being found on several small nearby islets as well; both are fairly common on the island. Ablepharus is a small terrestrial skink, about 75 mm in length, which is found mostly near the shore of the island. It is agile and quick and feeds on small insects. Gongylomorphus is likewise an indigenous terrestrial form. It is slightly larger, reaching a length of about 100 mm, and prefers the higher elevations on the island. It is a rather tame and inquisitive lizard, always on the move searching for insects.

Leiolopisma is the most interesting of the skinks. It is endemic to Round Island and is a striking animal both in size and behaviour. Reaching a length of nearly 300 mm, this terrestrial skink is also extremely tame and inquisitive,

even crawling up one's leg to take food from the hand. Although it is primarily insectivorous, it often attacks the smaller species of lizards which it can easily capture and kill. Leiolopisma is still fairly easy to find, but the population seems to be in a slow decline.

Two of the geckos of Round Island are members of the genus Phelsuma, which includes some of the most colourful geckos in the world. Phelsuma vinsoni is a small beautifully-coloured creature that is indigenous to Round Island. It is an arboreal species that is still quite common, especially on the endemic species of Vacoas, the fruit of which attracts the insects that the gecko eats.

A larger but less colourful gecko, Phelsuma guentheri, is endemic to Round Island. This large, heavy-bodied gecko reaches a length of over 250 mm, making it the arboreal counterpart of Leiolopisma. Cryptic coloration and retiring habits make this gecko rather difficult to locate. Usually it is found hiding in the axils of the Latanier leaves during the day, but at dusk it ventures forth to feed on insects, small lizards and the fruit of the Latanier. Phelsuma guentheri is not at all common, and censuses indicate that only about 2000 individuals may survive on the island. The population seems to suffer greatly in cyclones.

Cyrtodactylus serpentinsula is found only on Round Island and nearby Serpent Island. This small, secretive nocturnal gecko is rarely seen except at night and seems to hide amongst rocks and ground litter during the day. Because of its secretive habits, it was not discovered by scientists until 1948. Unlike most other geckos, Cyrtodactylus lacks foot pads and instead has clawed toes. Virtually all of the specimens that have been observed or collected have had broken tails and missing digits which may suggest that they are attacked often by either Phelsuma guentheri, Leiolopisma or even the two Round Island snakes. Very little is really known about this unique gecko which now seems to be threatened with extinction.

The continuing destruction of the vegetation of Round Island by introduced rabbits and goats is seriously threatening the island's lizard populations. The lizards require the palm forest habitat in order to survive, and if the rabbits and goats are allowed to remain on the island, the lizards will continue to decline in numbers. It is hoped that a programme to poison the rabbits and goats will be successful so that the lizard's habitat can be preserved.

The two snakes of Round Island are the most extraordinary of the reptiles to inhabit that island. Casarea dussumieri and Bolyeria multicarinata are the sole surviving members of the subfamily Bolyerinae, a group of primitive boas. They are, in a sense "living fossils" since all other closely related species have long ago passed into extinction. Once these bolyerine snakes were widespread over the Indo-Pacific region; species no doubt existed in the past on Mauritius itself. Then, for some yet unexplained reason, all the bolyerine snakes became extinct except for the two that live on Round Island.

Casarea dussumieri is the arboreal snake of Round Island. In appearance it has a flattened triangular-shaped head with a thin neck and long tail. It is known to reach a length of about 1 metre. Casarea is a dull grey colour on the back with a yellowish-white belly that has longitudinal rows of spots on it. Some smaller specimens of Casarea have a reddish colour on the back, and this difference is probably due to the age of the snake.

Casarea is thought to be primarily an arboreal snake, and, when it is seen, it is usually coiled amongst the leaves of the Lantanier Palm. Unfortunately, Casarea is not very often seen, and it would seem that this extremely rare snake is heading for extinction. During 9 days of searching in 1973, only 4 individual snakes were found. Fortunately one of these was a young snake indicating that the species can still breed successfully.

Very little is known of the habits of the Round Island snakes, but we do know that Casarea feeds mainly on the lizards of Round Island. After the snake grabs a lizard, it kills its prey by coiling around it and squeezing it to death. This is a typical trait of the Boas.

The second Round Island snake, Bolyeria multicarinata, is extremely rare and possibly already extinct. None could be found in 1973, and the last authentic sighting of the snake seems to have been in 1967.

Scientists know even less about the habits of Bolyeria since it is so rare. This species seems to be primarily fossorial, living on the ground and burrowing among the palm leaves, litter and loose rocks. As an adaptation for this mode of life, Bolyeria is built differently than Casarea. The head of Bolyeria is cylindrical in shape with a pointed snout. Its neck is also cylindrical and muscular to allow the snake to push its way through the ground litter.

Bolyeria no doubt feeds on the lizards of Round Island in the same way as Casarea. It would be, however, restricted to the ground-dwelling lizards, while Casarea could capture lizards in the trees.

The snakes of Round Island are the most interesting and unusual animals found in Mauritius. However, they now seem to be faced with extinction. The simple and very fragile food chain of Round Island (palms:insects:lizards:snakes) has been damaged severely at its very base by the introduced rabbits and goats. These destructive creatures have destroyed the vegetation on which the Round Island fauna depends not only for its ultimate food source but also for protection from the elements. Unless the threat of these introduced creatures is removed from the island, the lizards and snakes that make Round Island such a special place will someday soon be a thing of the past.

The Phelsuma Geckos

Among the animals endemic to the island of Mauritius are three species of green geckos belonging to the genus, Phelsuma : Phelsuma vinsoni, Phelsuma cepediana, and Phelsuma guimbeaui. These geckos can rightly be considered to be among the most beautiful lizards in the world. In all some 25 species of green geckos are found on Madagascar and on other islands in the south-west Indian Ocean. Presumably, long in the past all of the island forms reached their new homes by drifting on floating debris in the ocean. Once on the islands, they evolved different patterns of colour so that today each island has a more or less distinct form of Phelsuma.

On the main island of Mauritius, the three species of geckos are actually fairly common and well-known. Unlike some of the geckos that have been introduced to Mauritius, the Phelsumas are not particularly fond of living in houses. Most prefer to live on tree trunks or among leaves. All of the Phelsuma geckos are basically bright green in colour with various shades of blue, red and brown providing the intricate patterns of their bodies. Strangely enough, the colour of a Phelsuma is very strongly affected by its immediate environment. When sitting out in the warm sun, the green geckos are at their best colourwise. But, should the day be cloudy, windy and cold or if the gecko is disturbed, then it can quickly change its colour to a very dark, drab green.

Unlike many of their relatives, the Phelsuma geckos are not nocturnal in habits, and most species are active only during the day. They are also very sensitive

to weather conditions and prefer to stay hidden behind the bark of a tree or among leaves if the sun is not out or if high winds are blowing.

Many geckos have rather loud voices, but the Phelsumas of Mauritius only utter a slow, soft call that is not very distinctive.

The food of the Phelsuma geckos is mostly small insects, but they are also very fond of sweets. It is not unusual to discover a Phelsuma sitting on a flower lapping up nectar or hanging on a ripe fruit licking the sweet juices. Some plants are favourites such as the Vacoas. When the fruit is ripe and the seeds start to fall, sometimes dozens of geckos will collect on the fruit to lick the sweet juices.

Breeding usually takes place during the summer months, and each female lays two white eggs. Very often several females get together and lay their eggs together in one spot so that occasionally as many as 50 eggs are found in the same spot. Usually the eggs are placed in a crevice in a tree or in the fold of large leaves.

The three species of Phelsuma on Mauritius are easily identified, and each has some slightly different habits.

Phelsuma cepediana can be recognized by the large single red spot that lies on the head just in front of the eyes. This gecko is fairly well distributed over Mauritius, but seems to be most common at middle elevations.

Phelsuma vinsoni has a red T mark between its eyes and brown stripes on the side of the head and neck. It is one of the smallest species. Most specimens are under 150 mm in length. This is probably the most abundant Phelsuma, and it is found nearly all over Mauritius particularly at lower elevations. It is also found on many of the small offshore islets. This is the species most likely to be encountered in houses especially seaside bungalows.

Phelsuma guimbeaui can be recognised by its short tail and by a thin red circular mark on the back of the neck. The throat has a series of V-shaped marks on it, but this is difficult to see if the gecko is sitting on a tree. It is about the same size as Phelsuma cepediana, and the two species are sometimes found together.

The Phelsuma geckos have few serious predators on Mauritius. The only natural predator they have is the Mangeur de Poules, and this bird is so rare that it is of no significance to the lizards. Because these geckos are so beautiful, they were, in the past, caught and shipped overseas to collectors. This activity has now ceased since the government passed a law protecting all the Phelsuma lizards of Mauritius. They cannot now be captured or exported.

The Bats or Chauve-Souris

The only mammals that have reached Mauritius without the help of man are the bats. Because they can fly, bats have been able to reach even the most remote tropical islands. There are perhaps as many as six species of bats in Mauritius today, and several more are believed to have gone extinct after man arrived.

The most interesting Mauritian bat is the large fruit bat or flying fox (Pteropus niger) which is endemic to Mauritius. The bats of the genus Pteropus are widespread in the Indian Ocean, and most islands have their own endemic species. Even tiny Rodrigues has its own species of bat. These large bats are fairly well-known to Mauritians. They have a wingspread of about 750 mm and are light brown in colour.

The habits of the fruit bats are interesting. They spend most of the daylight hours hanging upside down by their feet from a tree limb usually in the company of several dozen or even hundreds of other bats. These communal gatherings are called roosts. Usually the roosts are located in secluded areas of forest where the bats are not disturbed by man. At dusk the bats become more active, and they leave the roost to search for fruit to feed on. They have large eyes to help them see well at night when flying in search of food.

The fruit bats feed exclusively on fruit, and before man came to Mauritius, they fed on the fruits of the indigenous trees. But when man introduced fruit trees to the island, the bats were not long in discovering a new source of food.

The fruit bats breed once a year and each female has one young. After birth, the young bat hangs on to the female's chest and is carried about for many weeks before finally flying alone. Often a female will carry a young one nearly as large as herself.

The fruit bats are becoming increasingly rare in Mauritius because many are shot by man. Certainly there is justification for shooting any bats that are found destroying fruit in an orchard, but the indiscriminate shooting of bats by the dozens for sport is totally unnecessary. The government should realise that these animals will soon be threatened with extinction if the present trend continues. Some protection should be given to them soon.

A second species of fruit bat (Pteropus subniger) which is slightly smaller and roosts in caves is thought to be extinct. It has not been seen in nearly 100 years.

Another species of bat that is familiar to most Mauritians is the small chauve-souris banane (Taphozous mauritianus) which is a widespread species through Africa and the Indian Ocean. Its small size and light-coloured belly are distinctive. This bat is an insectivorous bat feeding exclusively on flying insects which it captures at night. During the day the chauve-souris banane hides in such places as coconut palms, under eaves of houses or on cliffs.

The chauve-souris banane catches flying insects in a fascinating way. Since its eyes are not very large, the bat uses a type of echo-location, like that of the Salangane, but much more accurate. The bat can locate an insect and capture it by listening for the echo of its high-pitched voice. The voice of the bat is so high pitched that man cannot hear it.

There are three other small insectivorous bats on Mauritius. (Mornopterus acetabulosus, Liponycteris nudiventris and Scotophilus borbonicus). All are widespread species in Africa, but they are not too common on Mauritius. They are difficult to distinguish from the chauve-souris banane when seen flying at night.

The bats are the only truly Mauritian mammals, and they should be given protection since they are an interesting part of the natural heritage of Mauritius.

APPENDIX 8

GUIDELINES FOR A MANAGEMENT PLAN FOR ROUND ISLAND

1. BACKGROUND

1.1 Ownership and legal position

1.11 Round Island is a proclaimed Nature Reserve under the Ancient Monuments Ordinance, 1944.

1.12 Birds are protected under the Bird Protection Ordinance, 1967.

1.13 Reptiles are protected under Proclamation No. 13 of 1973.

1.14 Landing on the island is at present unrestricted.

1.15 It is an offence to damage trees, under the Forests and Mountain and River Reserves Act, 1971.

1.2 Ecology

1.21 Round Island supports a unique assembly of plants and animals, some of which are on the verge of extinction. (For a list of endemics, see Appendix I to Sir Peter Scott's report.)

1.22 Introduced rabbits and goats have so severely disrupted the native ecosystems that only active and determined intervention can start the indigenous communities on the road to recovery.

1.3 General

1.31 To achieve the objective of reversing the destruction of one and a half centuries, it must be accepted that a major input of effort is required.

1.32 The rehabilitation programme will require an input at three levels simultaneously:-

- 1 Funds for the establishment and maintenance of a station and a scientist/warden.
- 2 Hard labour.
- 3 Scientific expertise.

1.33 The difficulties of terrain and communications almost certainly mean that the normal channels for recruiting a nature reserve warden cannot be used. The candidate must be a qualified ecologist and must have the necessary dedication, determination, pioneering qualities and physical stamina to allow him to stay on the island and carry out the rehabilitation programme virtually single-handed, at least in its early stages.

1.34 It will almost certainly be possible to obtain some help, at the scientific level, the labouring level, and also at the vital 'moral support' level, but at the present time it would not be safe to assume that the total amount of such help will be very great.

1.35 Because there is not yet a National Parks and Wildlife Service, the scientist/warden would be operating to begin with, largely on his own initiative as regards infrastructure and contacts. There is no doubt that much goodwill exists for this enterprise in Mauritius, but again it would not be safe to assume the existence of a substantial working-base.

2. OBJECTS OF MANAGEMENT

2.1 Overall objective: to rehabilitate the native ecosystems of Round Island, with their component endemic species.

2.2 Tactical objectives:

- 1 To eliminate all introduced animals and plants from the island.
- 2 To take action to prevent the loss of the remaining soil.
- 3 To carry out anti-erosion measures to allow the accumulation of soil in areas where it is now lacking.
- 4 To re-introduce plants which are known or believed to have grown on Round Island, in an effort to reproduce near-natural communities.
- 5 To monitor the populations of the rare endemic animals as an index of the success of the rehabilitation programme.

3. PROPOSALS

3.1 IUCN/WWF should accept the initial responsibility of mounting the Round Island Project, in cooperation with the Mauritius Government. (cf Sir Peter Scott's Recommendation 4.1.3.).

3.2 That a capital sum of \$ 50 000 should be provided to initiate the project, plus the salary and costs of the scientist/warden.

3.3 That a scientist/warden should be recruited in Europe or America who should have the following qualifications:

- (a) Biological/ecological training, preferably with sea-birds, reptiles and tropical coastal plant communities.
- (b) Experience or training in soil conservation methods.
- (c) Experience with boats.
- (d) Knowledge of building and maintenance.
- (e) Pioneering qualities, physical fitness and good swimming ability.

3.4 The scientist/warden should be appointed for two years in the first instance.

3.5 That Round Island and Serpent Island be declared Special or Strict Natural Reserves as soon as a new National Parks and Wildlife Management Act is passed.

3.6 That subsidiary legislation for Round Island should be passed, under the National Parks and Wildlife Management Act (cf Recommendation), which:

- (a) would enable landing on Round and Serpent Islands to be controlled;
- (b) would provide for the rehabilitation work;
- (c) would provide satisfactory protection for the wildlife of the island, including all plant communities and the surrounding coral reefs.

3.7 The scientist/warden should begin work from a base on Flat Island, where some housing, a landing stage, water and communications are already available.

3.8 An improved landing-stage be constructed on Round Island. The design is still to be worked out but must be cyclone-resistant. One suggestion is a fixed stayed mast bedded into the rock at the present landing-place, on which would be mounted a derrick and a winch. The derrick would be designed to hoist

vertically against the mast for stowage and to be used as a gangway or crane for landing supplies, in the lowered position. The derrick could be supplemented by a semi-expendable pontoon which could act as a floating landing-stage when the sea was calm enough. This landing-stage should be built on contract and its installation supervised by the scientist/warden. Advice should be sought from the Mauritius Marine authorities, the Fisheries Department and others.

3.9 A simple house/store/Laboratory should be built on Round Island, probably on the gently-sloping southern part. The building must be cyclone-proof, must be reasonably well insulated against heat and must incorporate water-storage facilities.

3.91 A water catchment must be added to the house, either adapted from the existing rock slopes or made from concrete.

3.92 Fixed equipment must include a water-distillation plant (the Royal Society have experience with such plants on Aldabra), a wind-driven electricity-generator and storage batteries, and radio-communication equipment.

3.93 The establishment and maintenance of such a base would require guaranteed boat transport. This could be done in one of the following ways:

(a) By cooperation with the Fisheries Department or the Marine authorities.

(b) By contract with a boat-owner at Grande Baie etc.

(c) By buying a suitable boat, recruiting a crew and establishing a base at Grande Baie.

Probably (a) or (b) would be best initially; (c) might be advisable when a National Parks and Wildlife Service is a going concern.

3.94 The cooperation of the Forestry Service should be sought to provide plants (seedlings) of the palms and other woody plants known or believed to have grown on Round Island. Seed or other planting material of rocky-shore plants can be obtained from the other northern islands, but care should be taken not to introduce non-indigenous plants or animals.

3.95 It is not possible to lay down guide-lines for anti-erosion work. It will be best to decide after on-the-spot assessment and when the supply of labour, funds and materials are better known.

3.96 It is not possible to lay down guide-lines for biological monitoring. Mr Vinson's long experience of the island will be invaluable in assessing the significance of seasonal and diurnal cycles. The studies which have already been made on the island and the results of the Edinburgh University 1975 Expedition will be valuable in defining a base-line.

3.97 The objective of publishing the 'Round Island Story' in book form, should be consciously worked towards. It is a microcosm of most of the history, ideals (. and realisation?) of the fight for the preservation of species threatened by man's thoughtless actions.



Flat Island

Round Island

The Northern Islands

INDIAN OCEAN

Baie de l'Arsenal

Port Louis

MAURITIUS

THE BLACK RIVER GORGES

Blue Bay

INDIAN OCEAN

