

Ecologically Sensitive Sites in Africa

Volume III: South-Central Africa and
Indian Ocean

Angola
Burundi
Comoros
Djibouti
Madagascar
Mauritius
Rwanda
Seychelles
Zaire

Compiled by the World Conservation Monitoring Centre

For



The World Bank

WORLD CONSERVATION
MONITORING CENTRE

20 MAY 1995

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Volume III: South-Central Africa and Indian Ocean

Compiled by



**World Conservation Monitoring Centre
Cambridge, UK**

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ECOLOGICALLY SENSITIVE SITES IN AFRICA

PREFACE

During the last two decades, there has been growing evidence that environmental degradation in its many forms constitutes a threat of growing significance to economic development. In addition, the rapid evolution of the environmental agenda has led to an increased understanding of the interdependence among economic activities and their environmental consequences, both within and between countries. The economic and physical interdependence between nations is illustrated by the emergence of new kinds of environmental problems, such as the deterioration of the ozone layer, the greenhouse effect, tropical deforestation, and the transboundary movement of hazardous wastes.

The Bank has been active in the field of environmental protection and, in the last decade, has financed numerous projects containing environmental components as well as several free standing environmental projects, which have had solely environmental objectives, such as reforestation, watershed management and pollution control. Through the introduction of new directives on environmental assessment, environmental action plans, forestry policy, the global environmental facility, resettlement, indigenous people and wildlands, the Bank has definitely distinguished itself as a leader in environmental protection.

Despite the above efforts, it became evidently clear that the Bank's response did not match the changing realities in the degree of effort devoted to environmental matters or in the approaches actually used. This combined with a few well publicised cases in which World Bank projects actually had some negative environmental consequences - such as contributing to the destruction of tropical rain forests and posing threats to wildlife populations, indigenous people, and established human settlements, prompted the Bank to rethink and adjust its policies toward environmental management. In its recent reorganisation, the Bank management decided to bring environmental concerns more systematically into the mainstream of its operation by establishing a Vice Presidency on Environmentally Sustainable Development.

This new action reiterates the Bank's commitment to bringing environmental issues into the mainstream of the lending operations and policy work. Partly influenced by global events such as the Rio Summit and from the Bank's own experience in environmental work, there continues to be a general consensus on five priority areas which will require the Bank's special attention and also the attention of its member countries. These include destruction of natural habitats; land degradation; degradation and depletion of fresh water resources; urban, industrial, and agricultural pollution; and degradation of the "global commons". Although these five areas have been addressed in the Bank's operations through various country focused environmental action plans, through coverage of environmental issues in country economic and sector work, and through actual lending operations, there has been expressed concern by task

managers on the availability of environmental information on which to base certain decisions.

This publication is made in response to requests from task managers in the Africa region who wanted to know the location and properties of the ecologically sensitive sites in Africa to which they could refer while implementing Bank projects in the region. This publication is also made to assist task managers to comply with the Bank's Operational Policy Note No. 11.02 on "Wildlands: Their Protection and Management in Economic Development". The publication has been compiled by the World Conservation Monitoring Centre, UK in collaboration with the Africa Environment Division of the Technical Department at the World Bank. It contains the most up-to-date available data and we hope it will find wider application beyond the Bank's operations.

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SECTION I

ECOLOGICALLY SENSITIVE SITES IN AFRICA

A summary of key issues

INTRODUCTION

The challenge facing nations today is no longer deciding whether conservation is a good idea, but rather how it can be implemented in the national interest and within the means available to each country. (WCED, 1987)

In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it. (Principle 4, Rio Declaration on Environment and Development, UNCED 1992)

Environmental concerns are much in the news. Drought, poacher wars and civil strife are evident in many African countries, and a general feeling of malaise affects much of the continent. As a result, the natural and semi-natural ecosystems of Africa are having increasing stresses put upon them, and ecologically sensitive areas are being degraded through mismanagement, rather than conserved through effective management. This has serious implications for human well-being, as a wide range of benefits can result from investment in conserving ecologically sensitive areas. The value of such benefits will vary considerably from area to area and resource to resource, but most will fall into one or other of the following categories:

- ▶ Fixation of solar energy through photosynthesis, transfers energy through green plants into natural food chains, providing the support system for species which are harvested
- ▶ Maintenance of evolutionary processes and genetic variability
- ▶ Maintenance of water cycles, including recharging groundwater, protecting watersheds, and buffering extreme water conditions (such as flood and drought)
- ▶ Regulation of climate, at both macro- and micro-climatic levels (including influences on temperature, precipitation, and air turbulence)
- ▶ Production of soil and protection of soil from erosion, including protecting coastlines from erosion by the sea

Ecologically Sensitive Sites in Africa

- ▶ Storage, cycling and buffering of essential nutrients, including carbon, nitrogen, and oxygen
- ▶ Absorption and breakdown of pollutants, including the decomposition of organic wastes, pesticides, and air and water pollutants
- ▶ Provision of direct support to local communities through sustainable resource use
- ▶ Provision of recreational-aesthetic, socio-cultural, scientific, educational, spiritual, and historical values

Because the benefits of conservation are so important to society, the rate of natural habitat loss (see Table 1) and threats to species in Africa (see Table 2) is a source of great concern throughout the world.

Many development plans fail to recognize that retention of natural systems may constitute the optimal use of certain areas, in economic as well as ecological terms. Instead of conserving the rich resources of forest, wetland, and sea and managing them on a sustainable basis, current processes of development are depleting many biological resources at such a rate that they are rendered essentially non-renewable, thereby potentially reducing the benefits to society in the longer term. Experience has shown that market forces alone will often lead to such over-exploitation, largely because many of the costs are external and simply ignored.

Since biological resources will be inadequately conserved by market forces alone, given current means of assessing costs and benefits, effective government intervention is required to meet the conservation needs of society. Environmental management measures available to governments for promoting conservation include:

- ▶ establishing national parks and other types of protected area
- ▶ promoting citizen awareness and action through public education and supporting non-governmental conservation organizations
- ▶ modifying resource exploitation through legal or administrative means
- ▶ implementing international conservation conventions, particularly the *Convention on Biological Diversity*
- ▶ establishing government departments or ministries responsible for environmental matters
- ▶ implementing special action to conserve threatened species and habitats

Table 1 Original extent of closed canopy moist forest in four regions of Africa, compared with remaining extent as judged from maps and FAO (1988) statistics for 1980.

	Approximate original extent of closed tropical moist forests (sq.km)	Remaining extent of moist forests (sq.km)		Percentage of moist forest remaining	
		From atlas maps* (moist forests)	FAO (1988) data for 1980 (closed broadleaved forest)	From map data	From FAO (1988) data
Occidental and Central Africa	1,777,400	488,973	715,040	28	40
Eastern Africa	658,300	—	77,500	—	12
South Central Africa and Indian Ocean	2,301,936	1,234,419	1,189,890	54	52
West Africa	770,760	101,063	111,300	13	14

* Table adapted from table 10.1 in J.A.Sayer, C.S.Harcourt and N.M.Collins (Eds.) 1992. *The Conservation Atlas of Tropical Forests: Africa*. Macmillan, Basingstoke, Hants, UK. 288pp.

Table 2 Numbers, by country, of endemic and threatened mammals and birds

	Known species	Endemic species	Threatened species	Threatened endemics
Angola	1,148	16	26	4
Benin	818	0	12	0
Botswana	723	0	15	0
Burkina Faso	644	1	11	0
Burundi	740	0	9	0
Cameroon	1,145	21	44	8
CAR	877	2	14	0
Chad	630	0	22	0
Congo	700	1	15	0
Cote d'Ivoire	913	2	27	1
Djibouti	?	0	9	1
Equatorial Guinea	576	4	18	1
Ethiopia	1,091	52	39	16
Gabon	807	3	21	4
Gambia	597	0	8	0
Ghana	943	1	21	0
Guinea	719	1	23	0
Guinea-Bissau	484	0	7	0
Kenya	1,376	17	35	7
Lesotho	321	0	9	0
Liberia	783	3	28	1
Libya	156	4	21	0
Madagascar	355	164	81	78
Malawi	825	0	17	0
Mali	784	0	20	0
Mauritania	110	1	19	0
Mozambique	845	2	21	0
Niger	604	0	16	0
Nigeria	1,105	4	35	3
Rwanda	820	0	18	0
Senegal	780	1	16	0
Sierra Leone	761	0	20	0
Somalia	810	19	24	6
Sudan	1,205	7	25	1
Swaziland	428	0	5	0
Tanzania	1,322	25	56	19
Togo	826	1	10	0
Tunisia	251	1	20	0
Uganda	1,304	7	28	3
Zaire	1,501	48	58	19
Zambia	961	3	20	3
Zimbabwe	831	2	15	0

Data from: World Conservation Monitoring Centre 1992. *Global Biodiversity Status of the Earth's Living Resources*. Chapman and Hall. 594pp.

- ▶ building information gathering and monitoring capabilities as the basis for improved resource planning
- ▶ establishing special training programs for government officials
- ▶ promoting integrated rural development schemes which incorporate conservation
- ▶ developing *ex situ* facilities for preserving threatened genetic resources, in support of *in situ* conservation programs

However, conservation actions have been underway in Africa many years, yet natural habitats are still being lost at a rapid rate. Experience has taught the hard lesson that traditional protected areas will be unable to conserve most biological resources by themselves. Additional approaches to conservation are required to more effectively integrate protected areas within the broader processes of land-use planning, and to bring about policy shifts in a wide variety of sectors which have impacts on ecologically sensitive areas.

This has been the message of a number of reports and meetings in recent years, and is clearly stated within the articles of the *Convention on Biological Diversity*.

Article 8 of the *Convention* deals specifically with *in situ* conservation. It calls on contracting parties to:

- ▶ establish a system of protected areas where special measures are needed to conserve biodiversity
- ▶ develop guidelines for the selection, establishment and management of such areas
- ▶ manage biodiversity both within protected areas and in the wider landscape
- ▶ promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species
- ▶ promote environmentally sound and sustainable development in areas adjacent to protected areas
- ▶ restore degraded ecosystems and promote the recovery of threatened species
- ▶ control or eradicate alien species that threaten indigenous biodiversity
- ▶ respect and maintain the knowledge and practices of indigenous and local communities, including the equitable sharing of benefits arising from the utilization of such knowledge and practices

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- ▶ develop appropriate environmental legislation

These measures are all highly pertinent to the identification and conservation of ecologically sensitive areas, and one of the top priorities in promoting sustainable development must be to encourage countries to ratify the convention. The first step in implementation is to undertake a comprehensive national assessment of the status of, and threats to, the country's biodiversity, its utilization and management, the economic benefits it provides and the costs of its effective management. This process includes the identification of ecologically sensitive areas, both within and outside existing protected area systems. The management of these areas to maintain their ecological integrity, and thus to maximise their potential economic benefits, is then prescribed in the national biodiversity strategies and action plans countries are called upon to produce under Article 6 of the Convention.

Particularly important therefore is the development of management programs using a broad systems approach based on an increasingly sophisticated ecological understanding of ecosystem productivity, processes, and dynamics. Integrated rural development can draw on national conservation strategies, river basin development strategies, environmental impact assessment, Geographic Information Systems and other technologies to promote environmentally sound management of large ecosystems containing both natural and transformed habitats. While such programs can make important contributions to conservation of biodiversity, they also contribute indirectly through stabilizing resource use in areas which are not biologically diverse. These activities focus upon maintaining, or restoring, natural ecosystems so that the ecological and hydrological processes which they support are maintained, and the benefits which they provide to human society are made available on a sustainable basis.

By managing these ecosystems sustainably and stabilizing land-use, the root cause of many human population movements can be addressed, with biological diversity being a beneficiary. For example, in many parts of Africa, forests are being lost because of slash and burn agriculture. In most areas, the expansion of this agricultural practice is a consequence of non-sustainable resource use and declining agricultural productivity in other ecosystems which the rural poor have been forced to abandon. By focusing attention on restoring formerly productive agro-ecosystems, and by maintaining the ecological and hydrological processes which maintain the productivity of these systems, agricultural pressure on the marginal lands can be reduced and they can be allocated to activities which are more conducive to the conservation of biological diversity.

It is apparent that mechanisms need to be developed for identifying ecologically sensitive areas in a systematic manner and establishing minimum quality criteria for managing such areas. To enhance its contribution to sustainable development, the World Bank requires guidelines for rapid identification of ecologically sensitive areas, and needs to develop means of promoting special measures that could be incorporated

in project planning and implementation to maintain the ecological integrity of such areas. The aim of this report is to assist in this process.

However, no simple recipe exists for determining how resources should be used. Ecological, social, political, economic, and technological factors all enter into the decision. Each of these factors can change over time, and because the factors are inter-related, a change in one can affect all the others. Therefore, while this discussion will concentrate on ecological factors, it will consider the others as well. In the final analysis, guidelines need to be applied by people exercising their best judgement given the current state of knowledge. The dynamic state of development in the Africa region is likely to continue, and building the capacity to adapt to constant change will require concerted action.

This section of the report is based on material drafted by Jeffrey A. McNeely, Chief Conservation Officer at IUCN - The World Conservation Union. The section was originally drafted in December 1991, and then revised in early 1993 by Robin Pellew and Jeremy Harrison of the World Conservation Monitoring Centre to take account of subsequent developments.

WHAT IS AN ECOLOGICALLY SENSITIVE AREA?

1. Introduction

- 1.1 While many natural habitats are being converted into uses -- such as agriculture, aquaculture, or forestry -- which yield greater productivity to humans (at least in the short term), the natural value of some areas is so significant that they need to be converted with great care, or even left in their natural state. Areas of significant value in their natural state can be termed *Ecologically Sensitive Areas* (ESAs) (see Box 1). They may contain unique features, maintain key natural processes, support rare plants or animals and their habitats, or provide important breeding areas for wildlife. Some ESAs are natural, while others have been significantly altered by certain human activities. In terms of management, some ESAs will prosper through "benign neglect" while others will require intensive management to restore or maintain their natural values.

Box 1: Ecologically Sensitive Areas

Criteria for ecologically sensitive areas would include:

- provide protection of steep slopes, especially in watershed areas, against erosion
- support important natural vegetation on soils of inherently low productivity that would yield little of value to human communities if transformed
- regulate and purify water flow
- provide conditions essential for the perpetuation of species of medicinal and genetic conservation value
- maintain conditions vital for the perpetuation of species that enhance the attractiveness of the landscape or the viability of protected areas
- provide critical habitat that threatened species use for breeding, feeding or staging

Source: McNeely *et al.* 1990

- 1.2 In order to ensure effective management of ecologically sensitive areas, and to avoid inappropriate conversion, it is essential that criteria are developed which can be used to guide decisions on whether an area can be converted freely to alternative uses, can be converted to only certain uses (such as forest production), or should not be converted at all.

- 1.3 A useful scale for seeking an answer is the ecosystem, a community of organisms interacting with the local living and non-living elements of the environment and forming a system in which life-sustaining processes are maintained. The ecosystem involves the accumulation, circulation, and transformation of matter and energy through such biological processes as photosynthesis and decomposition. The processes often work through the means of water, which provides a means of transfer and storage of energy and materials used by living organisms within the ecosystem.
- 1.4 The boundaries of an ecosystem are often identified by changes in vegetation, soil, or landscape form. The scale of the ecosystem depends on the purpose of analysis; a small mountain pond is an ecosystem, and so is the mountain on which it is located. Almost all ecosystems are connected with others of various scales. Protected areas with artificial boundaries may be whole or partial ecosystems, depending on the size of the area and the form of the boundary; a protected area surrounded by forest is a much different ecosystem to a similar one surrounded by agricultural land.
- 1.5 Some ecosystems are relatively robust and resist permanent damage, while others are very sensitive to disturbance and may require long periods to recover from disruption. Grasslands naturally subject to periodic fires, are robust, while mature tropical rain forests may be easily disturbed and require decades or even centuries to recover. Particularly sensitive ecosystems include those which lie on geologically unstable substrata, such as steep slopes subject to landslides, and those which are dependent on influences from outside the system, such as estuaries and deltas. Ecosystems need to be classified according to their sensitivity to certain kinds of treatment by people, and the most useful indicators of sensitivity need to be identified.
- 1.6 People have shown the capacity to convert almost any piece of natural habitat into agricultural land which can produce a crop for at least a few growing seasons. But areas which are inappropriate to such use quickly degrade into wastelands, such as the great expanses of *Imperata* grasslands found in much of tropical Asia; worse, inappropriate conversions of watersheds, such as through illegal logging, can contribute to very high human costs downstream through floods, erosion, siltation, and other external factors.
- 1.7 Logically, an objective survey of all remaining natural habitats should first be conducted to ascertain which have the highest value in their present state, and the least value if transformed. In practical terms, and as a working rule of thumb where complete information is not yet available, it may be best to accept the rationale behind the process of selection of protected areas already followed. This would mean that first priority ESAs should include areas which are already given legal protection (though recognizing that not all areas given legal protection really qualify as an ESA); second priority ESAs should include all

areas which have been proposed for protection; and third priority ESAs should be all other areas where natural habitat remains.

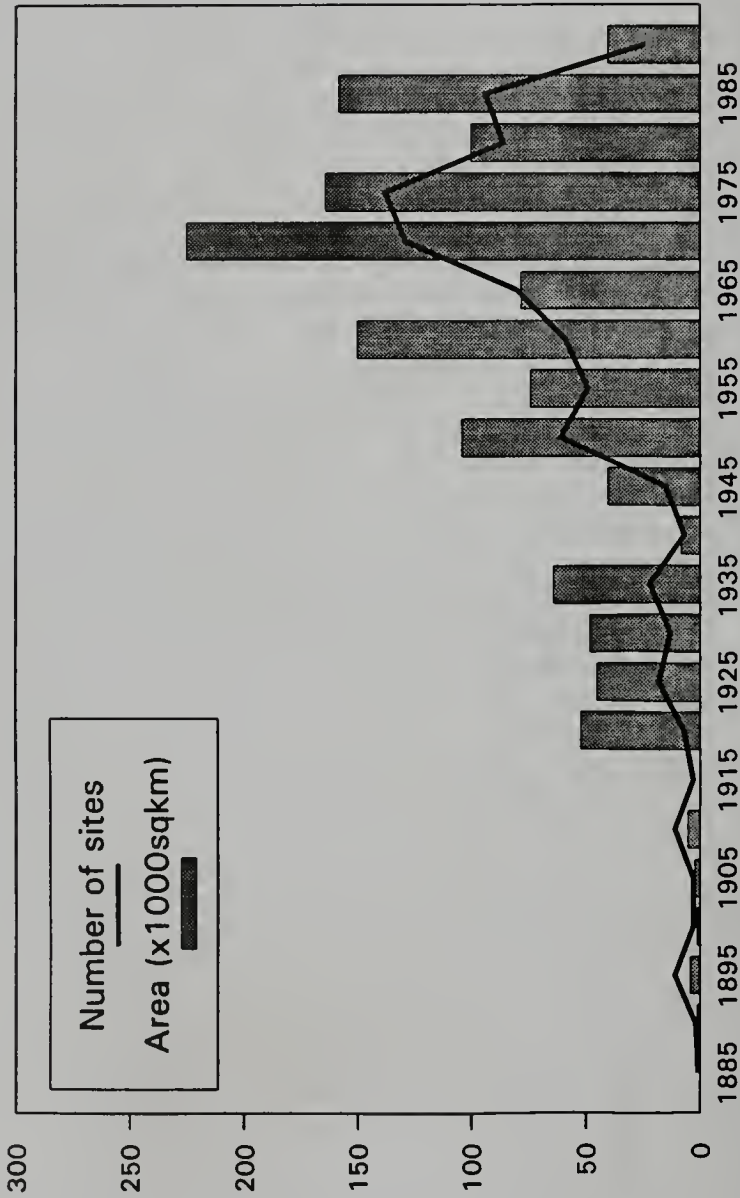
2. Legally protected areas

- 2.1 Areas which have been given legal protection preventing conversion to other uses should be among those not considered for alteration or conversion; their contribution to development is through maintaining their relatively natural state. In fact, the World Bank's policy on wildlands (World Bank, 1986) expressly prohibits the use of IBRD funds to convert legally protected areas to any other uses except under the most stringent and exceptional conditions.

As development has accelerated in the past few decades, the governments in the region have recognized the importance of legally protected areas as part of the overall pattern of land use, though of course the effectiveness of such legal regimes varies widely. Many of these areas have been established in the past 30 years (see Fig. 1), and over that period administration and management of protected area systems has also changed in many countries. WCMC (1992) summarises how each of the national protected area systems is set up in Sub-Saharan Africa, and Lusigi (1992) discusses many of the challenges and issues facing protected areas management in Africa.

- 2.2 However, it would be a mistake to consider that once an area is legally established, then all threats have been removed. In fact, virtually all protected areas in the Africa have an uneasy relationship with the people living around them. The reasons for this are apparent: the local people pay most of the costs of conservation by not being able to harvest resources as they might wish, while the bulk of the benefits go to the nation at large or even to the international community. Governments need to seek additional means of redressing this imbalance, by ensuring that the costs of conservation are shared more widely, and that more of the benefits are delivered to the local communities.
- 2.3 Protected areas within the wildlife sector are often augmented by a range of designated areas established and managed by other sectors (such as forestry or fisheries) with management objectives which support a nature conservation function. The World Conservation Monitoring Centre (WCMC) has carried out research on areas within the forest sector, and is working on a series of reports which will show the extensive nature of their contribution in some countries. Review of the conservation value of some of these areas on the ground may be a valuable next step (the development community is currently funding such a study in Sri Lanka).
- 2.4 In addition to being protected under national legislation, some areas are given further protection under international legislation, notably the *Convention on Wetlands of International Importance* (Ramsar, 1971) and the *Convention*

Fig. 1 Increase in area and number of protected sites in Sub-Saharan Africa 1885-1990



Five year period commencing....

Concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972). The list of areas given such protection expands each year as the States Party add areas to the list. Areas currently given such protection are identified and described in later sections.

- 2.5 While not a convention, the Biosphere Reserve programme of Unesco also has considerable relevance to the region. As part of UNESCO's Man and the Biosphere Programme (MAB), a biosphere reserve is established to conserve representative natural areas throughout the world, and to use these areas to further understanding of the interaction between man and nature. Biosphere reserves ideally take an existing protected area as the core, then incorporating land around the core with varying degrees of human intervention are permitted. Biosphere reserves in Africa are also listed in later sections.

3. Other critical habitats

- 3.1 While many countries in Africa have an impressive record on establishing protected areas, there are many gaps in coverage, with many ESAs of high priority for conservation yet to receive any effective management. The regional systems review carried out by IUCN (IUCN/UNEP, 1986) identifies a number of important sites, as does the action plan for protected areas in Africa (IUCN, 1987) and in the African Biodiversity Review prepared by IUCN (Stuart and Adams, 1990). Many of these unprotected ESAs may in fact deserve higher attention than the existing protected areas, because they are more liable to alteration to inappropriate uses, and a number are identified in the body of this report.
- 3.2 Even if they are not yet protected, habitats can also be considered ecologically sensitive areas if they meet the criteria identified in Box 3. The identification of such ESAs outside of existing protected areas ideally requires considerable research and information, but the pace of development is such that it will inevitably prove necessary to take some relatively arbitrary decisions on the limited information available. In making such decisions, use should be made of all available information, including both national and international reviews.
- 3.3 Threatened species are of particular concern to both governments and the general public. Many such species are protected under national legislation, and in addition many African countries are members of international conventions which provide protection to threatened species. It is widely accepted that the best way to conserve species is through protecting their habitats while simultaneously controlling exploitation. Critical habitats of threatened species are particularly important ESAs.
- 3.4 Potential ESAs can also be identified from digitized data on the distribution of key species using a Geographic Information System (GIS). By overlaying such

distribution data onto habitat maps, sites of particular species richness can be identified. These should then be priority areas for ground surveys. The application of information technology in this way enables proactive conservation planning to maintain the ecological integrity of such areas before they are disturbed by unsustainable management practices.

- 3.5 Information on the status and distribution of both habitats and species is central to the study of biodiversity conservation within a country, and a key part of both protected area systems reviews and the development of the national biodiversity strategies necessary for implementation of the *Convention on Biological Diversity*. Information is often widely distributed, and effort is required to bring the information together, and to develop research and monitoring programs to support biodiversity conservation. A range of international organizations, including UNEP and WCMC are in a position to support such activities.

4. Areas to be rehabilitated

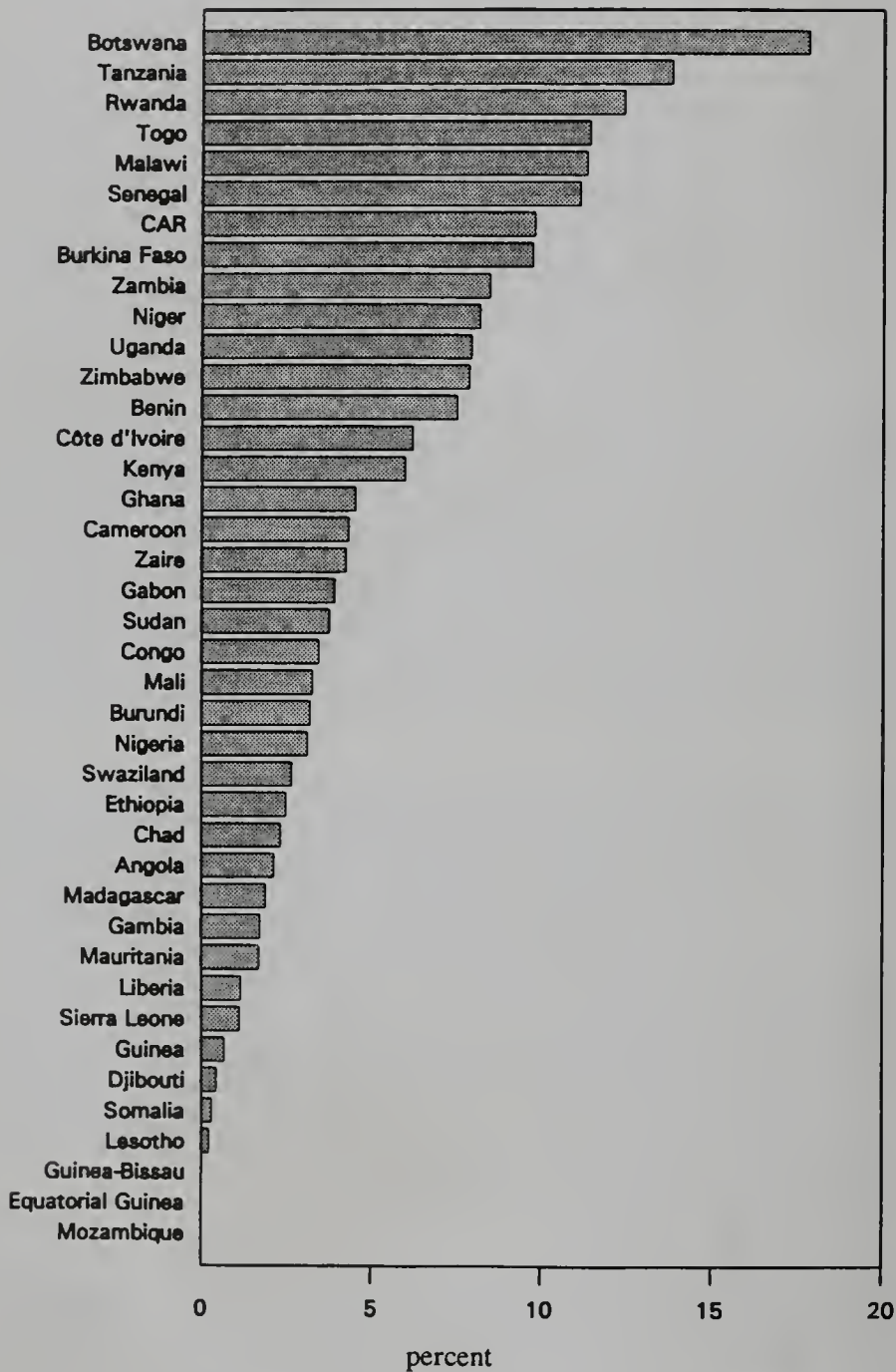
- 4.1 Many ESAs have already been over-exploited, with resulting degradation. These areas need to be rehabilitated so that they can once again make important contributions to sustainable development. Since tropical forests often grow on soils which are poor in cations or suffer from other deficiencies, attempts at agriculture are often followed rather quickly by abandoned fields and degraded vegetation. As a result, large areas of Africa are covered by devastated landscapes which are productive only for grazing at a very low stocking density. With proper economic incentives, such areas can be made productive again, either for agriculture, forestry, or conservation of biological diversity.
- 4.2 It may be more expensive in the short run to reconstitute damaged ecosystems than to conserve new lands (and is certainly more expensive to reconstitute damaged ecosystems than it is to exploit new ones), but it will often be as economically efficient in the long run to rebuild degraded local ecosystems rather than to exploit (and degrade, requiring rebuilding) other more remote land, which may itself be sensitive to degradation.
- 4.3 Given the right circumstances it is also possible to develop ecologically sensitive areas from lands which previously had no particular value, through careful development of new habitats. This may have economic as well as ecological benefits.

CONCEPTUAL FRAMEWORK FOR DESIGNATION AND CLASSIFICATION OF ENVIRONMENTALLY SENSITIVE AREAS

1. Introduction

- 1.1 Conservation of biological resources has become an important item on every country's development agenda. Conservation in the modern sense is part of development. As defined by the *World Conservation Strategy*, it means: "The management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. Thus conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration, and enhancement of the natural environment" (IUCN, 1980).
- 1.2 Conservation of biological resources is not a new idea. Farmers have always had the sense to avoid eating the seeds for growing next year's crop, to select the seeds which have the most favourable characteristics, and to plant a wide variety of crops. Herders don't slaughter their breeding stock, and they select the individuals for breeding which are the easiest to manage, have the most meat, or display other desirable traits. For most of human history, the natural world has been protected from the most disruptive human influences by cultural/ecological factors such as taboos preventing over-exploitation, tribal warfare which kept wide areas as wilderness "buffer zones" between groups, land ownership by ancestors or lineages rather than individuals, relatively sparse human populations, and so on.
- 1.3 But during the last few generations, economic growth based on the conversion of fossil fuels has spurred such rapid expansion of human numbers that new approaches to conservation are required. One such approach has been the establishment within the past 100 years of explicit government policies aimed at ensuring that wild living resources are conserved, usually through the designation of particular ecologically sensitive areas as national parks or other sorts of protected areas. Today, all but a small handful of countries have national parks and national legislation promoting conservation (see Fig. 2). Most governments have established wildlife management agencies, joined international conservation conventions, and built environmental considerations into the national education system. Non-governmental organizations are active throughout the region in promoting public awareness of conservation issues, including those dealing with biological diversity.
- 1.4 The conservation movement has been led by naturalists. While their contributions have been fundamental, they are unable to address fully the basic problems of conservation because the limiting factors are not biological, but rather political, economic, and social. The decisions affecting the natural

Fig.2 Percentage of each country within protected area system
(source: WCMC)



environment are influenced by pressures and incentives that go far beyond the relatively straight-forward technical considerations of what might in theory be best for the ecologically sensitive areas, and consider in addition questions of social equity, political possibility, and technical feasibility.

- 1.5 Advice on delivering conservation action needs to be sought from development practitioners, engineers, politicians, rural sociologists, agronomists, and economists. In the last analysis, local resource users are the ones who make local-level decisions, and their decisions are affected above all by enlightened self-interest. Those seeking to conserve ESAs need to be able to identify legitimate self-interests of rural people, and design ways of ensuring that the interests of ESAs and community self-interest coincide. Development aid agencies, including the Bank, therefore have an important role to play.
- 1.6 It has become apparent that a sectoral approach to managing ESAs is unlikely to be successful, even in the short run. While government institutions responsible for wildlife and protected areas need strengthening, even the most successful conservation programs will fail unless they are supported by appropriate developments in other sectors. Progress in sustainable approaches to forestry, agriculture, rural development, international trade, energy, population, national security, and other areas are so essential to the success of efforts to conserve ESAs that they deserve as much attention as the traditional conservation-related sectors.
- 1.7 The need for a broad based multi-sectoral approach to conservation is clearly identified in both the *Global Biodiversity Strategy* (IUCN/UNEP/WRI, 1992) and the *Convention on Biological Diversity*. Under the convention, countries will be required to prepare national biodiversity strategies and action plans, and to report on their implementation. These plans will need to focus on biodiversity outside the confines of protected areas, and address the fundamental requirements of reconciling the pressures of human development with conservation of ESAs in the wider landscape.
2. **Criteria for designating and managing Environmentally Sensitive Areas**
 - 2.1 In planning a system to protect ESAs for supporting national development goals, criteria for selection and management are essential. Criteria will enable a relatively systematic comparison of different sites; help communicate to decision-makers why certain areas or policy initiatives are important; help focus research on the most important questions; promote the drawing of boundaries for the ESA by specifying the features which need special management; and facilitate public information programs.
 - 2.2 In seeking to identify which sorts of protective regimes are most appropriate for each major ESA (including, but not limited to, designation as a protected area),

local social, political, and economic factors need to be considered along with the ecological ones. The following set of criteria are presented in rough descending order of importance, though modifications will be required for adapting to each particular situation. Each criterion is presented as an ideal against which each site can be considered. No site can be expected to meet the ideal, but the criteria can provide a basis for comparing sites against each other. In some cases, it may be appropriate for planning purposes to assign numerical scores to the various criteria, with relatively higher scores being assigned to the first four criteria.

a) Criteria which determine the importance of the site to human society

Economic benefit. The site provides obvious long-term economic benefits, such as watershed protection or tourism (even though their initial establishment might involve short-term economic disruptions).

Diversity. The site has a great variety of species and ecosystems, and is sufficiently large to contain viable populations of most species; it contains a variety of geomorphological features, soils, water regimes, and microhabitats.

Critical habitat, international. The site is essential to the survival of one or more threatened species which occurs in no other country, contains the only example of certain types of ecosystems, or contains landscapes of outstanding universal value.

Critical habitat, national. The site is essential to the survival of one or more species which are threatened nationally or internationally, or contains the nation's only example of certain types of ecosystems. The ecological functioning of the area is vital to the healthy maintenance of a natural system beyond its boundaries (such as habitat for migratory species, an important catchment area for lowland irrigation systems, protection of the coast against typhoons, etc.).

Cultural diversity. The site supports populations of indigenous people who have developed mechanisms for living in a sustainable balance with the natural ecosystems, and whose continued presence in the ESA would help ensure that the diversity of the area is maintained.

Urgency. Action is required quickly at the site in order to avert an immediate threat (though it should be realized that this is often a "damage control" action; it is usually best to protect far in advance of threat).

b) Criteria to determine additional elements which enhance the value of the site

Demonstration. The site demonstrates the benefits, values, or methods of protection, and can show how to resolve conflicts between natural resource values and human activities.

Representativeness. The site is representative of a habitat type, ecological process, biological community, physiographic feature, or other natural characteristic.

Tourism. The site lends itself to forms of tourism compatible with the aims of conservation; this criterion is often related to those of economic benefit and social acceptance.

Landscape. The site has features of outstanding natural beauty; these are usually also unique, easily destroyed, and attractive to tourists and any alteration would significantly reduce the area's amenity value.

Recreation. The site provides local communities with opportunities to use, enjoy, and learn about their natural environment.

Inventory and Monitoring. The site can serve as a non-manipulated area against which to measure changes occurring elsewhere; it can form the basis for assessing any ecological change. It can also serve as the site for detailed inventory of biodiversity to provide a baseline for long-term monitoring. Research has been carried out over a long period in the site, and major field studies have been carried out to provide a strong foundation on which new research can build. The site represents ecological characteristics of regional value so research can yield arguments that can have impacts far beyond the protected area.

Awareness. Education and training within the site can contribute knowledge and appreciation of regional values. The site can serve to exemplify techniques or scientific methods, making it particularly important for education purposes.

c) Criteria to help determine the management feasibility of a site

Social acceptance. The site is already protected by local people; or official protection by the government (particularly against outside exploitation) would be welcomed.

Opportunism. Existing conditions or actions at the site lend themselves to further action (such as the extension of an existing protected area or establishment of a buffer zone around an existing park).

Availability. The site can be acquired easily, through inter-departmental

transfer, easements, or other legal forms of control.

Convenience. The site is accessible to researchers or students for scientific and educational uses.

3. An expanded approach to protecting ecologically sensitive areas

- 3.1 The best-known method of managing ESAs is through national parks, but many other types of reserves can also make contributions to both conservation and development, providing a range of management "tools" (Box 2). Ten years ago, the leading professionals in the field of national parks management, meeting in Bali, Indonesia, asserted that while national parks must be as carefully protected as ever, they must be supplemented by a range of other categories of protected areas in order to fully meet the social and economic development needs of modern society.
- 3.2 In the Bali Declaration (in McNeely and Miller, 1984), these authorities pointed out that protected areas are an indispensable element of conservation because they maintain those essential ecological processes that depend on natural ecosystems; they preserve the diversity of species and the generic variation within them, thereby preventing irreversible damage to our natural heritage; they maintain the productive capacities of ecosystems and safeguard habitats critical for the sustainable use of species; they provide opportunities for scientific research, education, training, recreation, and tourism; and they provide opportunities for the sustainable use of their natural resources for the benefit of local communities.
- 3.3 Since 1970, the world's networks of protected areas have expanded in extent by more than 80 per cent, around two-thirds of which are in the Third World (IUCN, 1990). The IUCN review of the protected areas of Africa suggested that the total expanse of protected areas in Africa needs to be increased at least three times, if the protected areas are to be effective in delivering nature's benefits to people. But given the pressures on the land today, these additional protected areas will need to be of a new type, far more flexible in their management than the traditional national parks. They may in fact merit a new term such as "Sustainably Managed Areas", or "Managed Resource Protected Areas".
- 3.4 New approaches to linking protected areas to surrounding lands are required if the appropriate benefits are to flow to society. While the specifics will vary from case to case, the major generalization is that local support for protected areas must be increased through such measures as education, revenue sharing, participation in decisions, complementary development schemes adjacent to the protected area, and, where compatible with the protected area's objectives, access to resources. In short, economic incentives should be used to encourage people to behave according to their own enlightened interest, and sound

Box 2: Categories and management objectives of protected areas

While all protected areas control human occupancy or use of resources to some extent, there is wide variation in the degree of such control. Different protected areas are established for different purposes, and therefore have different management objectives. The following categories, which were first defined by IUCN in 1978, are currently under review. As a result of this review, it is likely that categories VI-VIII will be removed, and replaced with a new category VI - "Sustainably Managed Area" or "Managed Resource Protected Area".

- I Scientific reserve/strict nature reserve. To protect nature and maintain natural processes in an undisturbed state in order to have ecologically representative examples of the natural environment available for scientific study, environmental monitoring and education, and for the maintenance of genetic resources in a dynamic and evolutionary state.
- II National park. To protect relatively large natural and scenic areas of national or international significance for scientific, educational, and recreational use, under management by the highest competent authority of a nation.
- III Natural monument/natural landmark. To protect and preserve nationally significant natural features because of their special interest or unique characteristics.
- IV Managed nature reserve/wildlife sanctuary. To ensure the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment when these require specific human manipulation for their perpetuation.
- V Protected landscapes. To maintain nationally significant natural landscapes characteristic of the harmonious interaction of man and land while providing opportunities for public enjoyment through recreation and tourism within the normal life-style and economic activity of these areas.
- VI Resource reserve. To protect the natural resources of the area for future use and prevent or contain development activities that could affect the resource pending the establishment of objectives based on appropriate knowledge and planning.
- VII Natural biotic area/anthropological reserve. To allow the way of life of societies living in harmony with the environment to continue undisturbed by modern technology.
- VIII Multiple-use management area/managed resource area. To provide for the sustained production of water, timber, wildlife, pasture, and outdoor recreation, with the conservation of nature primarily oriented to the support of the economic activities (although specific zones can also be designed within these areas to achieve specific conservation objectives).

Adapted from: IUCN (1990)

government policies should be designed to ensure that conservation is indeed in their self-interest. Such approaches were extensively discussed at the IV World Congress on National Parks and Protected Areas, held in Caracas, Venezuela,

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in 1992, and the Caracas Action Plan (IUCN, 1992) calls for new and innovative programs of integrated planning and cooperative management.

- 3.5 Another theme of the World Parks Congress held in Caracas, 1992, was the contribution made by other sectors. Strictly protected areas are unlikely to ever cover more than about five percent of Africa. Since permanent agriculture seldom covers more than a quarter of a nation's land area, ample land exists for forestry, shifting cultivation, grazing, and other uses which may, with proper management, contribute to conservation of biological diversity.
- 3.6 By themselves protected areas will never be able to conserve all, or even most, of the species, genetic resources, and ecological processes they were established to protect; these areas are just too small to support viable populations of wildlife if the areas are isolated from the surrounding lands. Far greater expanses are required for conservation than modern societies can afford to remove from direct production. The best answer to this dilemma is to select and manage protected areas to support the overall fabric of social and economic development, not as islands of anti-development, but rather as critical elements of regionally envisioned harmonious landscapes. Through a planned mix of national parks and other categories of ESAs, amidst productive forests, agriculture, and grazing, conservation can serve human communities and safeguard the well-being of future generations of people living in balance with their local ecosystems.
- 3.7 Improvements in conservation over the coming decades will be of three main types:
- ▶ the establishment and improved management of categories of protected areas where some kinds of human use are tolerated or even encouraged
 - ▶ the establishment of new types of protected areas in degraded landscapes which have been restored to productive use for conservation
 - ▶ management regimes in non-protected areas which bring sustainable benefits from harvesting biological resources to local communities

and will be founded on a rapidly improving information base to support management decisions.

DEVELOPING GUIDELINES ON THE RELATIONSHIP BETWEEN VARIOUS TYPES OF BANK PROJECTS AND ECOLOGICALLY SENSITIVE AREAS

While many development projects have led to the abuse of ESAs, in fact a positive relationship between development projects and ESAs would be of benefit to both the project and the ESA. A series of guidelines can be developed for each major type of development project which would illustrate how the project can contribute to the viability of the ESA. The following examples indicate the sorts of guidelines which might be appropriate.

1. Water resources development projects

- 1.1 Natural vegetation cover on water catchments regulates and stabilizes water run-off. Deep penetration by tree roots or other vegetation makes the soil more permeable to rainwater so that run-off is slower and more uniform than on cleared land. As a consequence, streams in forested regions continue to flow in dry weather and floods are minimized in rainy weather. Water resources development projects -- dams, irrigation systems, urban water supply, and others -- depend on watershed protection to such an extent that many valuable reserves in these ESAs have been established by drawing support from the development projects involved; irrigation and energy agencies can therefore make powerful potential allies for protected areas which protect watersheds.
- 1.2 In many cases, the total costs of establishing and managing reserves which protect catchment areas can be met and justified as part of the hydrological investment. Guidelines should be developed to specify how the potential positive relationship between watershed protection and water resources development projects can be converted into reality.
- 1.3 One of the objectives of water resources development projects should be improved integration in the management of such resources. Guiding principles of integrated river basin management (Dugan, 1990) include:
 - a) The hydrological balance of the basin should be quantified, including measures of both water quantity and quality, and incorporating surface, underground and coastal waters.
 - b) The values of all the major ecosystems in the basin should be identified, as well as the full range of biophysical processes upon which they depend.
 - c) The products and services taken from each part of the system should be inventoried and the minimum requirements for the sustenance of these

features determined.

- d) The short and long term impact on the environment of planned changes to the system should be determined, and appropriate compensatory measures should be implemented as required.

1.4 The establishment and management of protected areas in coastal and marine ESAs is still in its infancy, with most such areas being merely an extension seaward of existing terrestrial protected areas. Many critical habitats in the coastal zone need protection so that they can provide services to mankind on a continuous basis; these services include support for fish breeding, shoreline protection, and sustainable harvesting of construction materials.

1.5 Virtually all wetland habitats are important for fisheries, but of particular relevance are inland floodplains which are often affected by development projects. Dams, irrigation systems, and other measures affect both inland and coastal wetlands important for fisheries, and alternative means of managing these systems need to be developed, along with guidelines to assessment of potential impacts on both environmental and socio-economic grounds.

2. Tourism development projects

2.1 Natural areas -- mountains, rivers, wetlands, forests, savannas, coral reefs, deserts, beaches -- are major attractions for tourists. Tourism can bring numerous socio-economic benefits to a country, in terms of creating local employment, stimulating local economies, generating foreign exchange, stimulating improvements to local transportation infrastructure, and creating recreational facilities. Positive effects on the environment often derive from these socio-economic benefits. Such positive effects may include:

- ▶ encouraging productive use for conservation objectives of lands which are marginal for agriculture, thereby enabling large tracts of land to remain covered in natural vegetation
- ▶ promoting conservation action by convincing government officials and the general public of the importance of natural areas for generating income from tourism
- ▶ increasing awareness amongst local communities of the benefits from conservation, including the economic opportunities it can generate
- ▶ stimulating investments in infrastructure and effective management of natural areas

- 2.2 These benefits can provide incentives for effective management of the natural areas which are tourist destinations, which in turn enhances the quality of the natural resources that attract tourists. Properly planned and managed tourism in natural areas is both non-polluting and renewable, and numerous examples exist where tourism has provided powerful incentives for conserving biological resources.
- 2.3 However, biological resources can also be damaged by inappropriate tourism developments. McNeely and Thorsell (1987) have outlined the positive and negative impacts that tourism can have on such resources and recommend that the guiding principle for tourism development in natural areas should be to manage the natural and human resources so as to maximize visitor enjoyment while minimizing negative impacts of tourism development.
- 2.4 Four general principles are relevant for linking investments in tourism with conservation of ESAs:
- ▶ Planning for tourism development must be integrated with other planning initiatives, particularly in national parks and other natural areas which are potential tourist destinations.
 - ▶ Tourism authorities working with protected area managers should determine the level of visitor use an area can accommodate with high levels of satisfaction for visitors and few negative impacts on the environment (the carrying capacity), and ensure that this level is not exceeded.
 - ▶ For each major tourist destination based on the attractions of biological diversity, a management plan should be developed to specify objectives for both tourism and resource management and to determine how sufficient income from tourism can be provided to the natural area to provide an incentive for improved management.
 - ▶ National policy should require environmental impact assessments (EIA) for all tourism development projects or programs, and specify the ways and means that the tourism development can provide economic benefits to both the local people and the natural areas which are the primary tourist destinations.
- 2.5 In short, tourism and conservation of ESAs can be natural partners, and each can benefit from the other if both are properly managed. Sufficient resources must be devoted to managing the natural areas, but it is often difficult to convince the governments who are responsible for budgets to allocate sufficient funds for this purpose. It is in the interest of both tourism and conservation that governments be so convinced.

3. Agricultural development projects

- 3.1 In addition to the water resource management benefits of ESAs, other positive linkages can also be formed. For example, good soil protection by natural vegetation cover and leaf litter can preserve the productive capacity of the reserve itself, prevent dangerous landslides, safeguard coastlines and riverbanks, and prevent the destruction of coral reefs and freshwater and coastal fisheries by siltation.
- 3.2 Linkages between conservation and agriculture are also important in industrialized countries. Under regulations adopted by the European Community, EC Governments may define certain areas of the farmed countryside as "Ecologically Sensitive Areas." Such areas are important in environmental terms, and their continued environmental protection depends upon the survival of the traditional forms of farming which give rise to their environmental qualities. Within ESAs, farmers are paid grants to encourage them to continue to farm in a traditional way; ESA payments, therefore, can involve limitations on the amount of fertilizer which can be used, restrictions on changes of agricultural land use and controls over the dates at which meadows are cut for hay; they may also include positive payments to encourage practical conservation, such as woodland management or the restoration of archaeological features.
- 3.3 A group of US-based NGOs called the "Committee on Agricultural Sustainability for Developing Countries" (CASDC) has suggested a series of criteria for developing sustainable farming systems. Such systems are required if pressures on marginal agricultural lands are to be reduced, thereby enabling such lands (which are often ESAs) to be devoted to conserving natural ecosystems and the benefits they provide. Sustainable farming systems:
 - a) Maintain and improve soil productivity, quality, and tilth.
 - b) Augment the potential for achieving the highest possible efficiency in the use and conservation of basic farm resources (soil, water, sunlight, energy, and farmers' time).
 - c) Incorporate as much biological interaction as possible, including such processes as mulching, the use of nitrogen-fixing plants, the use of agroforestry techniques, and the use of inter-cropping and crop rotations to control pests and weeds.
 - d) Minimize the use of external inputs which damage the environment and endanger human health (some chemical fertilizers; non-selective pesticides and herbicides; and some forms of energy), maximizing instead the use of available, affordable, renewable, and environmentally benign inputs.

- e) Avoid the contamination of groundwater by using only those fertilizers, pesticides and herbicides that do not penetrate below the plants' growing zone and then only in controlled doses.
- f) Meet the needs of farm families for energy to work their land, cook, and heat from readily available and affordable energy sources.
- g) Meet the needs of farm families for cash income, including from off-farm sources.
- h) Are adaptive, so that even as society evolves and communities change, they will strengthen communal cooperation, protect rural survival systems, through community support and sharing allow farm families to keep going in difficult times (famine, drought, and natural or political disasters), and make possible effective local management of community-controlled common property resources (ponds, woodlots, grazing lands, irrigation systems) in ways that permit equitable sharing of benefits.

3.4 Many of the conventional agricultural, water resources development, and forestry projects of the Bank can contribute to the conservation of ESAs by focusing attention on linkages between the ESA and the surrounding lands. To reduce inappropriate pressures on ESAs, the basic criteria of sustainability must be developed and applied to all kinds of farming systems, from the intensive mono-cropping systems to animal husbandry to agroforestry to the vast numbers of mixed systems used by small farmers throughout the region. Therefore, Bank projects in agriculture need to support work on the continuing evolution of the concepts and practices of sustainability, provide encouragement and incentives for the adoption of sustainable agricultural systems (many of which are discussed in McNeely, 1988), and ensure that farmers receive their fair share of the benefits from conserving ESAs.

4. Linkages with other sectors

4.1 Other types of projects for which such considerations can be developed include livestock development, cottage industries, aqua-culture, land classification and titling, reforestation, rangeland management, and mangrove management. While some guidelines will be common to all types of project, others will be specific to certain sectors (such as aqua-culture, forestry, or livestock development). For each type of project, guidelines should be developed for application in the design and implementation of the project. Such guidelines should not focus simply on mitigation, but be far more positive in linking development with conservation by showing the mutual benefits that can follow from enhanced consideration of how conservation can support development.

MINIMUM QUALITY STANDARDS FOR ECOLOGICALLY SENSITIVE AREAS

1. General considerations

- 1.1 Protected ESAs will succeed in realizing their conservation objectives only to the extent that the areas themselves are effectively managed, and to the extent that the management of the land surrounding them is compatible with the objectives of the protected areas. IUCN has conducted considerable work in this field (see for example Kelleher and Kenchington, 1990; MacKinnon *et al.*, 1985; Oldfield, 1988; Poore, 1992; Poore and Sayer, 1987), which can provide the basis for developing such quality standards. General considerations which need to be incorporated in development projects include:
- a) The acceptance of protection depends on putting a sufficient economic value on natural resources and biological diversity and, often, on demonstrating that such areas bring a positive benefit to the local communities around them. Examples may be provided by the role of ESAs as sources of water and products, their maintenance of regional climatic conditions, and their support for tourism.
 - b) Each ESA, or regional set of ESAs, should have a management plan which establishes the objectives of management, the obstacles to achieving the objectives, the steps required to overcome the obstacles, the resources required, and the costs and benefits of achieving the objectives.
 - c) Management of an ESA and that of the adjacent land must be planned together, since few protected areas are self-contained entities. The establishment of "buffer zones" (better referred to as "zones of influence") in which human activities including uses of natural resources in adjacent land are compatible with the conservation of natural ecosystems within protected areas, are often vital to the integrity of the latter.
 - d) The management context and likely ecological resilience of the area in the face of climatic trends and human pressures need critical review, taking into account the likely trend in human numbers in the area in question.
 - e) Certain "keystone" and critical species will be used as diagnostic indicators of the adequacy of the protected area system, it being assumed that if habitats capable of assuring the survival of viable populations of these are protected, the lesser known species will also be safeguarded.

- f) A conscious relationship needs to be established between *in situ* and *ex situ* approaches to conservation and these methods need to be integrated into over-all regional development; the potential contribution of the general managed landscape to conserving biological diversity should not be under-estimated.
- g) The national infrastructure needs to be so designed as to ensure that the protected area system designed to manage ESAs is properly evaluated as a national asset and that adequate resources are deployed in its management.
- h) The project must gather baseline data on key ecological, economic and social parameters, so that its long-term effects can be monitored.
- i) A major effort is needed to raise public consciousness, enlist the aid of professionals in the field (e.g. in universities, museums and professional networks), and educate local communities about the value of the ESA to the region.

2. Economic factors

- 2.1 Decisions about the identification and management of ESAs, including consideration of alternative land uses, must be based on analysis of costs and benefits, and their distribution. Realizing that change is a constant factor in land use, these economic factors require continual review. It is apparent, then, that economics must be an important foundation of all programs for enhancing the contributions of ESAs to society.
- 2.2 As a basis for applying economic incentives and calculating benefits and costs of various management options for ESAs, governments need to estimate the economic contribution that ESAs make to the national economy. This requires:
 - ▶ ensuring that national accounting systems make explicit the trade-offs and value judgements regarding impacts on biological resources that may not be measured in monetary terms
 - ▶ conducting research on methodologies for assessing the cross-sectoral impacts -- positive and negative -- of resource utilization
 - ▶ collecting information on the physical properties of resources in specific environments and for specific uses
 - ▶ developing methodologies for assigning values to non-marketed biological resources, appropriate to the needs of the country

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- ▶ estimating the economic productivity of various ecosystems, with various types of inputs

2.3 The sustainable levels of production of economic benefits from ESAs -- including goods such as fish, timber, wildlife, and medicinal plants, and services such as supply of clean water, tourism, and recreation -- should be estimated, and demands upon benefits planned within those limits. This should be reflected in the prices of forest products and other biological resources.

2.4 The review and formulation of all national policies which have a direct or indirect bearing upon ESAs and the biological resources they contain must therefore:

- ▶ estimate the relevant benefits which ESAs can produce
- ▶ treat ESAs as reservoirs of capital resources and invest accordingly in preventing the depletion of their productivity
- ▶ ensure that the objectives of sustainable utilization are met
- ▶ address the basic needs of the local people who depend on the ESAs for their continued prosperity

3. National policies for managing ESAs

3.1 The incentives which are required to bring the benefits of ESAs to the community require commensurate policies at the national level. A national or regional conservation strategy can be an effective means of reviewing such policies, and determining what shifts are required to achieve national objectives for conserving the productivity of biological resources. Major policy components of the required integrated action might include the following considerations:

- a) Sufficient data needs to be compiled from a wide range of sources to enable ESAs to be identified objectively, and to help define the most appropriate management regimes for these areas.
- b) The many economic and financial benefits of integrated rural development linked with conservation of ESAs and the biological resources they contain need to be quantified and brought to the attention of policy makers.
- c) Both conflicts and potential for cooperation between the various activities of agriculture, fisheries, forestry, conservation and rehabilitation need to be identified in integrated plans and programs.

- d) Institutional reform and improvement is often a prerequisite to good design and implementation of integrated sectoral development plans and programs.
- e) Legislation consonant with the socio-economic patterns of the target group and the natural resource needs to be formulated, both to institute disincentives and to ensure that incentives carry the power of law.
- f) Policies and legislation in other sectors need to be reviewed for possible application to conservation of biological resources and community involvement in such work.
- g) Effective incentives need to be devised to accelerate integrated development in and around ESAs, aimed at narrowing any gap between what the individual sees as an investment benefit and what the government considers to be in the national interest.
- h) The rural population needs to be involved in the design and follow-up of plans and projects regarding ESAs, not simply their implementation.

- 3.2 Systems of incentives for improving the contribution of ESAs to rural development can be designed in a large number of ways, and numerous options exist for coordinating these incentives with other national policy objectives. In designing systems of incentives, governments should compare several options, with estimated costs and benefits, for each of the various national objectives being addressed. Systems of incentives need to be supported by suitable machinery for implementing the system, including regulation, enforcement, monitoring, and feedback.
- 3.3 All government sectors which depend on the productivity of ESAs should design policies to encourage the sustainable use of these resource systems, possibly as part of the process of preparing a national conservation strategy. In addition, other sectors which have major impacts on ESAs, such as transport, highways, and the military, should ensure that their policies do not unnecessarily deplete biological diversity.
- 3.4 Coordination and control of natural resource use in and around ESAs, in particular to introduce systems of incentives which involve several sectors, may require the creation of new agencies with wide-ranging authority over certain aspects of the operations of implementing ministries within a particular region.
- 3.5 Based on the best available information, governments should establish national objectives for the management of ESAs. Drawing on the latest advances in conservation biology, governments need to state, as a matter of public record, what proportion of the current land and water area is intended to be legally

protected for conserving biological resources. Such policy objectives can often be incorporated as part of a national protected area system plan or a national conservation strategy; on the basis of such national objectives, governments can measure the costs and benefits of implementing conservation programs effectively.

4. Data needs

- 4.1 In order to identify ESAs and to develop informed policies on their management, governments should build the capacity to assess the status, trends, and utility of their biological resources. This capacity should include:
 - a) National compilations of the flora and fauna (at least higher plants and vertebrates) contained within the nation, in addition to the more usual assessment of stocks of timber, fish, and minerals.
 - b) Where these compilations do not yet exist, development projects might require that rapid appraisal methods be employed -- perhaps through the use of indicator species which can provide the optimal return on investment of field time -- to ensure that biological resources are being given an appropriate level of priority.
 - c) Institutionalized biological surveys, perhaps carried out by university departments of biology, to determine what species occur where and in what numbers, and how these parameters change over time.
 - d) A national program for monitoring the status and trends of biological resources, linked to international systems such as UNEP's Global Environmental Monitoring System and the World Conservation Monitoring Centre.
 - e) Regular publication of the available information on status and trends of biological resources, and the various forces which are affecting these trends.
- 4.2 These efforts will help governments to recognize the consequences of their development activities on the biological resources of the nation, and help identify external effects of development projects on biological resources. However, in-depth assessments are time-consuming, and action should not be delayed until "all" the information is available; instead, some rapid initial assessments need to be done. Development assistance agencies may be willing to assist in such efforts.

5. Policies on mitigating measures

- 5.1 ESAs, by definition, make their most important contributions to sustaining society by remaining relatively unaltered by human action; the goods and services they provide depend on natural ecological processes, so any forms of development should be aimed at enhancing rather than reducing their natural productivity.
- 5.2 In cases where objective and competent analysis dictates that public works are required in or near an ESA, environmental impact assessments should be conducted to ensure that the intrusion is made with the minimum detrimental impact on the natural systems in the ESA, and that appropriate mitigating measures are incorporated in the project. An independent decision-making process which has the confidence of the public may be required to ensure that all factors have been given sufficient consideration.
- 5.3 Since public works in or near an ESA can significantly increase the value of the ESA (for example, through maintaining low sedimentation rates in reservoirs), sufficient investments should be made in improving the management of the ESA so that it can make the most productive contribution. This may require measures to share the costs of improved management on a sustained basis.
- 5.4 In some cases, where a development project must intrude on an ESA, equivalent areas may be added to other parts of the ESA, or the value of the ESA lost to the project can be invested in other parts of the national ESA system. In this regard, full consideration should be given toward enhancing investments in ESAs which have been degraded through inappropriate uses.
- 5.5 Any mitigating measures which are proposed should be incorporated in the management plan for the ESA, and contribute to regional land-use objectives.

CONCLUSIONS

The governments of many of the countries of Africa have recognized the importance of Ecologically Sensitive Areas to their development programs, even if they have not used this exact term. However, few nations have been able to invest sufficiently in a systematic approach to designating and managing their ESAs, nor in conducting the economic analysis which would demonstrate the value of such areas to national development.

ESAs are important for social, economic, political, and ethical reasons, and they can make important contributions to sectors ranging from forestry to tourism to rural development. However, many ESAs are being abused rather than nurtured, and a number of general policy changes are required to enable ESAs to be identified, and for the most appropriate management regimes to be implemented.

Each country will have its own particular opportunities and constraints and no set of guidelines or criteria will automatically provide the right answers. Each country will need to design its own approaches to ESAs, and the Bank should stand prepared to provide whatever assistance might be requested.

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OPERATIONAL POLICY NOTE NO. 11.02

**WILDLANDS: THEIR PROTECTION AND MANAGEMENT
IN ECONOMIC DEVELOPMENT**

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1. INTRODUCTION

1. The maintenance of specific natural land and water areas in a state virtually unmodified by human activity, hereafter termed wildland management, is an important subset of the broad environmental concerns addressed in OMS 2.36, "Environmental Aspects of Bank Work". The conversion of wildlands to more intensive land and water uses (through land clearing, inundation, plantations, or other means)¹ continues to meet important development objectives, and is an element of certain World Bank-supported projects. At the same time, wildlands are rapidly diminishing in many Bank member countries. The remaining wildlands can often contribute significantly to economic development, particularly in the longer term, when maintained in their natural state. The Bank's policy therefore is to seek a balance between preserving the environmental values of the world's more important remaining wildlands, and converting some of them to more intensive, shorter term human uses.

2. The Bank already has considerable experience of wildland management in Bank-supported projects. This OPN codifies existing practices and provides operational guidance concerning conservation of wildlands.² For a more detailed discussion of wildland management, see the Bank's Technical Paper: *Wildlands: Their Protection and Management in Economic Development*³ which amplifies each section of this OPN. The Office of Environmental and Scientific Affairs in the Projects Policy Department (PPDES) is available to advise and assist staff on issues of wildland management.

2. JUSTIFICATION

3. There are two principal justifications for wildland management. First, wildlands serve to maintain biological diversity (i.e., the full range of the world's biota).

¹ Conversion here applies to permanent fundamental alteration of the natural ecosystem. Temporary modification by such means as highly selective, long rotation logging usually creates fewer relevant effects.

² Other conservation activities (designed to protect the environment, but not necessarily to preserve biological diversity) are discussed elsewhere, e.g., in the 1978 Forestry Sector Policy Paper.

³ Available from the Office of Environmental and Scientific Affairs.

Second, wildlands provide environmental services important to society. In addition, certain wildlands are essential for maintaining the livelihood of tribal peoples, discussed in OMS 2.34.

2.1 Biological Diversity

4. Wildland management is necessary to prevent the untimely and often irreversible loss of a large proportion of the world's remaining biota, including the more visible plant and animal species. Because their wildland habitats are today rapidly disappearing, a large and growing number of biotic forms face extinction. Appropriate, low-cost wildland management measures can greatly reduce current extinction rates to much lower (perhaps almost "natural") levels, without slowing the pace of economic progress. By preserving the integrity of the biotic community and its plant and animal species, wildlands are important for the replenishment of surrounding degraded or abandoned areas.

5. Preserving biological diversity is important to development because of the economic potential of species that are currently undiscovered, undervalued, or underutilized. Many previously unknown or obscure, and often threatened, species have turned out to have major economic benefits. But less than 20 per cent of the world's plant and animal (largely invertebrate) species have ever been inventoried, and even fewer screened for possible human uses. They therefore present valuable development opportunities if they are not irreversibly destroyed. In addition, there are important scientific, aesthetic, ethical, and practical reasons to avoid or minimize the extinction of the remaining biotic stock. While some species can be conserved *ex situ* (such as in zoos or seed banks), wildland management is the only technically and economically feasible means of preserving most of the world's existing biological diversity.

2.2 Environmental Services

6. In addition to maintaining biological diversity, many wildlands also perform important "environmental services", such as improving water availability for irrigated agriculture, industry, or human consumption; reducing sedimentation of reservoirs, harbors, and irrigation works; minimizing floods, landslides, and coastal erosion (and possibly droughts in some regions); improving water quality; and providing essential habitat for economically important fishery species. Despite their economic value and importance in meeting human needs, such environmental services are not always accorded adequate attention because they are usually public goods that tend to be poorly understood, undervalued, or even overlooked. When environmental services are lost due to wildland elimination, remedial measures are almost always far more expensive than prior maintenance. While many environmental services can also be maintained by establishing more intensive water and/or land use systems (e.g., bio-oxidation sewage treatment, tree plantations), wildland management is frequently more cost-effective.

2.3 Wildlands of Special Concern

7. Wildlands of special concern are areas that are recognized to be exceptionally important in conserving biological diversity or perpetuating environmental services. They can be classified into two types. First are wildlands officially designated as protected areas by governments, sometimes in collaboration with the United Nations or the international scientific community. These are National Parks, Biosphere Reserves, World Heritage Natural Sites, Wetlands of International Importance, areas designated for protected status in national conservation strategies or master plans, and similar "wildland management areas" (WMAs), i.e., areas where wildlands are protected and managed to retain a relatively unmodified state (Annex 1).

8. Second are wildlands as yet unprotected by legislation, but recognized by the national and/or international scientific and conservation communities, often in collaboration with the United Nations, as exceptionally endangered ecosystems, known sites of rare or endangered species, or important wildlife breeding, feeding, or staging areas. These include certain types of wildlands that are threatened throughout much of the world, yet are biologically unique, ecologically fragile, or of special importance for local people and environmental services. Wildlands of special concern often occur in tropical forests, Mediterranean-type brushlands, mangrove swamps, coastal marshes, estuaries, sea grass beds, coral reefs, small oceanic islands, and certain tropical freshwater lakes and riverine areas. Within the spectrum of tropical forests, lowland moist or wet forests are the most species-rich and often the most vulnerable. Wildlands of special concern also occur in certain geographical regions (Annex 2) that have been reduced to comparatively small patches and continue to undergo rapid attrition. As a result, these regions harbor some of the most threatened species in the world.

3. THE BANK'S INVOLVEMENT TO DATE

3.1 Existing Record

9. During the last 15 years, the World Bank Group⁴ has assisted with financing of upwards of 40 projects with significant wildland management components. Most of them have involved establishment or strengthening of WMAs. Bank-supported

⁴ Includes the International Development Association (IDA) and the International Finance Corporation (IFC)

WMAs include national parks, nature reserves, wildlife sanctuaries, and those forest reserves managed primarily for their watershed or biological values, rather than for wood harvest. Other wildland management components of Bank projects have involved management of wildlife and the humans that utilize it, including anti-poaching measures, management of water flows from reservoirs to maintain wildlife habitat, and relocation of certain species. In still other cases, the location of projects has been changed to avoid important wildland areas.

10. Wildland management components have two principal objectives: first, to prevent, minimize, or partially compensate for wildland elimination, thereby conserving biological diversity; second, to preserve or improve the environmental services provided by wildlands, thereby enhancing the project's economic or social benefits. Most Bank-supported projects emphasize one or the other objective, however some Bank projects have wildland components seeking both objectives.⁵

11. Costs of wildland management components in Bank projects have typically been low. They have normally accounted for less than three per cent of total project costs, and in half of the cases for less than one per cent. In many instances, it is difficult to separate out the cost of the wildland component because of its integration with other components.

12. In one case, wildland management was the sole objective, so accounts for 100 per cent of project costs. At the other extreme, a large number of Bank projects have achieved significant wildland management objectives at zero additional cost. For example, manipulation of a hydroelectric project's water release schedule costs little or nothing, even though it provides major downstream benefits for wildlife, as well as for people and cattle.

⁵ For example, the establishment of the Dumoga-Bone National Park in the Indonesia Irrigation XV project helps ensure a more reliable water supply while reducing sedimentation of valuable irrigation works; at the same time, it helps ensure that a significant portion of the project area remains in its natural state, despite surrounding developments.

13. Wildland management components require additional Bank staff time and can increase project complexity, but they have rarely caused significant delays at any stage of the project cycle. Moreover, the failure to incorporate adequate wildland components can result in much greater delays and complexity later on. Furthermore, the failure to incorporate adequate wildland components can substantially reduce project benefits and might result in project failure. As wildland management components within Bank-supported projects become more routine, the additional staff effort required to manage them successfully is expected to decrease further.

14. The Bank's track record in implementing wildland management components is encouraging. According to project completion reports or environmental post-audits, implementation of only three out of 43 wildland components has been markedly slower than for most other project components. In at least four cases, the wildland component has been implemented with less difficulty than other project components.

3.2 Lessons Learned

15. A number of important lessons have emerged from the Bank's experience with wildland management to date. First, wildland management components should be routinely and systematically incorporated into certain types of Bank projects (outlined in Section 4.1). Up to now, this has not always been done, and some projects which would have benefitted from wildland components have not included them.

16. Second, wildland components should be incorporated as early as possible within the project cycle (Annex 3) to minimize costs and facilitate implementation. While inclusion of wildland components in later stages of the project cycle may at times be necessary because of unforeseen circumstances, it is more effective and less costly to incorporate them as early as possible in the project cycle.

17. Third, meeting wildland management goals requires effective management "on the ground", not simply on paper. Colonists and resource extractive companies have rapidly moved into such "paper parks" (parks existing only on a legal document or map, rather than on the ground) unless they were inaccessible for other reasons. The wildland management objectives have to be translated into specific measures with a budget for their implementation. These measures include hiring and training of personnel, provision of necessary infrastructure and equipment, development of a scientifically sound management plan for each particular wildland, and a policy environment - legal, economic and institutional - which supports the wildland preservation objective. The mere declaration of intent to protect wildlands or wildlife, or even the designation of WMAs on a map, does not ensure effective management unless specific supporting measures are implemented.

18. Fourth, the multiple objectives of wildland management are most successfully attained if the WMA is carefully designed. For example, a WMA cannot preserve biological and genetic diversity, evolutionary processes, and environmental services

if it is too small. While some Bank-supported WMAs clearly appear sufficiently large to accomplish most or all of their objectives, others are so small that their ability to conserve biological diversity or provide environmental services or other benefits is questionable. Besides size, the specific location and shape of a WMA can be important factors in determining its success. Appropriate WMA design features are best determined for each case by a conservation specialist.

19. Finally, the success of a WMA, as of other project components, is contingent upon government commitment. This, in turn, often depends upon the degree of financial support provided by the Bank. Most of the Bank-supported wildland components have provided some direct support to establishing or strengthening WMAs. However, in some cases, the costs of the WMA establishment were assumed entirely by the Government, and the Bank took no specific measures to ensure the continued availability of such financing. By taking measures to ensure counterpart financing, or by providing the financing itself, the Bank can help ensure the availability of the relatively modest sums necessary for WMA establishment and continuation.

20. Financial support is usually not sufficient, however. It is often also necessary to maintain dialogue with governments, affected local people, and environmental advocates about the importance of conservation and the benefits of WMAs (tourism, watershed protection, etc.) and to include local people in the planning and benefits. Government commitment to the WMA is fostered by such dialogue, by supervision, by monitoring of national legal provisions, and by loan conditionality. In addition, two complementary and parallel activities contribute to WMA success: (1) rural development investments that provide farmers and villagers in the vicinity of the WMA an alternative to further encroachment, and (2) coherent national and sectoral planning and policies that promote wildland conservation.

4. POLICY GUIDANCE

21. The Bank's general policy regarding wildlands is to seek to avoid their elimination and rather to assist in their preservation. Specifically, (1) the Bank normally declines to finance projects involving conversion of wildlands of special concern (as defined in Section 2.3), even if this conversion occurred prior to the Bank being invited to consider financing. (2) When wildlands other than those of special concern may become involved, the Bank prefers to site projects on lands already converted (e.g., logged over, abandoned, degraded, or already cultivated areas) sometime in the past, rather than in anticipation of a Bank project. Deviations from this policy must be explicitly justified. (3) Where development of wildlands is justified, then less valuable wildlands should be converted rather than more valuable ones. (4) When significant conversion (e.g., 100 sq. kms., or a significant proportion of the remaining wildland area of a specific ecosystem, if smaller) of wildlands is justified, the loss should be compensated by inclusion of wildland management

components (see Section 4.2 below) in the project concerned, rather than in some future project. This component should directly support preservation of an ecologically similar area.⁶ This policy pertains to any project in which the Bank is involved, irrespective of whether the Bank is financing the project component that affects wildlands.

22. The success of projects that do not eliminate any wildland often depends on the environmental services provided by wildlands. In such cases, the Bank's policy is to include a project component to conserve the relevant wildland in a WMA, rather than leaving its preservation to chance. In areas without remaining wildlands, alternative conservation measures may be needed to provide similar project benefits. In other cases, where the wildlands do not directly benefit or serve the objectives of the project, the project may be improved by supporting management of wildlands to provide socio-economic benefits in the general project area (see paragraph 6). Projects with wildland management as the sole objective should also be encouraged.

4.1 Types of Projects Needing Wildland Management Components

23. Based upon these criteria, projects with the following aspects should normally contain wildland components:

- a. **Agriculture and livestock projects** involving: wildland clearing, wetland elimination,⁷ wildland inundation for irrigation storage reservoirs; watershed protection for irrigation; displacement of wildlife by fences or domestic livestock; **fishery projects** involving: elimination of important fish nursery, breeding, or feeding sites; overfishing or introduction of ecologically risky

⁶ The policy in the 1978 Forestry Sector Policy Paper states ".... in countries where there are no adequate natural resource conservation programs, the Bank will not support projects that might result in disintegration of a habitat not elsewhere represented in the country and not under suitable protection (as in national parks and wildlife reserves)."

⁷ Wetlands (such as ponds, marshes, swamps, flood plain forests, estuaries, mangroves) can be eliminated inadvertently through water diversions upstream or deliberately through drainage, diking, or filling.

exotic species within aquatic wildlands; **forestry projects** involving: access roads, clear-felling or other intensive logging of wildlands, wildland elimination.⁸

- b. **Transportation projects** involving: construction of highways, rural roads, railways, or canals which penetrate wildlands, thus easing access and facilitating spontaneous settlement; channelization of rivers for fluvial navigation; dredging and filling of coastal wetlands for ports projects.
- c. **Hydro projects** involving: large-scale water development, including reservoir, power, and water diversion schemes; inundation or other major transformation of aquatic or terrestrial wildlands; watershed protection for enhanced power output; construction of power transmission corridors.⁹
- d. **Industry projects** involving: chemical and thermal pollution which may damage wildlands¹⁰; wildland loss from large-scale mining; wildland conversion for industrial fuels or feedstocks.

4.2 Types of Wildland Management Components

24. The most effective type of wildland management component is support for the conservation of ecologically similar wildlands in one or more WMAs.¹¹ In cases where a WMA already exists in the same type of ecosystem that is to be converted by a Bank-supported project, it may be preferable, for administrative or biological conservation¹² reasons, to enlarge the existing WMA, rather than to establish a new one. The government's wildland agencies, local university wildlife departments, and various international organizations can often advise in such judgements.

⁸ Plantations of fast-growing tree species are often an important complement to more direct wildland management activities by reducing the economic pressures for cutting the remaining forest wildland. They should be sited preferentially on already deforested land. Reforestation and land rehabilitation are covered in the 1978 Forestry Sector Policy Paper.

⁹ & ¹⁰ Industrial pollution control is discussed in the Bank's Environmental Guidelines available from PPDES.

¹¹ See Section 5 for technical guidance on establishing a WMA.

¹² Biological conservation is usually more effective in one large WMA than in several small ones comprising the same total size and encompassing the same types of natural habitats.

25. A wildland management component could also involve the creation of wildlife habitat, in addition to or rather than preservation of already existing habitat. For example, marginal land on the fringes of irrigation projects could be converted to wildlife reserves by taking advantage of the water supply created by the projects. Natural depressions or seasonal swamps could be exploited by diverting water from the canal systems (probably a very small part of the total supply). Such reserves attract significant numbers of migratory and residential waterfowl with minimal additional project costs and land.¹³

26. A useful option is to improve the quality of management of existing WMAs. Many WMAs in Bank member countries receive insufficient on-the-ground management, due to lack of adequately paid staff, training, staff housing, other infrastructure, equipment, spare parts, fuel, or a well-developed management plan through which efficient resource allocation decisions can be made. Small components can often help correct these deficiencies. In countries where effective management is clearly lacking, it is generally preferable to improve the management of existing WMAs than to create new units "on paper", thereby further over-extending the limited capabilities of the responsible agencies. Whenever a new WMA is established as a project component, provisions are needed to ensure effective management. Since many wildland agencies (e.g., departments of national parks or wildlife) are not as operationally effective as necessary, institutional strengthening (particularly support for training) should be an important element of Bank-supported wildland management components.

27. The establishment or strengthening of WMAs is particularly effective when the Government includes these wildland areas in a national conservation or land use plan. A growing number of Bank member governments have undertaken some type of systematic land use planning for wildland management. Such planning can take various forms, ranging from "master plans" for a system of national parks and other WMAs, to "National Conservation Strategies" which address wildland management as only one component of a broad range of natural resource planning concerns, and in which policy intervention such as economic incentives are used to influence resource utilization. Bank assistance with such planning efforts greatly strengthens wildland management at the national level. When member governments agree to develop appropriate land use plans, it is important for the Bank to refrain from supporting projects which involve eliminating wildlands and run counter to these plans.

¹³ The Wildfowl Trust, Slimbridge, England, has set up such reserves on 5-8 sq. km.

28. In those relatively few Borrower countries in which wildland elimination pressures are still minor,¹⁴ the requirement of a compensatory wildland component can be interpreted more flexibly to involve measures other than the establishment or strengthening of one or more WMAs. Such alternative options include careful project siting to avoid converting the more environmentally sensitive wildlands, support for research on and management of particularly sensitive species, support for land use planning efforts, or institutional strengthening of the government's wildland management agency, and training in ecology, biological conservation, and wildland management.

5. DESIGN OF WILDLAND MANAGEMENT AREAS

5.1 Design Considerations

29. WMA design features include size, shape and siting. Because an optimal design may vary greatly in different ecosystems, it is best determined in each case by a conservation specialist.

30. The size of a compensatory WMA should be sufficient to maintain the biological diversity or other important values present in the area to be converted. A WMA which is large enough to encompass a viable population of the largest local predator (e.g., eagle, tiger), or the seasonal territories and migration routes of the largest local herbivore, will most likely preserve all other pertinent ecological values. These objectives would most likely be achieved in a WMA larger than 1,000 sq. kms. Many values are conserved in moist forest WMAs of 500 sq. kms, although possibly not all in perpetuity. Interim WMAs of less than 100 sq. kms can be useful short-term expedients for subsequent expansion into surrounding degraded areas. In general, the larger the WMA, the greater the number of ecological interdependencies and gene pools that will be preserved. Both are necessary to a healthy and self-perpetuating ecosystem. It is recognized that conflicting pressures for more intensive land use often make the establishment of large WMAs difficult. In any case, compensatory WMAs should be no smaller than the wildland area converted by the project.

¹⁴ Wildland elimination pressure may still be minor because of low human population densities and growth rates, little economic demand for agricultural land, timber, or other resources, or because a substantial proportion of each remaining wildland ecosystem in a country has been set aside in WMAs which receive good on-the-ground protection and have strong policy support from the Government.

31. The optimal shape of a WMA will depend upon its objectives. A more circular shape may preserve more biological diversity than other shapes of the same area. Shape is also determined by the location of centres of endemism and other wildlife resources. Boundaries are more effective when they coincide with natural surficial features, such as a river or watershed.

32. To ensure that the compensatory WMA is ecologically similar to the area to be converted, it is obviously necessary to site the WMA in the same ecosystem as the area to be converted. Moreover, siting the WMA some distance away from the converted area (separated by a managed buffer zone for example) helps reduce pressures for encroachment upon the WMA from people living in the converted area.

5.2 Management Categories

33. A variety of different use related categories can be used in establishing WMAs. The choice of category depends upon the particular objectives being accorded priority for management. The categories listed in Annex 1 indicate the variety of WMAs appropriate under different circumstances.

5.3 Personnel and Training Needs

34. The need for well-trained personnel in the proper management of WMAs cannot be overemphasized. Without adequate numbers of such trained people, WMAs cannot effectively serve their intended national or societal functions. Bank-supported wildland project components should therefore provide for staffing levels and training activities that ensure competent management of WMAs. The appropriate number and types of WMA personnel depend upon the category of WMA, its size, and its intensity of management. The minimum adequate permanent staff size for a "modest to average" WMA is usually about eight.

5.4 Equipment, Infrastructure, and Budgetary Needs

35. Designation of WMAs on a map in no way ensures that they will be managed to provide their greatest possible benefits to society. Effective on-the-ground management requires a variety of physical inputs. In Bank-supported WMAs, efforts should be made to ensure that these inputs are provided as a project component in adequate supply and on a timely basis. Annex 4 contains a basic checklist of the physical inputs that are typically needed for effective WMA management. Some types of WMAs will require a variety of additional inputs, according to specific management objectives.

36. The budgetary requirements for establishing and operating WMAs will vary according to size and the amounts of needed infrastructure, equipment, and personnel. The comparatively large (3,200 sq. kms.) Dumoga-Bone National Park, financed by the Indonesia Irrigation XV Project, cost roughly US\$ 1 million for establishment and

initial operating costs; most smaller WMAs can be expected to cost considerably less.

37. In some instances, establishment or enlargement of WMAs may require additional funds for purchasing land from private or tribal owners. It may at times also be necessary to resettle and compensate people living within the boundaries of a newly-established WMA.¹⁵ Usually, however, WMAs are established on wholly government-owned properties on which people have not settled.

38. The largest recurrent cost of WMAs is usually staff **salaries**. It is important to maintain salaries at levels that encourage high productivity and a degree of permanence, and discourage corruption.¹⁶ **Spare parts** for machinery, while usually a relatively small budget item, are also a vital recurrent expenditure. Without a reliable supply of spare parts for often remote WMA areas, necessary equipment will often lie idle or may become cannibalized to provide spare parts. In some cases, salaries, spare parts, fuel, and other recurrent costs can be fully or partly met by fees collected from tourists, persons engaged in some form of harvesting, or scientific researchers.¹⁷ Otherwise, small annual outlays from the national or other government budget will be needed.

¹⁵ See OMS 2.33 for guidelines regarding involuntary resettlement and OMS 2.34 for guidelines regarding tribal people in Bank-financed projects. In many cases, indigenous hunter-gatherer societies are as much a part of the "natural" environment as the wildlife, and can safely remain in the park as caretakers as long as traditional ways of life are continued.

¹⁶ High productivity also depends upon these important components: 1) environmental education for an understanding of the importance of the WMA; 2) pride in the WMA and the role of those who protect and support it; and 3) self-interest through some direct accrual of benefits of the WMA (aesthetic, recreational, moral, etc., as well as economic).

¹⁷ The proportion of recurrent costs that can be recovered in this manner varies greatly in different WMAs, from 0 to 100 per cent.

5.5 Management Plans

39. Wildland management areas typically need well-developed management plans to ensure efficient allocation of the scarce financial and skilled human resources devoted to their management. A management plan is a written document which guides and controls the use of the resources of a WMA and directs the design of subsequent programs of management and development. A thorough management plan will:

- (a) Describe the physical, biological, social, and cultural features of the WMA within a national, regional, and local context;
- (b) Identify those items of particular concern from which the objectives for managing specific areas of the WMA are derived;
- (c) Describe appropriate uses of the entire WMA through zoning; and
- (d) List in chronological order the activities to be carried out to realize the proposed management programmes.

40. Preparation and implementation of management plans are carried out by the government wildland agency. Project staff should ensure that Bank-supported WMAs either have adequate management plans or will develop them early in the project. Some parts of a management plan can be completed in a few days, while others may take years to refine. While a longer-term management plan is being developed as soon as possible after loan signing, an "interim management plan" or "operational plan" may be used. PPDES can be of assistance in these matters.

5.6 Legal Considerations

41. The success of a WMA may depend upon how its design fits into an overall national legal framework concerning natural resources management in general and wildland management in particular. To maintain their legitimacy in the eyes of policy-makers and local populations, WMAs must have a firm legal foundation. National legislation, sometimes accompanied by a specific Presidential designation, is often needed to establish a WMA. Depending upon the particular situation, such legislation needs to establish precise WMA boundaries; specific management zones within the WMA, including buffer zones; a central management authority (at the national or sub-national level) with unambiguous responsibilities; and a mechanism to channel local participation in WMA management decisions. Bank staff should ensure that Bank-supported WMAs are established and managed within a compatible legal and policy context.

June 2, 1986

ANNEX I

Categories of Wildland Management¹⁸

1 **Scientific or Strict Nature Reserves** represent the most restrictive WMA category, intended to maintain representative samples of natural ecosystems in an undisturbed state for scientific research, environmental monitoring, education, and preservation of biological diversity. Tourism, recreation, and most other human uses are usually not permitted.

2 **National Parks** are usually relatively large areas where native plant and animal species (and often outstanding geological or other scenic features) are of special interest. Controlled tourism and scientific research are permitted; more intensive human uses usually are not.

3 **Natural Monuments** are often smaller WMAs intended to protect highly localized species, ecosystems, or geological formations. Tourism and scientific research are permitted to the extent that they are compatible with preservation of the unique natural features.

4 **Managed Nature Reserves or Wildlife Sanctuaries** protect rare plant or animal species, or large concentrations of resident or migratory wildlife. Manipulation of vegetation and other intensive management may be done to improve the habitat for species of special concern. Tourism, research, and occasionally limited livestock grazing or fuelwood collection are permitted, when these activities are compatible with wildlife management objectives.

5 **Tribal Peoples Reserves** are relatively unmodified natural areas in which indigenous tribal peoples or vulnerable ethnic minorities (see OMS 2.34) continue to practice traditional, low-intensity forms of land use such as hunting and gathering or nomadic pastoralism. Settlement or potentially disruptive resource utilization by outsiders is not permitted.

6 **Protected Landscapes** are areas which have often been significantly modified by people, but which still contain important wildland resources. Traditional land uses, including fishing, grazing, and some agriculture, are often permitted to accommodate the needs and interests of local populations. Land use control is often at the local government level.

¹⁸ Recognizing that different countries use different names for various types of WMAs, the standardized system of WMA nomenclature developed by the International Union for Conservation of Nature and Natural Resources (IUCN) is used here to facilitate comparisons and reduce confusion.

7 **Resource Reserves** are "interim" WMAs. They are typically fairly extensive areas which are not yet heavily settled, but which may be under relatively recent pressure for colonization, timber or mineral extraction, or other intensive uses. This WMA category is designed to restrict such uses until a land use plan or other management guide is issued to channel further development in an environmentally suitable manner.

8 **Multiple Use Management Areas** are intended to allow sustainable production of such economic goods as water for downstream uses; timber (obtained through low-intensity logging); fuelwood; wild fruits, herbs, gums, or other plant products; wildlife; fish; grazing; and outdoor recreation. Included in this category are most "forest reserves" and "protection forests," including those established largely for watershed catchment protection. Within these WMAs, management is primarily oriented to the sustaining of these economic activities, although special zones may also be designated within these areas to achieve more specific conservation objectives, such as preservation of biological diversity. These WMAs are generally large and capable of sustaining these types of economic activities without degradation or elimination of the wildland resource. Generally, these wildland areas do not possess nationally unique or exceptional natural features.

ANNEX II

Some Tropical Wildlands of Special Concern¹⁹

Eastern Africa

- 1 Madagascar: significant proportions of the northern and eastern moist forests.
- 2 Ethiopia: much of the remaining highland forest.
- 3 Tanzania: Usambara, Pare, and Uluguru Mountains.
- 4 Rwanda: mountain forests along the Zaïre and Uganda borders.
- 5 Kenya: Kakamega, Nandi, and Arabuko-Sokoke forests.

Western Africa

- 6 Cameroon: particularly Cameroon Mountain and the moist forested area extending into Gabon, and to the vicinity of the Cross River in southeastern Nigeria, including the Oban Hills.
- 7 Ivory Coast: southwestern forests (including the Taï forest), and adjacent parts of Liberia and Sierra Leone.

East Asia and Pacific

- 8 The Malay Peninsular (including parts of Thailand): Lowland forests, especially along the northwestern and eastern coasts.
- 9 Indonesia: much of the remaining lowland forests of Kalimantan, Sumatra, Sulawesi (especially the two southern peninsulas), and many smaller islands (e.g., Siberut).
- 10 Philippines: much lowland forest on all larger islands.

South Asia

- 11 Sri Lanka: the coastal hills of the southwest and the Sinharaja forest of the "wet zone."
- 12 India: most of the forests remaining on the Western Ghats.
- 13 Burma: the untouched teak forests in the northern regions.

Latin America and Caribbean

- 14 Ecuador: lowland coastal forest
- 15 Mexico: Lacandon forest in Chiapas.
- 16 Honduras-Nicaragua border: Mosquitia forest.
- 17 Panama: Darien province.
- 18 Colombia: the Choco region adjacent to Darien province.
- 19 Brazil: coastal forests of the "Cocoa Region" in the southeastern extension of Bahia between the coast and 41°30'W longitude, and between 13° and 18°15'S latitude, and an outlier near Linhares, Espiritu Santo.
- 20 Brazil: parts of the eastern and southern Amazon region.

¹⁹ This list is by no means to be interpreted as comprehensive.

Tropical Aquatic Areas

- 1 Amazon River and associated wetlands (including varzea forests) (Brazil, Peru, Colombia, Ecuador, and Bolivia.)
- 2 Orinoco River and Delta (Venezuela and Colombia).
- 3 Purari River (Papua New Guinea).
- 4 Musi River (Sumatra, Indonesia).
- 5 Lake Malawi (Malawi), and other Rift Valley Lakes.
- 6 Lake Toba (Sumatra, Indonesia).
- 7 Sudd Swamp (Sudan).
- 8 Pantanal Swamp (Mato Grosso, Brazil).
- 9 Lake Atitlan (Guatemala).

ANNEX III

The Project Cycle

Responsibility for implementing wildland management projects or components rests primarily with regional operations staff, with advice and operational support provided by PPDES, as detailed for all environmental work in OMS 2.36. At *identification*, projects being considered are reviewed by regional staff in conjunction with PPDES to identify, as early as possible, the need to avoid converting a wildland tract or to preserve such a tract as part of the project. To determine whether a proposed project will develop or be in close proximity to environmentally important wildlands, Bank staff can consult those government agencies with jurisdiction over wildland management authority. PPDES maintains contacts with such agencies and will assist upon request. Additional sources of information on ecologically important wildlands are computerized data bases maintained by some non-governmental organizations (NGOs) and several published directories, available from PPDES. In this manner, it will often be possible to learn quickly whether a proposed project site contains existing or proposed WMAs; known endangered species; major wildlife or fish breeding, feeding, or staging areas; important watershed catchments; or living resources of major importance to local people. If none of these mechanisms reveal the existence of ecologically important wildlands in the project area, a brief pre-project field survey is necessary since many important wildlands are not yet identified. This field survey should be undertaken by relevant specialists from the government's environmental ministry, wildlife agency, national university, or similar institution. This brief survey indicates the nature and extent of impacts on critical wildlands that would result from the implementation of the project and puts the information in a national context. The results should be recorded on the form provided in Annex 5.

During *preparation*, project staff (or their consultants) may assist the Borrower or project sponsor in carrying out the necessary environmental studies, including those pertaining to wildlands. PPDES can recommend consultants or other experts who can identify important wildland areas, carry out necessary field surveys, or help design appropriate wildland management project components. At the completion of any necessary studies, the Project Brief (see OMS 2.13) should highlight whether the project involves the conversion or disintegration of a relatively unmodified ecosystem and include alternative suggestions for achieving the goals of the government. If conversion is justified, the Brief should outline why, together with the wildland management components needed.

As part of *appraisal*, project staff assess the planned wildland management and other environmental measures, as specified by OMS 2.20. The Staff Appraisal Report specifically describes any planned wildland management measures, including budgets and agency responsibilities. While PPDES is available for consultation and assistance at any stage of the project cycle, it is also responsible for reviewing projects at the Yellow Cover stage (see OMS 2.00). In addition to the Staff Appraisal Report, the

Ecologically Sensitive Sites in Africa

President's Report (see OMS 3.02) also notes any significant environmental -- including wildland management -- issues and mitigatory measures. Once wildland measures are identified as necessary, timely action should be ensured by conditionality such as loan effectiveness of disbursement. Since wildland management must be done in perpetuity to be effective, the loan agreement should specify long-term measures which the Borrower has agreed to implement.

Supervision missions should routinely review implementation of the wildland component with the Borrower. Such aspects are handled as for environmental issues in general (see OMS 2.36). Implementation of important wildland components should, as a general principle, be well underway before a project's major land clearing or construction works are allowed to proceed.

ANNEX IV

Physical Inputs Required in Most Wildland Management Areas

- a. Headquarters building and guard posts at entry points.
- b. Staff housing
- c. Visitor information center, including educational and interpretive exhibits where appropriate.
- d. Research facilities, including laboratory and housing for scientists.
- e. Roads and trails (amount will vary according to intensity of management desired).
- f. Fencing and signs, adequate to ensure proper demarcation and to control access.
- g. Communications, internal and external to the WMA: radio, walkie-talkies, mail, and telephone (where appropriate).
- h. Electricity, gas, or other energy systems.
- i. Sewage and waste systems.
- j. Four-wheel drive, motor bikes, or other vehicles.
- k. Boats, outboard motors, and docking facilities, where needed.
- l. Appropriate tools, maintenance equipment, and *spare parts*.
- m. Fuel.
- n. Management-oriented publications: maps, species lists, pamphlets for visitors, etc.

ANNEX V

Wildland Survey and Management Form²⁰
(Sample only)

Name of Project:

Expected Appraisal (or other) Date:

Date of this Survey:

Surveyor:

Affiliation:

Methodology(ies) (circle one):

Site inspection/Library research/Both/Other(specify)

- 1 Specific subcategory(ies) of ecosystem that proposed project will affect: (e.g., tropical semi-evergreen moist forest, salt-marsh, wet savanna)
- 2 Important environmental and biological features of ecosystem(s): (e.g., water catchment area for large agricultural valley and habitat for the endangered mountain gorilla)
- 3 Projected general impact type on ecosystem(s) of proposed project: (e.g., deforestation, flooding, draining)
- 4 Proportion (%) of the region's remaining ecosystem(s) (as in #1 above) to be converted (and/or impacted, if different): (e.g., this project will flood about 10% of this country's remaining lowland riparian swamp forest.)
- 5 Estimated annual rates of attrition of affected ecosystem(s) in this country and historical trend of this rate: e.g., The current annual rate of attrition of (semi-montane forest) is 3% a year. This rate was 0.5% in 1975 and 1% in 1980.)

Maps and more complete reports used or available can be appended or cited.

²⁰ This type of information is expected as part of identification, and can be used for the project brief. This form can be completed by the government's environmental ministry or wildlife agency, or by the project pre-feasibility team's wildlands specialist.

SECTION II

SOUTH-CENTRAL AFRICA AND INDIAN OCEAN

Angola, Burundi, Comoros, Djibouti, Madagascar, Mauritius, Rwanda,
Seychelles, Zaïre

ANNOTATED LIST OF SITES

Within each country, sites are divided into four subsections, according to the degree of protection they appear to enjoy.

INTERNATIONALLY DESIGNATED PROTECTED AREAS These are the World Heritage sites, Biosphere Reserves and Ramsar sites within each country.

NATIONALLY PROTECTED AREAS Excluding those in the above section, these include all nationally designated protected areas having objectives which qualify them for IUCN Management Categories I-VII (see below).

OTHER MANAGED AREAS In this section are other designated sites which have a nature conservation function (including forest reserves and other IUCN Management Category VIII sites), as well as some well managed private reserves.

UNPROTECTED SITES This section includes sites where there is no officially recognised protection status. Three types of site are included: proposed protected areas, where implementation is either being studied or is under way; recommended sites, where protection has been recommended by an individual or group but where implementation is yet to be initiated; and other sensitive sites which have been recognised as valuable wildlands.

In some countries, the political situation may have caused management to lapse, and in these and other cases information on the current status of the site can be hard to obtain. The annotated list is based on the information available.

The protected areas information shown on the maps for each chapter have been classified by management authority; i.e the forestry sector, wildlife sector or additional sector (e.g. Presidential reserve). Information concerning the location of all numbered sites was not available. Hence some sites numbered on the lists do not appear on the maps.

This list has been prepared as a desk study, and is based on available information. It should be taken as a guide rather than a definitive study.

Information Sources

The World Conservation Monitoring Centre gathers, analyzes and disseminates information on the status, security and management of the Earth's biological diversity as a service to the international community. The information presented in this publication has been drawn from WCMC's databases and geographical files which have been developed in collaboration with numerous national and international sources. These data, which have been gathered over a number of years, are held within tabular databases, paper files and geographic information systems (GIS) at the Centre. WCMC relies on its own and its sponsors' worldwide network of contacts, as well as published and unpublished literature, to provide accurate information and an efficient service to its users.

The protected areas listings in the country chapters have been downloaded from the WCMC Protected Areas Database which contains over 32,000 records. The WCMC maintains these data in collaboration with the IUCN Commission on National Parks and Protected Areas, the UNESCO Man and the Biosphere Programme, the World Heritage Convention and others. This desk study has concentrated heavily on these data and on the extensive conservation library held at WCMC.

Much of the information WCMC holds has a spatial element and since 1989 WCMC has been operating a GIS. A substantial amount of data on threatened habitats, protected and unprotected sites and other related subjects have now been assembled. The digital spatial data run in parallel with the supporting structured data, and the locational or boundary information shown on the maps within the country chapters are updated as new data are acquired. The spatial data are maintained within the Centre's GIS in ARC/INFO format and are available to all parties concerned with environmental conservation, via the WCMC *Biodiversity Map Library* (BML). The BML has been designed and implemented to enhance the Centre's information service providing a method for maintaining the environmental data in a structured and easily accessible manner. The information shown on the maps in this book are stored in the BML.

The following text was originally drafted in December 1991 by James Culverwell and Hilary Tye, and updated in 1993 by James Culverwell and Harriet Gillett. Maps were prepared by Mary Edwards. Final copy was prepared by Harriet Gillett with assistance from Mark Lewis. Secretarial support was provided by Veronica Greenwood, with assistance from Deborah Rothera. Clare Billington and Jerry Harrison were responsible for overall coordination.

ANGOLA

INTERNATIONALLY DESIGNATED PROTECTED AREAS

None

NATIONALLY PROTECTED AREAS

Bikuar National Park

IUCN Category II

This park of 790,000ha is situated on an undulating plateau at an altitude of about 1000m, and is traversed by one perennial and one seasonal river. Much of the area consists of open grassy plains with seasonally waterlogged depressions, but there are also areas of savanna, deciduous woodland, tall forest and a few remaining areas of miombo woodland. The area supports a number of threatened mammals including cheetah, African wild dog, leopard and elephant; the wattled crane (of special concern) also occurs. There are a few human inhabitants within the park, and the tourist infrastructure has been damaged by dissidents. Because of the political situation, wildlife field staff have been restricted to the provincial capital since 1988 (IUCN/UNEP, 1987).

Chimalavera Regional Nature Park

IUCN Category V

This reserve of 10,000ha comprises an arid plain surrounded by mountains. There is no permanent surface water, but subterranean water is pumped to the surface. Vegetation is sparse. The area is inhabited by a variety of animals, including savanna monkey, side-striped jackal, zebra and many springbuck (IUCN/UNEP, 1987).

Ilheu dos Passaros Integral Nature Reserve

IUCN Category IV

The reserve is a tidally inundated 200ha island of mudflats and mangroves off the coast near Luanda. The island is protected mainly due to the large numbers of waterbirds which use it. An increase in recreational activities in the Baia do Mussolo is a threat to the reserve (IUCN/UNEP, 1987).

Iona National Park

IUCN Category VI

An arid coastal area of 1,515,000ha which rises to an elevation of 2040m and includes sand dunes up to 100m high. The vegetation is predominantly sublittoral steppe with shrubs and herbs, merging into desert (Namib). A number of threatened mammals occur, including African wild dog, leopard, cheetah, elephant, black rhinoceros, black-faced impala, Hartmann's mountain zebra, Cape fur seal and manatee. Both green and loggerhead turtles nest along the shore. However, about 200 nomadic pastoralists use the park to graze their cattle and goats; competition between domestic stock and wild animals is aggravated by the lack of water. Diamond prospecting has taken place, and there has been concern over decreased levels of management, owing to the recent political situation (IUCN, 1990; IUCN/UNEP, 1987).

Kameia National Park

IUCN Category VI

Covering 1,445,000ha, this park is an area of extensive plains at an elevation of about 1000m. It is crossed by three major rivers, parts of which are periodically flooded.

The vegetation is predominantly typical of poorly-drained upland grasslands (dambos). The area supports many threatened species, including leopard, cheetah, red lechwe and wattled crane. About 5000 people, primarily fishermen, live within the park. There has been concern over a decrease in management levels owing to the recent political situation (IUCN, 1990; IUCN/UNEP, 1987).

Kangandala National Park

IUCN Category IV

This park of 63,000ha consists of rolling hills, and includes four major perennial rivers and numerous marshy areas. The predominant vegetation types are miombo woodland and savanna. It is particularly important as a sanctuary for giant sable, and other threatened species such as African wild dog and leopard are known to occur; wildlife density however, is very low. Over 2000 people live in villages along the main access road, from where they practise fishing, graze livestock and grow crops. There is a dense network of paths, and poaching occurs. In some areas the *Brachystegia* woodland is being degraded, and the park boundaries are in need of revision; an extension to **Luando Integral Nature Reserve** would link the two populations of sable antelope to form the combined **Giant Sable National Park** (IUCN/UNEP, 1987).

Kisama National Park

IUCN Category V

This coastal park includes 950,000ha of diverse topography, including extensive floodplains and gently undulating hills. Two perennial rivers, both of which flood periodically and along which are numerous lagoons, meander through the park; several permanent lakes exist. Vegetation is varied, including dry forest, savanna, dry thickets, marsh and coastal mangroves. Threatened fauna includes elephant, cheetah, African wild dog, leopard, Cape fur seal, Nile crocodile and manatee; green and loggerhead turtles nest along the coast. About 10,000 people live within the park, and staff numbers and equipment are inadequate to control poaching and illegal activities such as fishing, subsistence farming and grazing of livestock. Much of the grassland has become overgrazed and is now subject to erosion. Human encroachment has been facilitated by tracks made during oil exploration exercises. The aquatic wildlife (particularly waterfowl) and larger animals have been extensively hunted (IUCN/UNEP, 1987).

Luando Integral Nature Reserve

IUCN Category IV

This 828,000ha reserve consists of gently undulating land between two perennial rivers, and includes many lagoons. The vegetation is predominantly miombo woodland and savanna. It is an important sanctuary for giant sable antelope. Other threatened species include African wild dog, leopard, cheetah, red lechwe and wattled crane. About 20,000 people live in several villages within the reserve, where they practise fishing, subsistence cultivation and cattle grazing. Poaching of giant sable occurs. An extension to the **Luando Integral Nature Reserve** would link the two populations of sable antelope to form the combined **Giant Sable National Park**. The northern region is classified as a military operations zone, and rebel factions operate in the south (IUCN/UNEP, 1987).

Mupa National Park

IUCN Category VI

This park includes 660,000ha of undulating country, dissected by rivers and including extensive dambos. Vegetation is primarily deciduous woodland, tall forest and mopane savanna mosaic. The fauna includes threatened species such as African wild dog, leopard, elephant and wattled crane. There has been concern over decreased management levels due to the recent political situation (IUCN, 1990; IUCN/UNEP, 1987).

OTHER MANAGED AREAS**Bufalo Partial Reserve**

This reserve covers 40,000ha of fairly rugged country with a number of rock outcrops. Several perennial rivers cross the area, and woodland and savanna predominates. Buffalo are the most abundant large mammal, and threatened mammals that occur include cheetah, lion, leopard and African wild dog (IUCN/UNEP, 1987).

Luiana Partial Reserve

This reserve, covering an area of 840,000ha, consists of extensive plains drained by two rivers. The main vegetation types are dry deciduous forest, savanna steppe and dry semi-deciduous woodland. Threatened fauna includes cheetah, African wild dog, leopard, elephant, black rhinoceros, red lechwe and wattled crane (IUCN/UNEP, 1987).

Mavinga Partial Reserve

This area of 595,000ha includes extensive undulating plains crossed by four main rivers with marshlands along their courses. The main vegetation types are savanna and dry semi-deciduous woodland. The area supports a number of threatened animals including cheetah, African wild dog, leopard, elephant, black rhinoceros, red lechwe and wattled crane. There has been concern over decreased management levels owing to the recent political situation (IUCN, 1990; IUCN/UNEP, 1987).

Mocamedes Partial Reserve

This arid reserve covering 445,000ha is very close to **Iona National Park**. Topography includes desert dunes, extensive plains and rugged mountain areas. Two intermittent rivers cross the area, and surface water is scarce. Vegetation includes littoral steppe, with small patches of thick forest and savanna. Threatened species which it supports include African wild dog, leopard, elephant, black rhinoceros and Hartmann's mountain zebra. Cattle grazing occurs as part of a transhumance system. There has been concern over decreased management levels due to the recent political situation (IUCN, 1990; IUCN/UNEP, 1987).

UNPROTECTED SITES**Amboim/Gabela Nature Reserve**

Recommended

10°40'S, 14°15'E These are a series of varied small forest patches along the Angolan Escarpment to the north and south of Gabela, the largest of which is Amboim Forest.

Several threatened and near-threatened bird species occur, three of which (Gabela helmet shrike, Gabela akalat and Amboim bush shrike) are near-endemics, whilst further species are restricted to the Angolan Escarpment. The forests are considered to be biologically important because of high levels of endemism (Collar and Stuart, 1988; IUCN, 1987).

Anharas do Alto Nature Reserve

Recommended

13°00'S, 15°00'E (approx.) A new reserve is needed in the provinces of Huambo and Benguela (Stuart *et al.*, 1990).

Bailuudu Highlands - see Huambo/Bailuudo Mountains

Bengo River Delta

8°47'S, 13°82'E Situated in the Bay of Bengo, this is one of the most significant mangrove areas in the country (Hughes and Hughes, 1992).

Cabinda Enclave Lowland Forests

5°00'S, 12°25'E (approx.) Consisting of lowland forest, this is home to the endangered lowland gorilla and chimpanzee. It is threatened by logging and prospecting (IUCN, 1987; Stuart *et al.*, 1990).

Chicamba Mangroves

5°01'S, 12°08'E These are situated in the Chissambe Lagoon in the Cabinda Enclave, west of Chicamba. Well-developed mangroves occur (Hughes and Hughes, 1992).

Cuando-Cabango Contada Controlled Hunting Area

Situated in the south-east of the country, the controlled hunting areas of Luengué, Longa Mavinga, Mucusso and Luiana were established in 1957 and cover 91,500ha. Luiana has been upgraded as the **Luiana Partial Reserve**. The area is primarily *Baikiaea* woodland with extensive drainage-line grasslands and floodplain swamps. Although primarily a semi-arid zone, the drainage systems of the Cubango and Cuando rivers create local moist habitats inhabited by elephant, hippopotamus, sitatunga, red lechwe and buffalo. The drier areas are inhabited by giraffe, sable antelope, impala, tsessebe and wildebeest. Current status of the area is unknown (Huntley, 1974).

Duque de Branganza Forests

8°40'S, 16°17'E (approx.) The area north-east of Duque de Branganza is known to be of ornithological interest, and a number of primate species occur. Little is known of the area.

Giant Sable National Park

Proposed

This would be created by joining **Kangandala National Park** with **Luando Integral Nature Reserve**, forming a large, viable ecosystem, covering most of the existing range of the giant sable. Further habitats requiring protection include floodplain (for

red lechwe), riverine habitat (for hippopotami), and scenic stretches of the Cuanzo and Luando Rivers (IUCN, 1987).

Huambo/Bailuudo Mountains

Recommended

12°28'S, 15°10'E (centred on Mount Moco) These highlands include the recommended **Mount Moco Nature Reserve**, Mount Bandeira (in the south-west) and the Mombolo Plateau. Vegetatively they are mostly grassland, with two patches of deciduous woodland around Mount Moco and Mount Soque and numerous very small forest patches. Swierstra's francolin *Francolinus swierstrai* is endemic to the Angolan scarp, and other rare and threatened species occur. There is limited information on the area, but they are known to be under severe threat due to timber and fuelwood extraction. A managed nature reserve has been recommended (Collar and Stuart, 1988; IUCN, 1987).

Milando Special Reserve

Mount Molo Nature Reserve - see **Huambo/Bailuudo Mountains**

Zaire River Delta

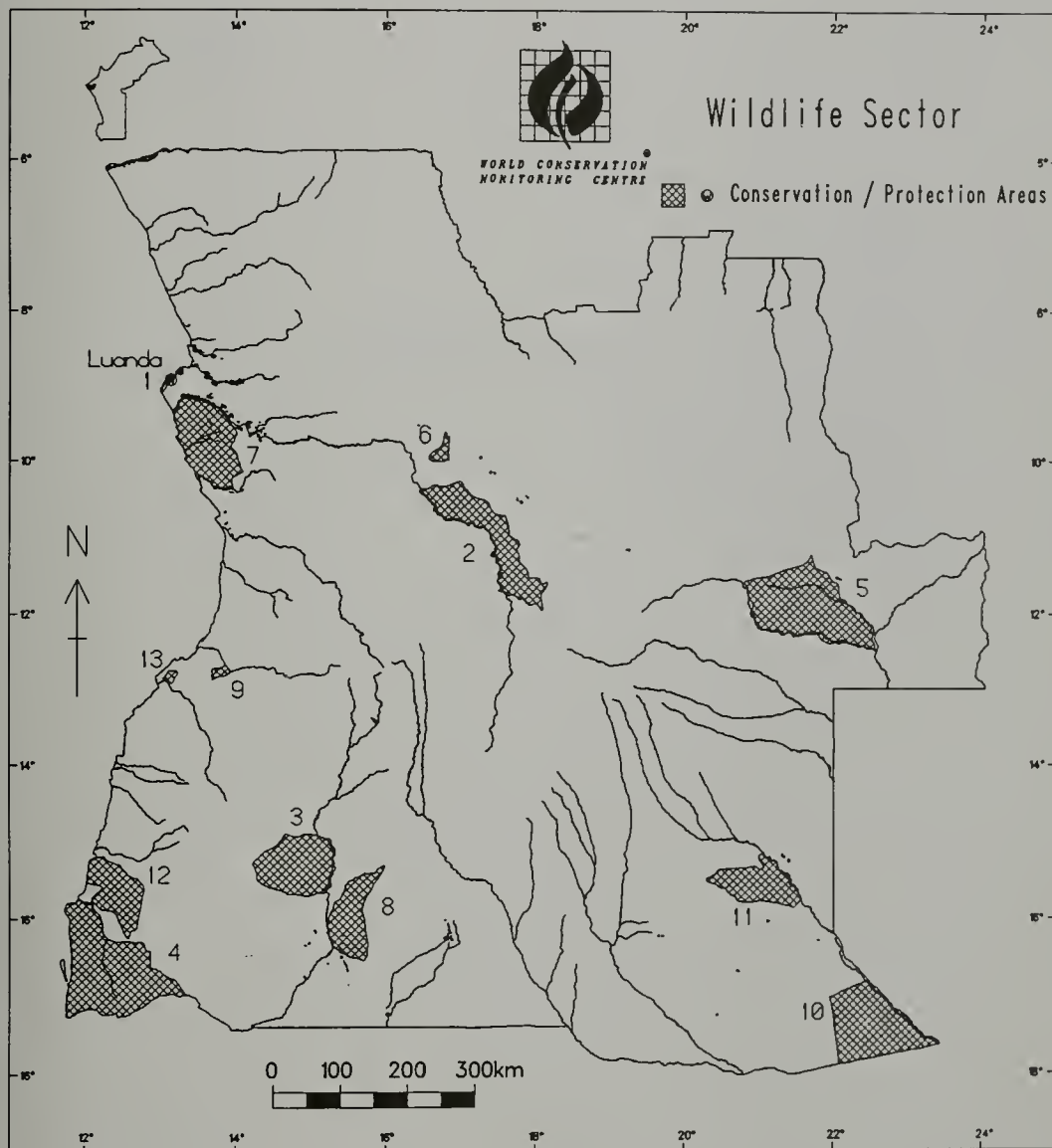
6°00'S, 12°40'E (centre) This area supports mangroves which extend upstream on the south bank as far as Pedra do Feitico. Manatees occur, as do hippopotamus, blue monkey, talapoin and red-capped mangabey (Hughes and Hughes, 1992).

ANGOLA - PROTECTED SITES

National/international designations

Name of area and map reference (see Fig. 1.1)	Management area (ha)	Year notified
Integral Nature Reserves		
1 Ilheu dos Passaros	200	1973
2 Luando	828,000	1955
National Parks		
3 Bikuar	790,000	1964
4 Iona	1,515,000	1964
5 Kameia	1,445,000	1938
6 Kangandala	63,000	1970
7 Kisama	950,000	1957
8 Mupa	660,000	1964
Partial Reserves		
9 Bufalo	40,000	1974
10 Luiana	840,000	1966
11 Mavinga	595,000	1966
12 Mocamedes	445,000	1960
Regional Nature Park		
13 Chimalavera	10,000	1974

Fig 1.1 Angola: protected ecologically sensitive sites



ANGOLA - UNPROTECTED SITES

Name of area and map reference (see Fig. 1.2)	Management area (ha)
1 Amboin/Gabela Nature Reserve	
2 Anharas do Alto Nature Reserve	
3 Bengo River Delta	
4 Cabinda Enclave Lowland Forests	
5 Chicamba Mangroves	
Cuando-Cabango Contada Controlled Hunting Area	91,500
6 Duque de Branganza Forests	
Giant Sable National Park	
7 Huambo/Bailundo Mountains	
Milando Special Reserve	
Mount Molo Nature Reserve	
8 Zaire River Delta	

BURUNDI

INTERNATIONALLY DESIGNATED PROTECTED AREAS

None

NATIONALLY PROTECTED AREAS

Chutes de Karera Natural Monument
15ha

IUCN Category III

Kibira National Park

IUCN Category V

Established in 1980 and covering 40,000ha, this park contains the largest area of montane forest in Burundi and is an important site for primate conservation. It is an essential water catchment area. The proposed **Mont Teza Biosphere Reserve** constitutes the highest area of the park, its 1400ha consisting of uplands ranging from 2100m to the summit of Mont Teza lying on the Nile/Zaire watershed at 2666m. The vegetation consists of open *Ericaceae* and *Proteaceae*-dominated ridges, and brush and low secondary forest with an occasional understorey of bracken *Pteridium aquilinum* in the valley bottoms. The area is notable for its diversity of primate, bird and reptile faunas, including chimpanzee, blue and l'Hoeist's monkeys, red colobus, potto, bushpig, black-fronted and yellow-backed duiker, palm-civet, golden cat, leopard and serval. Less than 100 pairs of the threatened Grauer's swamp warbler *Bradypterus graueri* survive, north of Teza. The area has been subjected to considerable human pressure for many years, and heavy long-term grazing has led to ground cover destruction and erosion in some areas (INCEN, 1985; Stuart *et al.*, 1990; Weber and Vedder 1984; Wilson 1990).

Nyakazu Gorge Natural Monument
20ha

IUCN Category III

Rusizi National Park
- see **Rusizi Plain Biosphere Reserve**

IUCN Category V

Ruvubu National Park

IUCN Category V

This park will cover 43,630ha and include 125km of the Ruvubu River valley, which drains a large area of the country. There are flood meadows, tree savanna and extensive gallery forest, the last acting as a refuge for many animals. It is the most important site in Burundi for large mammals, including many hippopotami and a number of ungulate species, and the area supports large numbers of waterbirds, including white pelican and yellow-billed stork. Most of the 3000 families living in the park have been relocated, although some fishermen remain. Habitat degradation, partly through fire, is considerable in the valley. Controlled hunting is permitted by law, but poaching is a serious threat and has resulted in the extermination of a few species and reductions in many game animals. Prospecting for nickel is occurring in the north-east section and will cause serious disturbance if it is successful (INCEN, 1985).

OTHER MANAGED SITES

Bururi Forest Nature Reserve

IUCN Category VIII

This 3300ha reserve contains some of the finest emergent *Entandophragma excelsum* forest in Africa, as well as vast stretches of *Arundinaria* bamboo. Situated in an area of biogeographical overlap at altitudes between 1900m and 2150m, it supports unusual associations of flora and fauna; 87 bird species, five carnivores, one ungulate and five primate species, including chimpanzee, occur. The threatened Kungwe apalis survives in 10ha of dry montane forest. The area has been heavily grazed by cattle over several decades, resulting in groundcover destruction and erosion. The nearby Massif du Nanzerwa supports some restricted amphibian species (Stuart *et al.*, 1990; Verschuren, 1977; Weber and Vedder, 1984).

Kigwena Nature Reserve

IUCN Category VIII

Established in 1983, this covers 400ha on the shores of **Lake Tanganyika** in Bururi Province, at 780-800m. Trees include *Dracaena steudnesi*, *Newtonia buchananii* and *Pycnanthus angolensis* (Wilson, 1990)

Lac Rwihinda Nature Reserve

IUCN Category VIII

2°32'-2°34'S, 30°03'-30°06'E Covering 9200ha, of which 1200ha is open water and 425ha is protected within the nature reserve, this very beautiful lake is flanked by an extensive belt of permanent swamps on the south-western shore. Low swamp forest, beds of reeds and sedge occur. It is completely surrounded by human settlement (Hughes and Hughes, 1992; Wilson 1990).

Monge Forest Nature Reserve

IUCN Category VIII

2,000ha reserve established in 1990.

UNPROTECTED SITES

Ankanyaru River - see Kanyaru River

Kanyaru River

Large areas of swamp occur along the border with Rwanda, which are deserving of protection (Stuart *et al.*, 1990).

Karuzi Papyrus Swamp

Situated in the centre of the country, these are biologically interesting and currently unprotected. The threatened papyrus yellow warbler *Chloropeta gracilirostris* occurs (Stuart *et al.*, 1990).

Lake Kanzigiri

2°26'-2°29'S, 30°21'-30°23'E Covering a total area of 5200ha, of which 1600ha is open water, this lake is situated 10km south-east of **Lake Rugwero**, from which it is separated by forests. It is fished, and some cultivation takes place (Hughes and Hughes, 1992).

Lake Rugwero

2°21'-2°28'S, 30°16'-30°22'E This unprotected lake, the northern end of which intrudes into Rwanda, has an open water area of 6000ha. The southern and south-western shores are forested, and extensive swamplands abut the western, northern and north-eastern shores. Innumerable floating papyrus islands occur in the lake, which is fished, and there is local cultivation (Hughes and Hughes, 1992).

Lake Tanganyika

About 263,200ha of this 3,290,000ha lake occur in Burundi. Slightly brackish, it is the second deepest lake in the world. Fed by the Rusizi River in the north, it supports an important fish fauna of 193 known species, the majority of which are endemic. There are two species of fully aquatic fish-eating snakes in the lake. Threats to the integrity of the lake include over-fishing, pollution and introduced alien fish species. No part of it is protected apart from a small area (9600ha) included in **Mahale Mountain National Park** in Tanzania (Hughes and Hughes, 1992; Stuart *et al.*, 1990).

Lake Tshohoha South

2°20'-2°32'S, 29°59'-30°10'E About 5000ha of this 7000ha lake are within Burundi. It lies on the floor of a swampy forested basin between two ridges, fringed by papyrus and *Miscanthidium* swamps, with some arborescent swamp forest patches and seasonally inundated *Acacia* savanna (Hughes and Hughes, 1992).

Luvironza/Kayongozi/Ruvubu System

3°00'-3°04'S, 30°32'-30°36'E Extensive permanent papyrus swamps occur in the headwater basin of the Koyongozi. Agriculture is precluded by the denseness of vegetation and water level variations, but once extensive swamp forests have now largely been cleared. The lower parts of this system are within **Ruvubu National Park** (Hughes and Hughes, 1992).

Malagarasi River System

4°00'S, 30°10'E (centre) The Malagarasi river valley is wide and shallow along the southern borders of Burundi, and is covered in savanna; broad gallery forest following the river is usually inundated during the rains. The river is of special interest as it contains several fish species representative of the Zaïre Basin that do not occur in **Lake Tanganyika**. Permanent swampland (about 14,000ha) and bamboo forests occur in the north. This is one of the few areas in Burundi where warthog still survive. There is some hunting and fishing (Hughes and Hughes, 1992; Stuart *et al.*, 1990).

Mont Teza Biosphere Reserve - see Kibira National Park

Proposed

Murugaragara

Situated in the Mosso Plain near the Tanzanian border, this is an important, but currently unprotected, site for the endemic toad *Schoutedenella massoensis* (Stuart *et al.*, 1990).

Ndurumu Valley

3°08'S, 30°07'E (approx.) This area contains biologically interesting papyrus swamps, which are currently unprotected. The threatened papyrus yellow warbler *Chloropeta gracilirostris* occurs (Stuart *et al.*, 1990).

Rumonge-Vyanda Forest Nature Reserve

Covering 400ha to the east of **Lake Tanganyika** on very hilly and broken country from the lake shore at 800m to almost 1900m, this area consists of moist *Brachystegia* woodland, with remnants of evergreen forests in the valleys (Wilson, 1990).

Rusizi Delta Biosphere Reserve

Proposed

3°20'S/29°15'E (centre) The Rusizi Delta lies at the northern end of **Lake Tanganyika** where the Rusizi River enters the lake close to the town of Bujumbura. Mainly a sandy alluvial plain vegetated by *Phragmites* reed thickets interspersed with belts of *Acacia* and old cultivated areas, it is the home of the Nile crocodile, hippopotamus, bushbuck and a wide variety of Palaearctic and other waterfowl. The area is used for grazing, farming and fishing activities, and is vulnerable to abuse owing to its easy accessibility (Hughes and Hughes, 1992; Zimmerman, 1982).

Rusizi Plain Biosphere Reserve

Proposed

3°08'-3°11'S, 29°12'-29°20'E (approx.) The Rusizi Plain covers an area of 181,000ha (50% of which is in Burundi) on the floor of the Western Rift Valley. It includes the 5235ha of **Rusizi National Park**. There are grasslands adjacent to the floodplain, 12,000ha of *Phragmites* and papyrus reedbeds, areas of a unique palm savanna of the endemic variety *Hyphaene benguellensis* var. *ventricosa*, trees such as *Acacia albida* and *Euphorbia candelabrum*, and gallery forest along rivers nearer the mountains. Waterfowl are abundant, and Nile crocodiles, hippopotami, warthog, bushbuck, small mammals and numerous species of reptile and amphibian still survive despite the area being intensively settled and grazed. Sitatunga may still occur in low numbers. The area is vulnerable to abuse (Hughes and Hughes, 1992; Wilson 1990; Zimmerman, 1982).

BURUNDI - PROTECTED SITES*National/international designations*

Name of area and map reference (see Fig. 2.1)	Management area (ha)	Year notified
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National Parks

1 Kibira	40,000	1933
2 Rusizi	5,235	
3 Ruvubu	43,630	

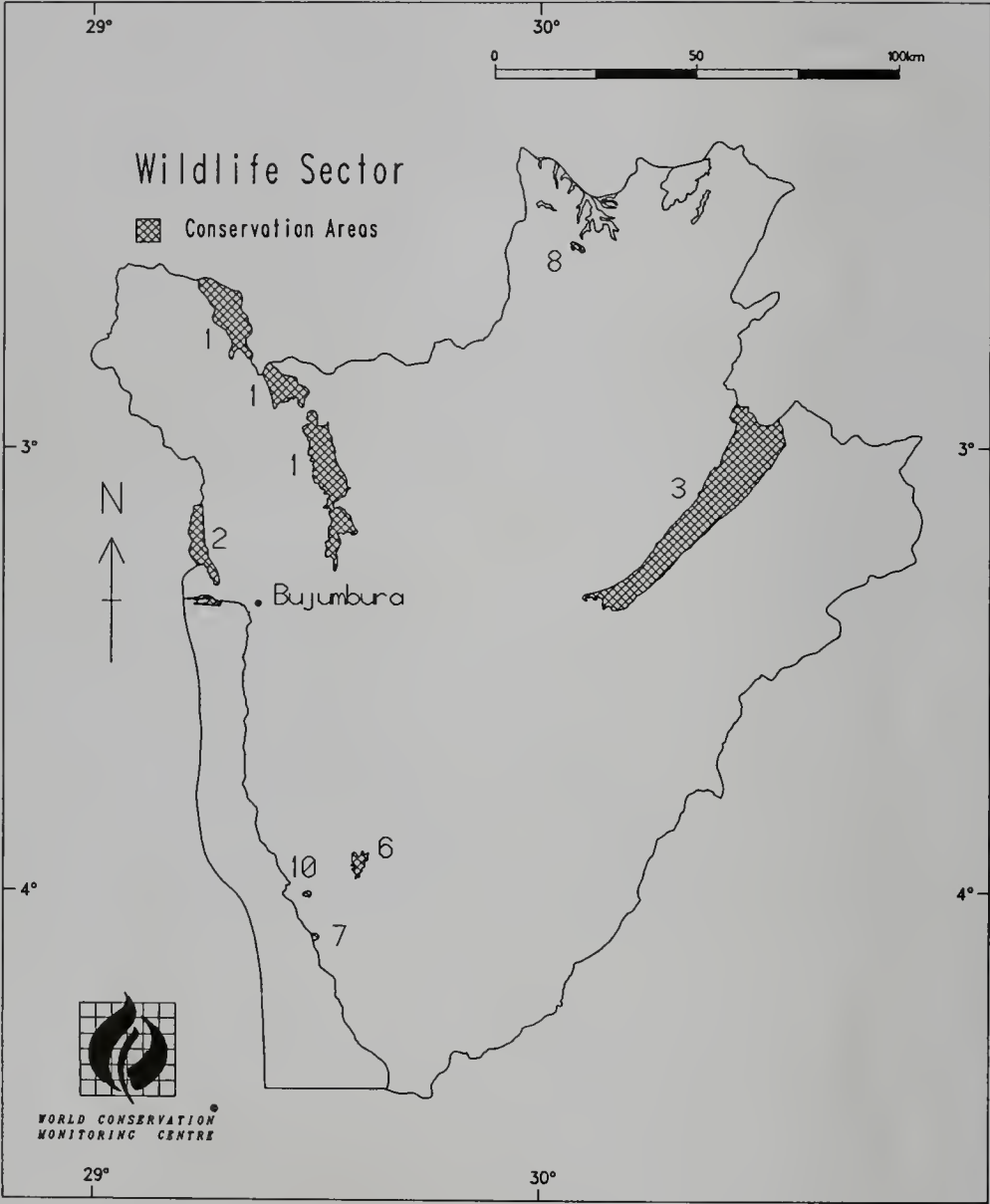
Natural Monuments

4 Chutes de Karera	15	
5 Nyakazu Gorge	20	

Nature Reserves

6 Bururi Forest	3,300	1951
7 Kigwena Forest	400	1951
8 Lac Rwihinda	425	
9 Monge Forest	2,000	1990

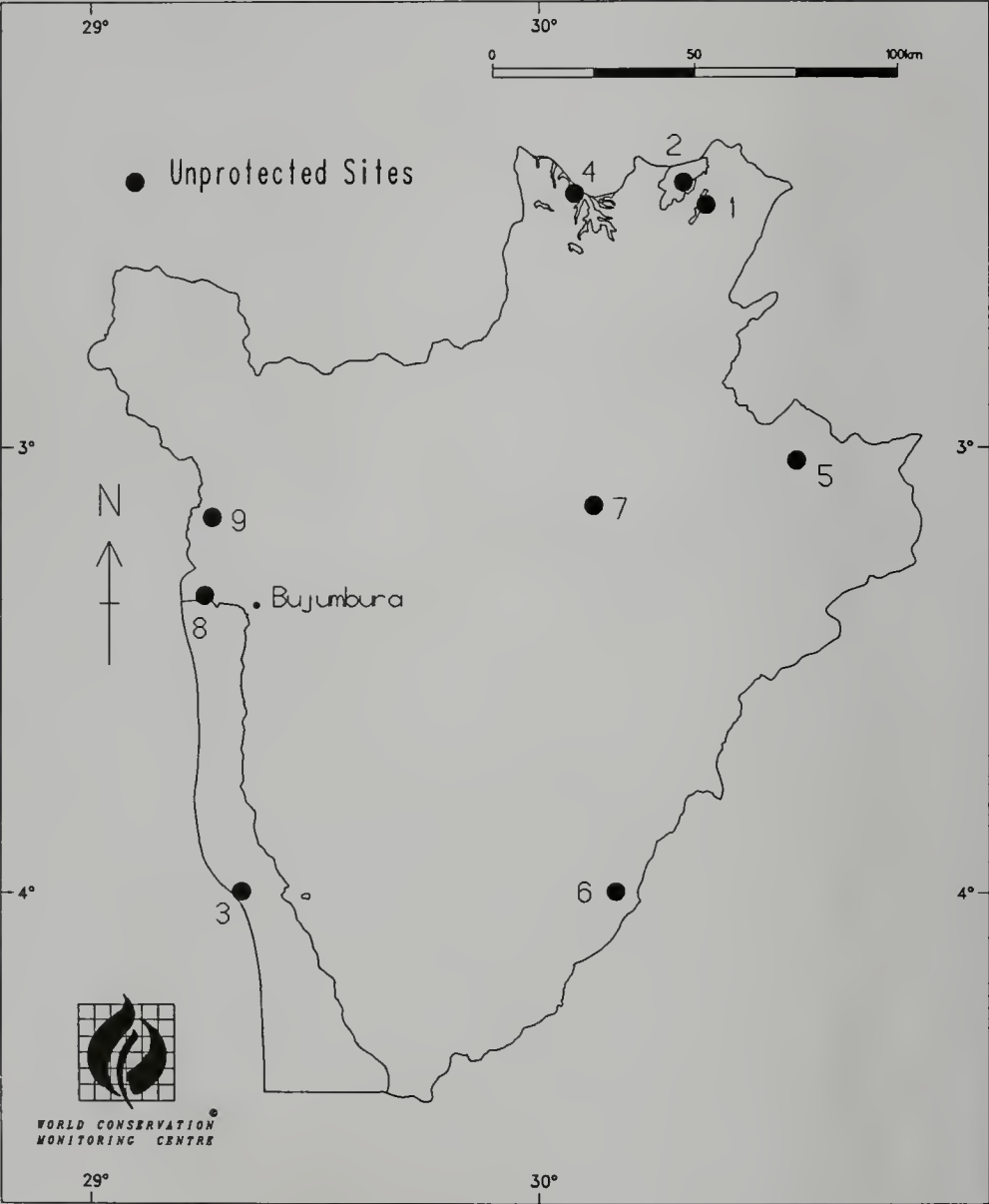
Fig 2.1 Burundi: protected ecologically sensitive sites



BURUNDI - UNPROTECTED SITES

Name of area and map reference (see Fig. 2.2)	Management area (ha)
Kanyaru River	
Karuzi Papyrus Swamp	
1 Lake Kanzigiri	
2 Lake Rugwero	
3 Lake Tanganyika	
4 Lake Tshohoha South	
5 Luvironza/Kayongozi/Ruvubu System	
6 Malagarasi River System	
Mont Teza Biosphere Reserve	
Murugaragara	
7 Ndurumu Valley	
Rumonge-Vyanda Natural Forest Reserve	6,000
8 Rusizi Delta Biosphere Reserve	
9 Rusizi Plain Biosphere Reserve	

Fig 2.2 Burundi: unprotected ecologically sensitive sites



COMOROS

INTERNATIONALLY DESIGNATED PROTECTED AREAS

None

NATIONALLY PROTECTED AREAS

None

UNPROTECTED AREAS

Anjouan Island

12°15'S, 44°25'E Important coral reefs occur in the proposed **Chiroroni Reserve** at the south end of the island, where artisanal fishing is to be permitted. On the island itself, the mongoose lemur *Lemur mongoz* population is critically endangered; about 60 of the endemic Comoro fruit bat *Pteropus livingstonii* survive between here and **Mohéli**. Mangroves occur at Bimbini, in the north-west (Stuart *et al.*, 1990; Tattersall, 1977).

Grand Comore-Karthala Volcano

11°46'S, 43°18'E This is the largest of the islands, covering 95,000ha. A protected area of 8000ha is proposed on the central massif, an active volcano 2361m high, forested between 500m and 1800m; above the forest is a giant heath *Philippia* zone. The forest is almost undisturbed at higher elevations, but is mixed with crops lower down; protection is required above 800m. Four endemic bird species occur, as do the tenrec *Tenrec ecaudatus*, and the two bats *Rousettus obliviosus* (endemic) and *Pteropus seychellensis comorensis*. The central massif is a vital water catchment, of which about 5000ha are owned by a timber company. Other proposed protected areas are **Chindini-Malé Marine Park** in the south and the proposed **Bangoi Kouni-Ivoini Marine Park** in the north, both of which include coral reefs (Collar and Stuart, 1988; Frame, 1987; IUCN, 1987).

Mayotte Island

12°30'S, 45°10' Rain forest and some unusual stands of palms requiring protection occur above 200m on this island, which has an area of 37,500ha. The Mayotte drongo is an endemic bird, and the lemur *Lemur fulvus mayottensis* occurs. Coral reefs and extensive mangroves worthy of protection also exist, the former constituting the best-developed barrier reefs in the Indian Ocean. An estimated 500 green and 25 hawksbill turtles breed here annually. There is promotion of tourism (IUCN, 1987; Stuart *et al.*, 1990; UNEP/IUCN, 1988).

Mohéli Island

12°18'S, 43°41'E Forest covers about 1000ha of this 25,000ha island, intermixed with crops at lower elevations where slash and burn agriculture is practised. Mangroves occur along the southern side. The fauna is similar to that found on other Comoro islands, but is better-preserved. The endemic warbler *Nesillas mariaae* occurs,

as do the three bats *Pteropus livingstonii* (endemic), *Rousettus obliviosus* and *Pteropus comorensi*, the lemur *Lemur mongoz* and the tenrec *Tenrec ecaudatus*. An estimated 1850 green and 50 hawksbill turtles breed here annually, and the island has been recommended as a turtle reserve. Human population density is low, making this a good area in which to develop multiple-use forest plans. Recommended protected areas off the south of the island are the coral reefs of Chissioua Ouénéfou, which are some of the Comoros' richest reefs with three of the six major turtle nesting beaches, and the gazetted Nioumachoua Islets (Frame, 1987; IUCN, 1987; Stuart *et al.*, 1990; Tattersall, 1977).

Nioumachoua Islets

Proposed

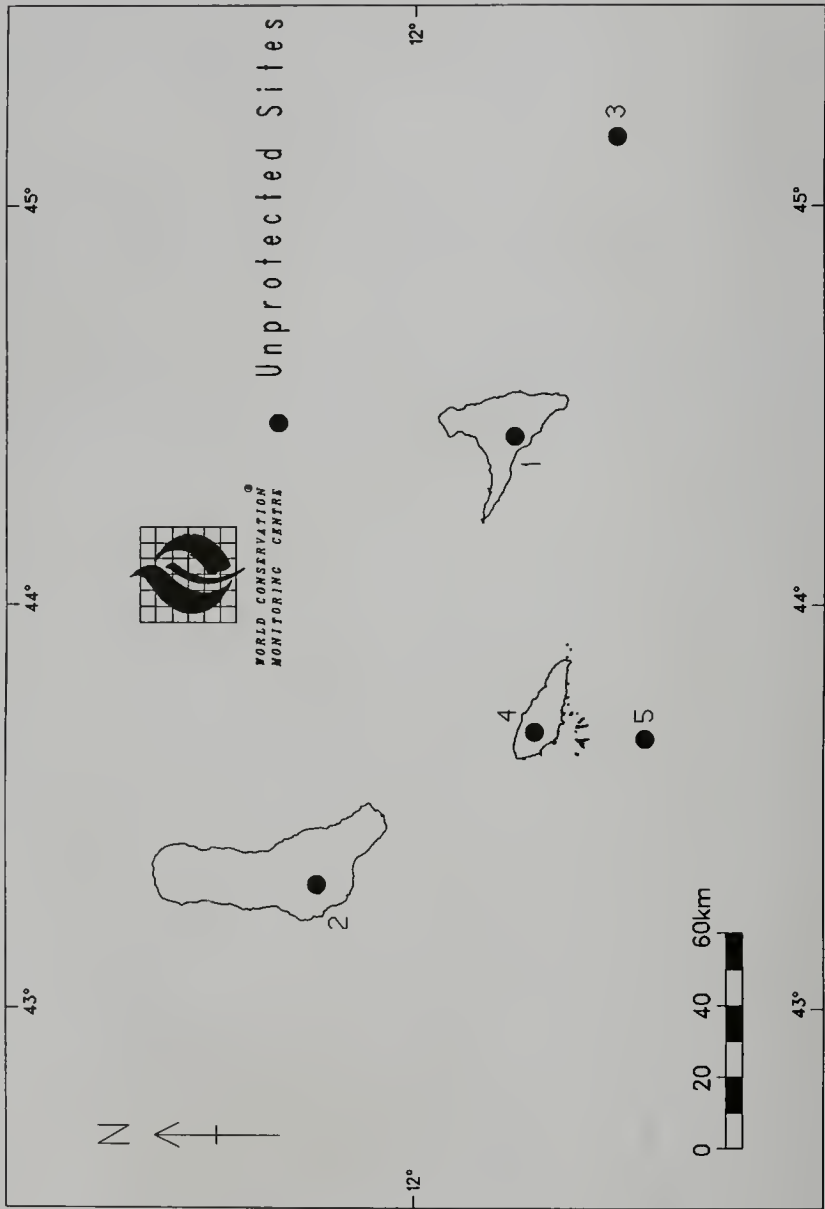
12°34'S, 43°40'E These islets cover an area of 5ha to the south of **Mohéli Island**, including the marine environs to protect coral reefs. Dugong occur. Artisanal fishing is permitted in the coastal buffer zone.

General: The islands support eight endemic species and 46 endemic races of bird. In addition, 11 reptile species are endemic, as are two threatened species of swallowtail butterfly. Marine and coastal habitats of importance to the coelacanth should be established (Drummond, 1985; IUCN 1987; Stuart *et al.*, 1990).

COMOROS - UNPROTECTED SITES

Name of area and map reference (see Fig. 3.1)	Management area (ha)
1 Anjouan Island	
2 Grand Comore-Karthala Volcano	8,000
3 Mayotte Island	37,500
4 Mohéli Island	25,000
5 Nioumachoua Islets	5

Fig 3.1 Comoros: unprotected ecologically sensitive sites



DJIBOUTI

INTERNATIONALLY DESIGNATED PROTECTED AREAS

None

NATIONALLY PROTECTED AREAS

Forêt du Day National Park

IUCN Category II

This park of 10,000ha includes the two small plateaux of Garrab and Adonta, on the east side of the steep-sided Goda Mountains. The forests, mainly juniper, are the last remnants in the country and include about 1400ha of fairly open primary forest. One wadi at Bankoulé also holds a significant proportion of the world's entire population of Bankoulé palm *Wissmannia carinensis*, of which there are only about 500 specimens left. The juniper forest of the Goda and Mabla mountains is the only known site for the threatened Djibouti francolin *Francoelinus ochropectus*, of which 1000-5000 exist. However, as some 5000 people are reliant upon the area for their livelihood, the forest is rapidly disappearing as a result of overgrazing, trampling, and cutting for firewood and for honey. The army uses the area during the summer, and protection is hampered due to local authorities maintaining that climatic change is the principal cause of degradation. A housing plan for the area was due to proceed in 1985 (IUCN/UNEP, 1987).

Maskali Sud Integral Reserve

IUCN Category I

11°40'N, 43°10'E Established in 1980, this coastal reserve is situated at the mouth of the Golfe de Tadjoura, within **Musha Territorial Park**. Growing on the remains of an ancient coral platform, the present reefs are of scientific interest because of their remarkable richness (UNEP/IUCN, 1988).

Musha Territorial Park

IUCN Category I

11°43'N, 43°12'E Established in 1972, this park is situated at the mouth of the Golfe de Tadjoura. Growing on the remains of an ancient coral platform, the reefs are of scientific interest because of their remarkable richness. There is considerable tourism potential. **Maskali Sud Integral Reserve** occurs within the territorial park (UNEP/IUCN, 1988).

OTHER MANAGED AREAS

None

UNPROTECTED SITES

Day Forest

11°50'N, 42°38'E Outside **Forêt du Day National Park** (10,000ha) there are a further 42,000ha of unprotected ancient, relict forest of juniper and box in the Goda Mountains, 25km west of Tadjourah. The area is mountainous, with deep ravines and plateaux up to 1783m, and including the **Forêt du Day National Park** is the only

extensively wooded area in Djibouti. The Djibouti francolin is confined to the Goda and Mabla mountains, and the threatened Bankoualé palm is endemic. The area is locally important for klipspringer and warthog. Loss of vegetational cover through trampling and firewood collection has resulted in severe soil erosion, and there is a long history of overgrazing and tree exploitation (Collar and Stuart, 1988; Frame, 1987; Stuart *et al.*, 1990).

Golfe de Tadjoura - see Musha Territorial Park and Maskali Sud Integral Reserve

Lake Abbé

11°10'N, 41°50'E About 11,000ha of this 34,000ha lake are within Djibouti. Some 37m deep, its size has been reduced by about one third due to the diversion of water for irrigation; there is little other direct human impact. Spectacular salt-encrusted pinnacles are a notable feature of the area, and the biology of the lake is unknown (Hughes and Hughes, 1992).

Lake Asal

11°40'N, 42°25'E Situated 105km east-south-east of the town of Djibouti, this hypersaline lake covers 5200ha and a further 5600ha of salt flats occur in the immediate vicinity. Patchy Red Sea coastal salt desert vegetation occurs, and there is no human utilisation (Burgis and Symoens, 1987; Hughes and Hughes, 1992).

Mabla Massif

12°00'N, 43°00'E This mountainous area supports forests of *Acacia seyal* and box, mostly above 500m, in an arid to semi-arid area. The original vegetation has largely been replaced by *Acacia* spp. and scrub. There is a history of overgrazing by domestic stock, and tree exploitation. 4300ha of the Goula region have been recommended as a national park, which would encompass much of the range of the Djibouti francolin (Frame, 1987; Welch and Welch, 1986).

Ra's Siyyam Mangroves

12°29'N, 43°19'E This is a small area of mangroves dominated by *Avicennia marina* and salt marsh vegetation (Hughes and Hughes, 1992).

Sept Frères Islands

12°29'N, 43°25'E These islands support coastal mangroves and seabird colonies (IUCN, 1987; Stuart *et al.*, 1990).

DJIBOUTI - PROTECTED SITES*National/international designations*

Name of area and map reference (see Fig. 4.1)	Management area (ha)	Year notified
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Integral Reserve

1 Maskali Sud		1980
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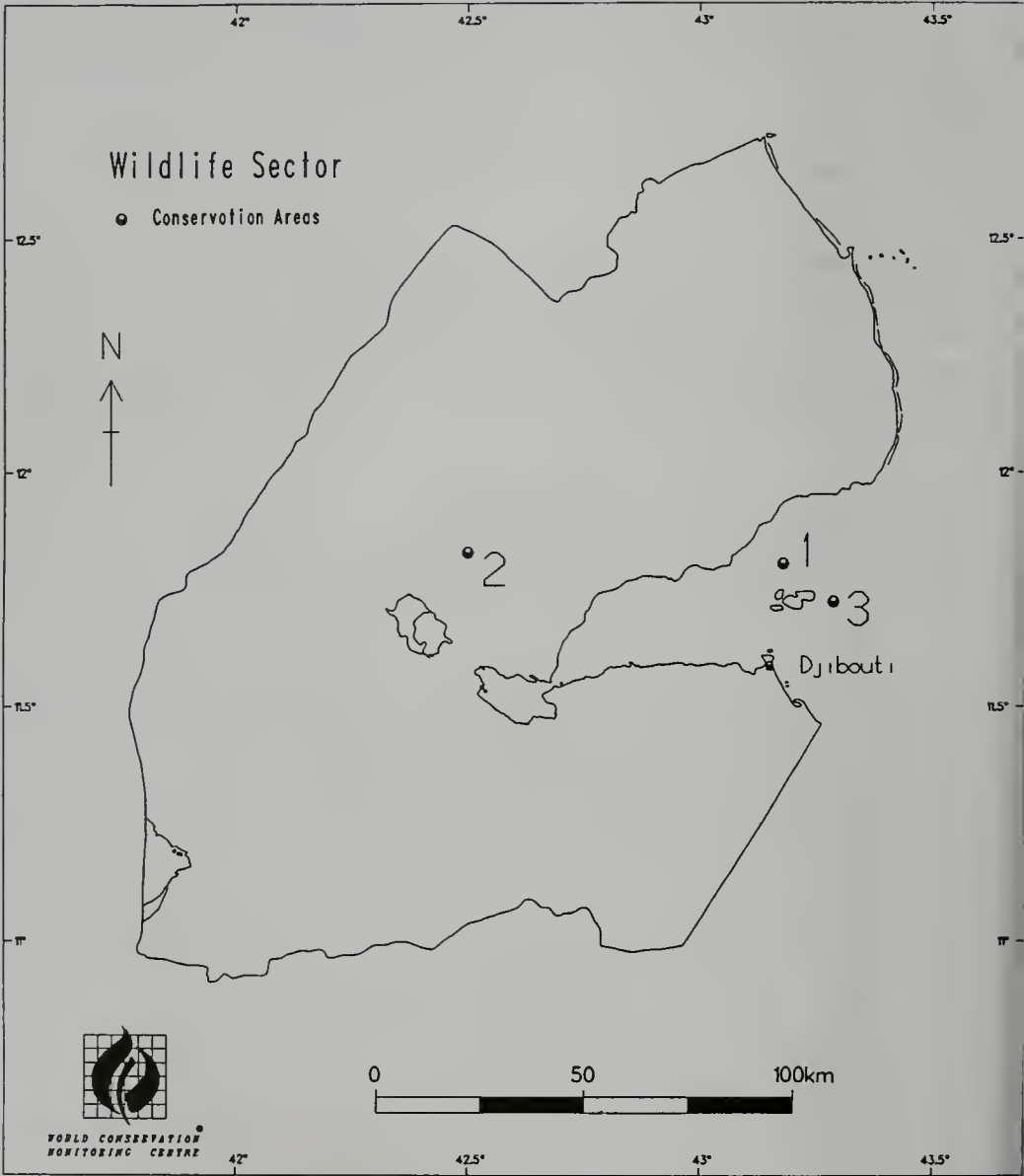
National Park

2 Forêt du Day	10,000	1939
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Park

3 Musha Territorial		1972
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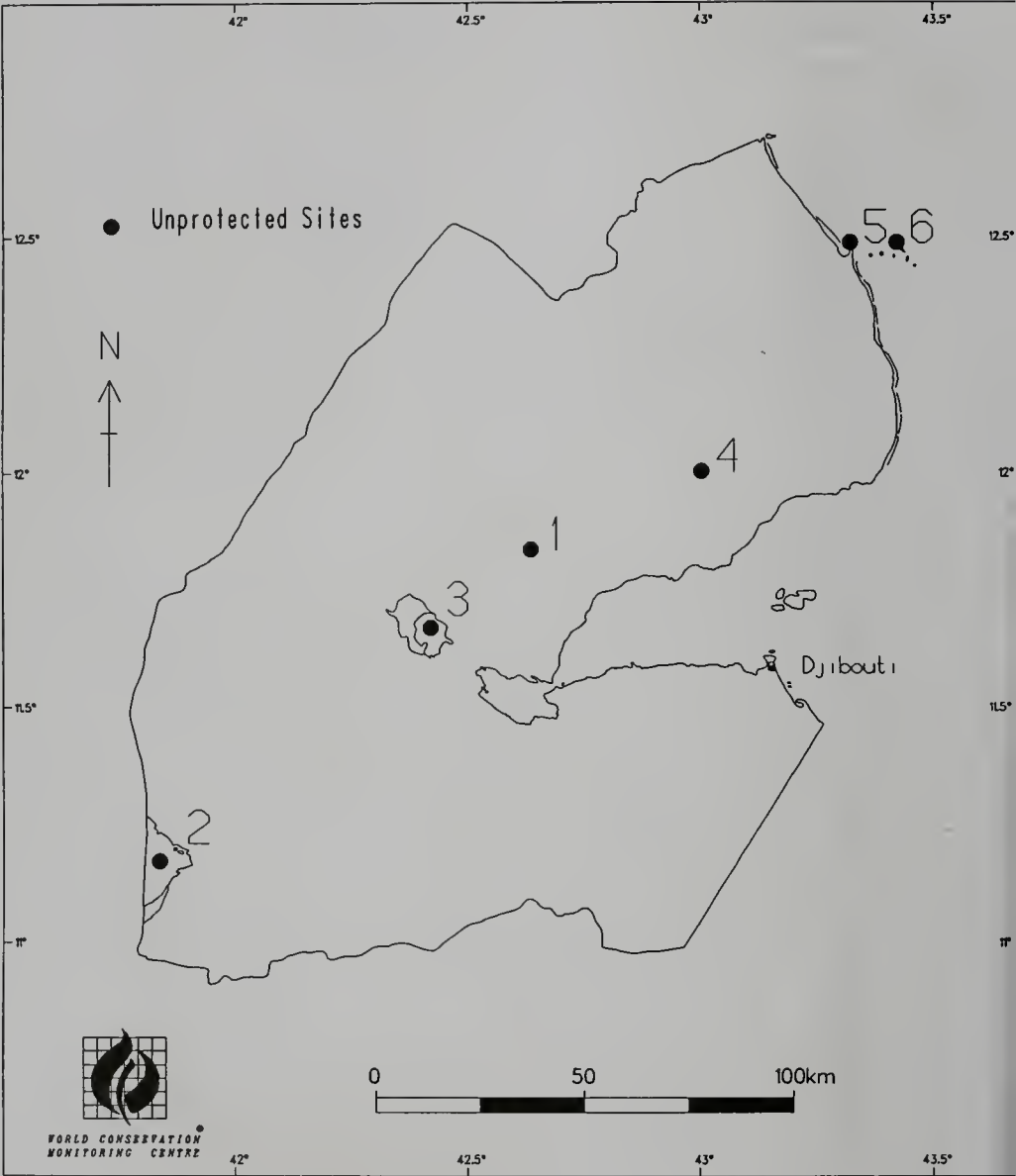
Fig 4.1 Djibouti: protected ecologically sensitive sites



DJIBOUTI - UNPROTECTED SITES

Name of area and map reference (see Fig. 4.2)	Management area (ha)
1 Day Forest	42,000
2 Lake Abbé	11,000
3 Lake Asal	10,800
4 Mabla Massif	4,300
5 Ra's Siyyam Mangroves	
6 Sept Frères Islands	

Fig 4.2 Djibouti: unprotected ecologically sensitive sites



MADAGASCAR

INTERNATIONALLY DESIGNATED PROTECTED AREAS

Réserve de la Biosphère du Mananara Nord

IUCN Categories IV and IX

A coastal biosphere reserve of 140,000ha, the core of which comprises **Mananara Marine National Park** (23,000ha) and **Mananara Terrestrial National Park** (1000ha), plus buffer and transition zones. The marine park (16°20'S, 49°51'E) was established in 1989, and includes coral reefs up to 200m offshore, with mangroves along the shoreline. The area is good dugong habitat. The terrestrial area is representative of the Maroantsetra Forests, tall evergreen rain forests from sea-level to about 1000m in the eastern rainforest belt lying in the lowlands, foothills and mountains from Maroantsetra to Antongil Bay. It comprises the largest legally protected forest area in the country. Many rare birds and mammals occur, including indri *Indri indri*, the rare local endemic hairy-eared dwarf lemur *Allocebus trichotis*, and woolly lemur *Avahi laniger*, and the highest known concentration of the endangered aye-aye *Daubentonia madagascariensis*. It is one of the few refuges for white-browed owl, and at least one reptile and three molluscs are endemic to these forests. The reserve is located in an important agricultural area, and the forest immediately outside the reserve boundary has been cleared for shifting cultivation. Illegal timber exploitation in classified forest areas, and poaching (mainly of lemurs and dugong) occur. Tracks abandoned 20 years ago have been reopened by forest exploiters and facilitate the incursion of shifting agriculture. About 40,000 people live in the reserve, mainly in the buffer zone, but with several families in the core areas. A road through the reserve has been suggested by farmers. There is as yet no management plan (IUCN 1990a; (Collar and Stuart, 1988; IUCN/UNEP, 1987; Nicoll and Langrand, 1989; Stuart *et al.*, 1990; WWF, 1986).

NATIONALLY PROTECTED AREAS

Ambatovaky Special Reserve

IUCN Category IV

16°55'S, 48°35'E 1958 Situated in Toamasina Province, this reserve covers an area of 60,050ha (IUCN/UNEP/WWF, 1987).

Ambohijanahary Special Reserve

IUCN Category IV

18°32'S, 45°26'E Established in 1958, this reserve covers an area of 24,750ha in Mahajanga Province. Elevations within the reserve range between 560 and 1124m. It is forested, and is transitional between the Central and Eastern Domains. The fauna is not well known, but Verreaux's sifaka *Propithecus verreauxi deckenii* does occur.

Ambohitantly Special Botanical Reserve

IUCN Category IV

This reserve of 5600ha is on a high dissected plateau bordered by steep escarpments, and contains one of the last surviving remnants of the central plateau forest not destroyed by fire over the past 1000 years. The main forest covers an area of about 2000ha, with an additional 1000ha of small scattered forest fragments. The fauna is not well known. The most serious danger to the forest is from fire, but boundary marks and guards are insufficient, and access into the area needs to be controlled.

Reafforestation is being considered. Being near Antananarivo, it has educational potential (IUCN/UNEP, 1987).

Analamerana Special Reserve

IUCN Category IV

12°44'S, 49°44'E Established in 1956 and covering an area of 34,700ha, this plateau supports wet forests that are biologically different from forests in the east. A very rare subspecies of diademed sifaka, *Propithecus diadema perrieri*, appears to be restricted to this area, but it is not known how well-represented the species is within the reserve. Its total population is estimated at around 2000 individuals. Several other lemur species occur, as do several rare birds. The area is an important water catchment (Nicoll and Langrand, 1989; Stuart *et al.*, 1990; WWF, 1986).

Andohahela Strict Nature Reserve

IUCN Category I

This 76,020ha reserve consists of three separate blocks of 63,100ha, 12,420ha and 500ha, respectively. The largest block (which is mainly submontane tropical forest) is an important watershed, and encompasses the headwaters of ten rivers. The second largest area is mainly thorn forest, scrub and gallery forest. Both these areas contain several endemic plants. The smallest section was originally created to specifically protect the endemic palm *Neodypsis decaryi*, which occurs in high densities. There are reports of 15 lemur species (the most in any Madagascan reserve), including the endangered aye-aye. Fire control schemes have been introduced, but need extending. Boundary changes have been suggested to exclude unforested areas (which are present in all three blocks) and to incorporate more forest; the boundaries also need clearer delimitation. Livestock grazing and woodcutting occur in some areas, and hunting is a problem in a few locations. The reserve is seriously understaffed, with only two guards responsible for all three areas (IUCN/UNEP, 1987; O'Connor, *et al.*, 1987).

Andranomena Special Reserve

IUCN Category IV

20°10'S, 44°30'E Established in 1958, this 6420ha reserve extends from sea-level to 100m in Toliara Province, 60km north of Morondava. Situated on the coastal plain, it consists of western deciduous dry forest dominated by the baobabs *Adansonia grandidieri*, *A. za* and *A. fony*. The fauna includes both endemics, and species at the limit of their distribution. The mammals include Verreaux's sifaka and fork-marked lemur *Phaner furcifer*. It is one of only two known localities of the Madagascar flat-tailed tortoise *Pyxis planicauda* (Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Andringitra Strict Nature Reserve

IUCN Category I

This reserve covers 31,160ha in the Andringitra mountains, a rugged granite massif which contains the headwaters of many streams. It has the coldest climate of the Madagascan mountains and is rich in endemic plants. Xerophytic and ericaceous plants occur at high altitudes, with mid-altitude and moss forest on lower slopes. The latter in particular has been severely affected by fires. Several lemur species have been recorded, and the fauna includes a number of endemic species. Fire protection is of concern. However, local people seem well aware of the reserve's boundaries and conservation value (IUCN/UNEP, 1987).

Anjanaharibe-Sud Special Reserve

IUCN Category IV

14°42'S, 49°26'E Established in 1958, this mountainous reserve covers an area of 32,100ha between altitudes of 500m and 2064m. Flora is similar to that occurring in **Marojejy Strict Nature Reserve**, and consists primarily of rain forest. The fauna is very rich; several lemur species occur, including indri, woolly and brown lemurs. The reserve is considered to be biologically important (Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Ankarafantsika Strict Nature Reserve

IUCN Category I

This 60,520ha reserve has a very rugged relief in the east, descending gently in a sandy plateau to the west. It includes a range of habitats typical of the arenaceous soils of western Madagascar. It helps protect the catchment of one of Madagascar's most important rice growing areas. The reserve is still largely covered with dense deciduous forest. Seven lemur species occur, and the avifauna is diverse, with over 90 species recorded. One-third of the bird species are endemic to Madagascar, including threatened birds such as white-breasted mesite *Mesitornis variegata*, Van Dam's vanga *Xenopirostris damii*, Madagascar little grebe *Tachybaptus pelzelinii* and Madagascar fish eagle *Haliaeetus vociferoides*. The reserve is insufficiently staffed, and frequent fires and cattle grazing have degraded many areas, particularly in the more accessible west. Boundaries are not clearly marked on the ground, nor on maps. The reserve borders another nature reserve, and an extension to the north has been suggested (IUCN/UNEP, 1987).

Ankarana Special Reserve

IUCN Category IV

12°55'S, 49°06'E Established in 1956, this reserve of 18,220ha is situated in the far north of Madagascar, to the south of **Montagne d'Ambre National Park**. It contains wet forest, biologically distinct from forests in the east and is extremely rich in fauna, including a number of endemic forms found in the country's longest known cave system - the Grotte d'Andrafiabe. Nile crocodiles are found, and among the mammals are the endangered aye-aye, the rare subspecies of diademed sifaka *Propithecus diadema perrieri*, and crowned lemur *Lemur coronatus* (IUCN/UNEP/WWF, 1987; Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Bemarivo Special Reserve

IUCN Category IV

17°00'S, 44°20'E Established in 1956, this reserve covers an area of 11,570ha.

Betampona Strict Nature Reserve

IUCN Category I

This 2228ha reserve occupies a rocky spur and several ridges overlooking the coastal plain, and contains the headwaters of numerous streams. An example of the low-altitude dense evergreen rain forest of eastern Madagascar, it is the only forest in a vast deforested area. The fauna includes nine species of lemur. The reserve is clearly delimited, but funds do not permit further management. The protective zone of 200m around the reserve is reported to have been reclaimed by local inhabitants. The proximity of numerous villages leads to poaching and illegal fishing. Less than half the reserve area is actually under forest; the rest has been regenerating from farmland for the past 40 years (IUCN/UNEP, 1987).

Beza-Mahafaly Strict Nature Reserve

IUCN Category IV

This reserve consists of two non-contiguous parts: one of 500ha which consists mainly of thorn forest, and one of c.100ha beside a seasonal river supporting gallery forest. Four lemur species are present, and threatened animal species include the radiated tortoise *Geochelone radiata* and sideneck turtle *Erymnochelys madagascariensis*. One of the main roles of the reserve is as a joint research site between the Universities of Madagascar, Washington and Yale; work on the flora and fauna of south-west Madagascar and on vegetation regeneration is being undertaken. Both areas are clearly delimited; the smaller area has been fenced, excluded grazing livestock (IUCN/UNEP, 1987; Rakotomanga *et al.*, 1987; Richard *et al.*, 1987).

Bora Special Reserve

IUCN Category IV

14°52'-15°05'S, 48°11'-48°17'E Established in 1956, this reserve covers an area of 4780ha between elevations of 115m and 411m in Mahajanga Province. The Ankofia River constitutes the boundary of the reserve. Forest, transitional between evergreen and deciduous dry forests, covers the whole of the protected area. There are records of 52 species of bird, including coua *Coua verreauxi* and sicklebill, and mammals include the brown lemur and Verreaux's sifaka (Nicoll and Langrand, 1989).

Cap Sainte Marie Special Reserve

IUCN Category IV

25°36'S, 49°09'E Established in 1962, this reserve covers 1750ha between 110m and 199m in Toliara Province. Vegetation consists predominantly of succulent spiny vegetation in a semi-arid environment, including several species of *Commiphora*. The reserve reputedly supports large numbers of the endemic and possibly threatened radiated tortoise *Geochelone radiata*, as well as common spider tortoise *Pyxis arachnoides*. Three species of tenrec and coua occur. There is a proposal to enlarge the reserve, as the area is thinly populated (Nicoll and Langrand, 1989; Stuart *et al.*, 1990; WWF, 1986).

Forêt d'Ambre Special Reserve

IUCN Category IV

12°30'S, 49°10'E Established in 1958, the reserve covers an area of 4810ha divided into two units; altitudes range between 417m and 1143m. It is situated close to Montagne d'Ambre National Park, and the flora and fauna is similar. The wet forest that occurs is biologically distinct from forests to the east (Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Forêt de Ranomafana Classified Forest

IUCN Category VI

- see Ranomafana National Park

Isalo National Park

IUCN Category II

This 81,540ha park consists of a highly dissected massif. The flora and fauna are not well known, but the recently-described Benson's rock-thrush is found here and the endemic Madagascan boa *Acrantophis madagascariensis* also occurs. Some cattle are grazed in the area, and fires occur (IUCN/UNEP, 1987).

Kalambatritra Special Reserve

IUCN Category IV

23°28'S, 46°29'E Established in 1959, this reserve covers an area of 28,250ha between 1300m and 1500m elevations. It supports mid-altitude eastern rain forest in good condition. It is considered to be of biological importance (Stuart *et al.*, 1990).

Kasijy Special Reserve

IUCN Category IV

16°50'S, 46°00'E Established in 1956, this reserve covers an area of 18,800ha.

Lac Ihotry Hunting Reserve

IUCN Category VI

21°59'S, 43°36'E Covering an area of c.11,200ha, this lake is situated in the northern-most extension of the "spiny desert", characterised by *Didierea madagascariensis* bushes and the small baobab *Adansonia fony*. The area of the lake itself varies between 865ha at low water (when it can become extremely saline) and about 9400ha at high water. It has been identified as a region of considerable importance for waterbirds, and four threatened bird species occur. Endemic avifauna occurs, and the subdesert mesite *Monias benschi* and long-tailed ground-roller *Uratelornis chimaera* are restricted to this vegetation type (Collar and Stuart, 1988; IUCN/UNEP/WWF, 1987; Nicoll and Langrand, 1989; Stuart *et al.*, 1990; WWF, 1986).

Lac Kinkony Hunting Reserve

IUCN Category VI

16°07'-16°13'S, 45°44'-45°53'E Gazetted in 1972, this reserve lies in the basin of the lower Mahavavy, covering an area of 15,000ha at high water levels and 10,000ha at low. This is the second largest lake in Madagascar, and of considerable importance for bird conservation; species include Madagascar fish eagle *Haliaeetus vociferoides* and the duck *Anas bernieri*. The Madagascar big-headed turtle *Erymnochelys madagascariensis* is abundant. Forests to the south are dominated by the palm *Medemia nobilis*, and other genera such as *Acridocarpus*, *Zizyphus* and *Stereospermum*. Verreaux's sifaka is common. The lake is of importance to surrounding human populations, and requires increased protection (IUCN/UNEP/WWF, 1987; Nicoll and Langrand, 1989; Stuart *et al.*, 1990; WWF, 1986).

Lokobe Strict Nature Reserve

IUCN Category I

This reserve covers 740ha on the south-east side of the steep, rugged basaltic island of Nosy Bé, and forms an important water catchment for the island. It contains most of the island's remaining dense, humid forest. Many plant and animal species endemic to Nosy Bé and numerous Madagascan endemics, including an important colony of black lemur *Lemur macaco*, are found here. The reserve is vulnerable because of its small size, and forest in the proposed buffer zone, which is not yet formally protected, is being cleared for farming. There are proposals to increase the size of the reserve and to provide vehicles to enable staff to increase their efficiency (IUCN/UNEP, 1987).

Mananara Marine National Park - see **Réserve de la Biosphère du Mananara Nord**

Mananara Terrestrial National Park - see **Réserve de la Biosphère du Mananara Nord**

Mangerivola Special Reserve IUCN Category IV
18°19'S, 49°02'E Established in 1958, this reserve covers an area of 11,900ha (800ha in IUCN/UNEP/WWF, 1987)

Maningozo Special Reserve IUCN Category IV
17°00'S, 45°10'E Established in 1956, this reserve covers an area of 7900ha.

Manombo Special Reserve IUCN Category IV
23°02'S, 47°44'E Established in 1962, this 5020ha reserve extends from sea-level to 137m. It is an important smaller reserve, 50% of which is covered in forest. The brown lemur *Lemur fulvus fulvus* and the endangered aye-aye *Daubentonia madagascariensis* are known to occur (Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Manongarivo Special Reserve IUCN Category IV
13°53'-14°07'S, 48°15'-48°32'E Established in 1956, this 35,250ha reserve ranges between elevations of 155m and 1876m, with a corresponding variation in vegetation types. Wet forest occurs 150-800m, biologically distinct from forests in the east. Mammals that occur include the endangered aye-aye *Daubentonia madagascariensis*, black lemur *Lemur macaco* and fork-marked lemur *Phaner furcifer*. It is an important water catchment area (Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Mantadia National Park IUCN Category II
Established in 1989, this 10,000ha park is about 14km north of Andasibe. It supports 10 lemur species, as well as endemic central Madagascan plants. Farmers who previously farmed in the area continue to come into the park to clear land, and shortage of staff makes control difficult.

Marojejy Strict Nature Reserve IUCN Category I
This reserve covers 60,150ha of the rugged volcanic massif of Marojejy (up to 2137m high) and its foothills, which consist of some of the most spectacular scenery in Madagascar. Four altitudinal zones exist: dense, closed canopy lowland rain forest; mid-altitude rain forest; lichen or moss forest; and maquis or heath on the highest ridges. The area is relatively undisturbed. Plant diversity is high with over 2000 species recorded, several of which are endemic to the massif. The reserve is important for birds, with about 30 species endemic to Madagascar recorded, including eight threatened species. It was here that the endangered Madagascar serpent eagle *Eutriorchis astur* was sighted (in 1988) for the first time since 1932. Illegal clearing of forest on the lower slopes needs controlling to prevent large-scale soil erosion. Illegal lemur hunting may have almost exterminated diurnal species. Security needs to be improved, as does demarcation of boundaries. The higher parts of the reserve are less threatened because of their inaccessibility, but the high summit vegetation merits special protection from fires as it is the last unburned example of the original

Madagascan high-altitude vegetation, and upgrading to national park status has been recommended (IUCN/UNEP, 1987; Safford and Duckworth, 1988).

Marotandrano Special Reserve

IUCN Category IV

17°50'S, 47°40'E Established in 1956, this 42,200ha reserve is situated in Mahajanga Province (IUCN/UNEP/WWF, 1987).

Midongy-Sud Classified Forest

IUCN Category VI

This protected area consists of two classified forests; Soarano (Lavaraty: 23°16'S, 46°59'E) and Befotaka (Midongy: 23°35'S, 47°02'E). Established in 1953, these reserves cover an area of 24,145ha and 43,423ha, respectively, between 850m and 1357m. The rainforest includes species of *Diospyros*, *Dalbergia*, *Brachylaena* and *Cryptocarya*, among others. Several rare birds occur, and mammals include the endangered aye-aye, and diademed sifaka. The conservation of the area is considered a high priority (Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Montagne d'Ambre National Park

IUCN Category II

Covering 18,200ha of scenic volcanic massif up to 1475m above sea-level, this park is mostly covered with moist tropical upland forest. The fauna is diverse, including many Madagascan and regional endemics. Boundaries are ill-defined, and deforestation and grazing occur. Fires have damaged forest on the south and west flanks of the mountain, and there has been a proposal to extract 20,000m² of timber on lower slopes close outside the reserve which could threaten water resources. This has been opposed by the local authorities (IUCN/UNEP, 1987).

Nosy Mangabe Special Reserve

IUCN Category IV

This reserve covers all 520ha of this rugged limestone island. The reserve was established to protect a reintroduced population of the endangered aye-aye. Four other lemur species occur on the island, and there are several endemic species of amphibian. The vegetation is typical east coast rainforest, much of it secondary. More introductions may be conducted, including lemur food plants and other threatened lemur species. The island can support limited tourism, and will need strict control in this regard (IUCN/UNEP, 1987).

Perinet-Analamazaotra Faunal Reserve

IUCN Category IV

This mountainous reserve covers 810ha at an elevation of about 1000m. The medium altitude tropical moist forest is characteristic of the eastern escarpment region, and the flora and fauna are much richer than in surrounding logged and hunted areas; its logging concession was never exploited. The reserve was originally set up to conserve a population of endangered indri; a further eight lemur species occur. At least 70 endemic Madagascan birds occur, including eight threatened species, and the reserve has been identified as the fourth most important forest for the conservation of threatened birds in Africa and Madagascar. Several reptiles and amphibians are endemic to the reserve. The reserve is too small to adequately protect this forest type and its fauna, and it has been isolated from other forests. There is also some evidence

of poaching and timber exploitation within the reserve (Collar and Stuart, 1988; IUCN/UNEP, 1987).

Pic d'Ivohibe Special Reserve

IUCN Category IV

22°29'-22°34'S, 46°58'-47°00'E Established in 1964, this reserve covers an area of 3450ha at elevations between 775m and 2060m. Part of the Andringitra massif, the reserve supports an important population of the brown lemur, and the diademed sifaka has been reported to occur (Nicoll and Langrand, 1989).

Ranomafana National Park

IUCN Category II

21°16'S, 47°28'E Situated in south-central Madagascar north of Fianarantsoa, this park covers 37,567ha between 800m and 1200m. A very important watershed, it consists of steep-sided hills intersected by minor river tributaries. The vegetation is transitional, including low scrub forest and rain forest of the central Malagasy type. There are records of 23 mammal, 96 bird and six reptile species, including numerous rare and threatened forms such as the aquatic tenrec *Limnogale mergulus*, the endemic broad-nosed gentle lemur *Haplemur simus*, red-bellied *Lemur rubriventer* and black-and-white ruffed lemur *Varecia variegata variegata*. Hot springs exist, and there is obvious tourist potential. Forest clearing and cultivation are threats (Collar and Stuart, 1988; IUCN/UNEP/WWF, 1987; Nicoll and Langrand, 1989; Stuart *et al.*, 1990.).

Tampoketsa d'Analamaitso Special Reserve

IUCN Category IV

16°15'S, 48°00'E Established in 1958; covers 17,150ha

Tsaratanana Strict Nature Reserve

IUCN Category I

This reserve covers 48,622ha of mountains, and includes Mont Maromokotra, the highest mountain in Madagascar (2876m). Vegetation includes both primary and secondary high and low altitude tropical evergreen forests, with shrubs and herbaceous vegetation on the summits. Over 50 bird species endemic to Madagascar occur, including the threatened Crossley's ground roller *Atelornis crossleyi*. Three amphibians and two reptiles are believed to be endemic to the massif. It is also the most important area of Madagascar for molluscs, with 45 species recorded, 30 being endemic to the massif. There are seven species of lemur. Because of the very cold winter temperatures and steep terrain, much of the reserve is little disturbed; burning of the summit vegetation and some illegal cultivation occur (IUCN/UNEP, 1987).

Tsimanampetsotsa Strict Nature Reserve

IUCN Category I

This flat, low-lying reserve of 43,200ha includes shallow brackish Lake Tsimanampetsotsa, 20km long. The sandy shores are virtually unvegetated, but other areas support xerophytic forest and scrub. There is a rich variety of Didiereaceae (an endemic family of cactiform euphorbias) and Euphorbiaceae species. The avifauna includes at least 28 species endemic to Madagascar, including the threatened black-banded sand plover, and numerous other waterbirds such as lesser and greater flamingo. The threatened radiated tortoise *Geochelone radiata*, endemic to the southern *Didierea* forests, is found here. The reserve is said to be the only one in the region without feral zebu cattle owing to the scarcity of fresh water, and it is little

disturbed. The xerophytic vegetation is fire-resistant. Boundaries are unmarked, but there is little human encroachment and the surroundings have a low human density. It has been suggested that the plateau bordering the lake, and a nearby area with potholes (home to a species of blind fish) should be included in the reserve (IUCN/UNEP, 1987).

Tsingy de Bemaraha Strict Nature Reserve IUCN Category I

This is the largest natural reserve in Madagascar (152,000ha), situated in a deeply dissected limestone karst area with many caves and springs. Much of the eastern edge of the reserve is delimited by a cliff. The vegetation is representative of the country's western calcareous regions, comprising predominantly dense, dry forest and savanna with many endemic plants and animals. Seven lemur species occur. The inaccessibility of much of the reserve has preserved the integrity of most areas, but a cattle track crosses the reserve and cattle encroach into accessible valleys. Illegal settlement and poaching have been recorded (IUCN/UNEP, 1987).

Tsingy de Namoroka Strict Nature Reserve IUCN Category I

This reserve comprises 21,742ha of calcareous karst relief with many cliffs, caves and springs. The reserve is a mosaic of dense dry forest, savanna and karst-adapted vegetation. The fauna includes four lemur species and a number of endemic Madagascan birds. Fires are frequent in the dry season, and there is a village within the reserve, resulting in illegal cultivation and grazing. Laws protecting the reserve cannot be adequately enforced because of the low staff numbers (IUCN/UNEP, 1987).

Zahamena Integral Nature Reserve IUCN Category I

This 73,160ha reserve consists of two sections separated by a large enclosed area. The relief is rugged, supporting medium altitude tropical evergreen forest between 700m and 1500m, with belts of bamboo. Secondary ericaceous scrub occurs at higher altitudes. Nine lemur species have been recorded, including the threatened indri *Indri indri*, ruffed lemur *Varecia variegata* and grey gentle lemur *Hapalemur griseus griseus*. About 60 Madagascan endemic bird species have been recorded. Much of the reserve supports unbroken forest, but paths through it have led to trapping, and clearing for agriculture in some parts. Fires could affect the western edge of the reserve, and villagers have moved into the area between the two sections and used it for crops and grazing (IUCN/UNEP, 1987; Raxworthy, 1987).

Zombitse Classified Forest IUCN Category VI

22°47'S, 44°40'E Established in 1962, this reserve covers an area of 21,500ha east of Sakaraha in south-west Madagascar. It consists of gently undulating hills between 485m and 824m, supporting 1000km² of dense, dry deciduous forest; 215km² are proposed for protection. A major watershed, it is the home of several rare and/or threatened forms such as Appert's greenbul *Phyllastrephus apperti*, an endemic gecko *Phelsuma standingi* and a threatened butterfly. Six species of lemur and 67 birds have been recorded. Threats include forest clearing, and currently the forest is considered to be severely threatened (Collar and Stuart, 1988; Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

OTHER MANAGED AREAS

Analabe Private Reserve

19°29'S, 44°34'E Situated near the village of Beroboka about 60km north of Morondava, this reserve lies on the Morondava coastal plain in the southern portion of the western dry deciduous forest. It is characterised by the trees *Adansonia grandidieri* and *Tamarindus indica*, and spiny succulent species of *Euphorbia*, *Pachypodium* and *Adenium*. Mangroves occur. Estimates of its area vary between 2000ha and 12,000ha, from sea-level to 100m. It includes about 6000ha of primary and 3000ha of degraded forest, and is considered to be one of the most important protected areas in western Madagascar. Fauna and flora include giant Malagasy jumping rat *Hypogeomys antimenae*, tenrec, flat-shelled spider tortoise *Pyxis planicauda*, five nocturnal lemur species and the Malagasy narrow-striped mongoose *Mungotictis lineatus*. Tourism potential is high, but the reserve is threatened by bush fires, hunting and cultivation. See also **Morondava Forests** (IUCN/UNEP/WWF, 1987; Nicoll and Langrand, 1989; WWF, 1986).

Berenty Private Reserve

A privately-owned area of 650ha held in trust, this reserve made up of one 200ha and four very small sectors. It is situated on a sisal plantation, with indigenous vegetation consisting mainly thorn forest; the largest area supports gallery forest close to the river. One section has been planted with *Pithecellobium dulce*, now mixed with old acacias and tamarinds. Six lemur species occur in the reserve, and over 40 bird species have been recorded. A captive group of radiated tortoise is kept here (IUCN/UNEP, 1987).

Kirindy Forest Reserve

IUCN Category VIII

Established in 1987, this reserve covers an area of 10,000ha between sea-level and 100m. The vegetation cover consists of western deciduous forest including three baobab species, and species of *Euphorbia* and *Pachypodium*. It supports important populations of rare species such as the endemic tortoise *Pyxis planicauda* and turtle *Erymnochelys madagascariensis*. Verreaux's sifaka, fat-tailed dwarf lemur *Cheirogaleus medius* and fork-marked lemur occur, and it is at the northern limit of distribution of the two tenrec species *Echinops telfairi* and *Geogale aurita* (Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Lac Kasanga Hunting Reserve

Lac Masama et Bemamba Hunting Reserve

18°04'S, 44°02'E Established in 1972, this reserve covers an area from sea-level to 280m. The forest is variable, but tall evergreen rain forest occurs near the coast. Drier forests in the reserve support *Adansonia za* and *Tamarindus indica*, and there are areas of *Rhizophora* and *Avicennia* spp. mangroves. Crocodiles and *Dermochelys* turtles occur, and 107 bird species have been recorded including several rare and/or threatened forms. Several mammal species occur, including Verreaux's sifaka *Propithecus verreauxi deckeni* and probably dugong (Nicoll and Langrand, 1989).

Lokobe Integral Reserve - see Nosy Bé

Manjakatempo Forest Station

19°22'S, 47°16'E Established in 1922 this protected area covers 8320ha, of which 650ha consist of indigenous forest; the remainder of the area is under exotic plantations. Situated in the Ankaratra Massif, this is an important relict of the depleted central plateau forests. Several species of rare bird occur, as do 14 species of reptile (IUCN/UNEP/WWF, 1987; Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Tsimembo Forest Reserve

IUCN Category VIII

This classified forest covers 13,900ha and is contiguous to **Tsingy Bemaraha Strict Nature Reserve**. Situated in an area of alluvial deposits, lakes, sand dunes and estuarine muds with mangroves, Tsimembo is one of the best surviving examples of the western coastal deciduous forests. Verreaux's sifaka is found, and dugong are likely to occur along the coast. Nile crocodile and the endemic Madagascan sideneck turtle are locally common. The avifauna is particularly rich, especially in aquatic birds, and supports many overwintering migrants and at least five threatened endemic species. Waterfowl are hunted, and there is some rice production. Throughout the region, bush fires occur during the dry season. Oil exploration has affected the whole region and made areas more accessible for timber extraction. However, the reserve is much less degraded compared with most west coast sites, and deserves high conservation status and improved management, linked to that in the adjacent **Tsingy Bemaraha Strict Nature Reserve** (IUCN/UNEP, 1987).

UNPROTECTED SITES

Ambodibonara Mangroves

Mangroves occur along the coast west of Ambodibonara (IUCN 1987).

Anjorozone Forest

A relict of the central plateau forests, this forest is in urgent need of protection (Stuart *et al.*, 1990).

Ankaratra Massif

18°50'S, 47°18'E A volcanic massif situated about 70km south of Antananarivo, this mountain supports badly degraded forests; the area is considered to be biologically important. See also **Manjakatempo Forest Station** (IUCN/UNEP/WWF, 1987).

Antsohihy

14°38'S, 48°00'E Mangroves occur in this area (IUCN, 1987).

Bombetoka Bay

15°30'S, 47°10'E About 46,000ha of mangroves occur around the estuary of the Betsiboka River (IUCN, 1987; IUCN/UNEP/WWF, 1987).

Cap Sada

This area has been suggested as a suitable reserve site for the angonoka tortoise, only 100-400 of which may survive in the wild (Nicoll and Langrand, 1989; WWF, 1986).

Cap Saint-André

16°18'S, 44°40'E Mangroves occur in this area (IUCN, 1987).

Grand Récif Marine National Park

Proposed

23°25'S, 43°40'E This reef is located off south-west Madagascar, near Toliara. It extends over 15km from north to south, and is up to 3km wide; the plateau of the reef flat may be exposed during low spring tides. A total of 62 coral genera have been reported, and seagrass beds occur. Mangroves grow around Saradrano. The reef is the most researched in the Indian Ocean; there have been some negative impacts on the reef due to exploitation (IUCN/UNEP/WWF, 1987; UNEP/IUCN, 1988).

Hatokaliotsy

Proposed

24°24'-24°39'S, 43°52'-44°04'E Covering 21,850ha at elevations between 55m and 258m, this is an important area of 'spiny forest' in the semi-arid south-west. Several rare reptiles and birds occur (Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Lac Alaotra

Proposed

17°19'-17°55'S, 48°13'-48°39'E This is the largest lake in Madagascar covering a minimum dry season area of 22,000ha, expanding to a maximum of 35,000ha in the wet season. Situated at an elevation of 750m, it is a priority lake for conservation. It is the home of the Madagascar pochard *Aythya innotata* and Alaotra grebe *Tachybaptus rufolavatus*, both of which are possibly extinct, and home to a rich endemic fish fauna. The Lac Alaotra gentle lemur *Haplemur griseus alaotrensis* is confined to floating reed beds in the lake. The area is densely settled, and deforestation and erosion are threats. A biosphere reserve, including **Zahamena Strict Nature Reserve** to the east, is a possibility (Nicoll and Langrand, 1989; Stuart *et al.*, 1990; WWF, 1986).

Lac Anony

Proposed

25°09'S, 46°30'E Situated in Toliara Province 75km east of Tolanaro, this lake has a surface area of 2350ha at an elevation of 100m. It is an important lake for waterbirds, including greater and lesser flamingo. The surrounding area is a major sisal-producing region. The lake is in need of better protection (Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Lac Befotoka

14°33'S, 48°00'E Covering 3.8km² at an elevation of 30m, this lake requires protection (Burgis and Symoens, 1987; Stuart *et al.*, 1990).

Lac Itasy

19°04'S, 46°25'E Covering 3500ha at an altitude of 1221m, this lake is situated in the volcanic Itasy Massif in the centre of the island. The endemic duck *Anas melleri*

occurs, and there is a colony of the bat *Eidolon helvum* to the south of the lake. Several species of fish occur, including the introduced *Micropterus salmonoides*. The lake is unprotected, but is considered to be biologically important. Subsistence fishing occurs (IUCN/UNEP/WWF, 1987; Nicoll and Langrand, 1989; Stuart *et al.*, 1990).

Loza Mangroves

This very large lagoon situated in the north-west of the island supports 18,000ha of mangroves (IUCN/UNEP/WWF, 1987).

Maharika Plateau

15°40'S, 49°26'E Forests occur on this plateau west of Maroantsera and Antongil Bay, including those of Ambohitsitondrona, Beanana and Ambohivoangy. A number of rare birds and primates occur (Frame, 1987; IUCN, 1987; IUCN/UNEP/WWF, 1987).

Mangoky River Estuary

21°26'S, 43°44'E Mangroves occur in this area (IUCN, 1987).

Masoala Peninsula

15°38'S, 50°09'E Contiguous with the Antongil bay region, a 27,682ha reserve in the north-eastern part of this peninsula was degazetted in 1964. However, in view of its especially high level of plant and animal endemism, the area is considered to be amongst the highest of the country's conservation priorities. An area of 300,000ha has been proposed for protection as a national park, from sea-level to 1224m. The area is largely forested; two new palm genera were discovered in 1986, and red-ruffed lemur *Varecia variegata rubra* and fossa occur, amongst others. Local community involvement is seen as being a necessary component of future protection (Frame, 1987; IUCN, 1987; IUCN/UNEP/WWF, 1987; Nicoll and Langrand, 1989).

Montagne des Français

12°04'S, 49°08'E Situated across the bay from Antsiranana, this is a calcareous massif up to 450m in height, covering 11km². It supports a dry forest type, at risk from burning and forest clearing. The fauna includes crowned and northern weasel lemurs, *Lemur coronatus* and *Lepilemur septentrionalis*. It is ideally situated for local educational activities (WWF, 1986).

Morondava Forests

The natural forests of the Morondava region are highly threatened; there is only one private reserve, **Analabe Private Reserve**, although an area of 10,000ha to the south of this reserve is being managed by Coop ration Suisse. The lakes, coast and forests of the area between Morondava and Antsalova are, however, being considered as a World Heritage site which would include part of **Tsingy de Bemaraha Strict Nature Reserve**. These forests are adapted to dry conditions, are fire-resistant, and support a number of lemur species although many of these are declining in numbers (Petter, 1987).

Nord de Toliara PK32

23°03'S, 43°38'E This area of 12,500ha of coastal plain extends onto the plateau, between sea-level and 131m. The vegetation is primarily of the spiny desert type, with species of *Didiera*, *Euphorbia*, *Aloe* and *Pachypodium*. The fauna is rich, with 31 species of reptile, including the endemic tortoise *Pyxis arachnoides* and the gecko *Phelsuma stangini*, and 79 species of bird, including restricted and rare species (Nicoll and Langrand, 1989).

Nosy Bé

13°20'S, 48°15'E This is a volcanic island off the north-west coast of Madagascar; coral reefs up to 1.5km wide surround much of it. Seagrass beds occur on both sides of the reefs, and mangroves are abundant in many of the bays and estuaries. The 740ha **Lokobe Integral Reserve** is situated in the south-east corner of the island. The island is an important tourist centre, and some resulting negative impacts have been reported. The small island of **Nosy Tanikely** 8km to the south is protected on account of its terrestrial fauna and is surrounded by a marine reserve, but there is no legal protection. A marine park is seen as a desirable development (IUCN, 1987; IUCN/UNEP/WWF, 1987; Stuart *et al.*, 1990; UNEP/IUCN, 1988).

Nosy Tanikely - see **Nosy Bé**

Offshore Sand Cays

12-13°20'S, 48-49°00'E These include the cays of Nosy Anambo, Nosy Faho, Nosy Fasy, Nose Faty, Nosy Foty and Nosy Langna. Situated on the north-west continental shelf they are small, low islands with surrounding reefs, some of which are emergent at low tide. Seagrass beds occur (IUCN/UNEP/WWF, 1987).

Presqu'île Masoala - see **Masoala Peninsula**

Ramomatan

Proposed

37,567ha

Rodo Bay

2220ha of mangroves occur at this site (IUCN/UNEP/WWF, 1987).

Sept Lacs - see **Lake Ihotry**

Sihanaka Forest

18°00'S, 48°45'E This comprises a broad belt of humid forest lying between the east coast and the Mangoro valley, in particular in the Tamatave hinterland between Didy and Fito, north to and including **Zahamena Integral Nature Reserve**. Numerous threatened birds and mammals occur in the forest, which is several times larger than the 732km² protected within **Zahamena**. Indri, woolly lemur *Avahi laniger*, ruffed lemur *Varecia variegata*, grey gentle lemur *Hapalemur griseus griseus* and diademed sifaka occur (Collar and Stuart, 1988; IUCN, 1987; IUCN/UNEP/WWF, 1987).

Soalala National Park

16°03'S, 45°20'E Covering 113,000ha of forests and shrublands in the western deciduous forests, this is the home of the endemic angonoka tortoise *Geochelone yniphora*, of which only 100-400 individuals may survive in the wild. Verreaux's sifaka occurs (Nicoll and Langrand, 1989; Stuart *et al.*, 1990; WWF, 1986).

Tanjona Vohimena - see Cap Sainte Marie Special Reserve

Toliara Coral Reefs

23°40'S, 43°40'S South-west of Toliara, these reefs are included in the proposed **Grand Récif Marine National Park** (IUCN, 1987; Stuart *et al.*, 1990).

Tsarafidy and Ankazomivady Forests

21°09'S, 47°10'E Lying north of Fianarantsoa in south-central Madagascar, these forests lie in a hilly area. They are eastern humid rainforest between 1300m and 1500m, biologically rich, with several rare and vulnerable bird species. Threatened mammals such as diademed sifaka, ruffed and weasel lemurs occur. Parts of the forest have been damaged by woodcutting, and their current status is uncertain (Collar and Stuart, 1988).

Tsiribihana River Estuary

19°49'S, 44°30'E Mangroves occur on the estuary of this river, and should be protected (IUCN, 1987).

MADAGASCAR - PROTECTED SITES

National/international designations

Name of area and map reference (see Fig. 5.1)	Management area (ha)	Year notified
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Classified Forests

Kirindy	10,000	1987
Midongy-Sud	67,568	1953
Tsimembo	13,900	
Zombitse	21,500	1962

Forest Station

Manjakatempo	8,320	1922
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Hunting Reserves

1 Lac Ihotry		1972
2 Lac Kasanga		
3 Lac Kinkony	15,000	1972
4 Lac Masama et Bemamba		1972

National Parks

5 Isalo	81,540	1962
6 Mananara Marine	1,000	1989
7 Mananara Terrestrial	23,000	1990
8 Mantadia	10,000	1989
9 Montagne d'Ambre	18,200	1958
10 Ranomafana	37,567	1991

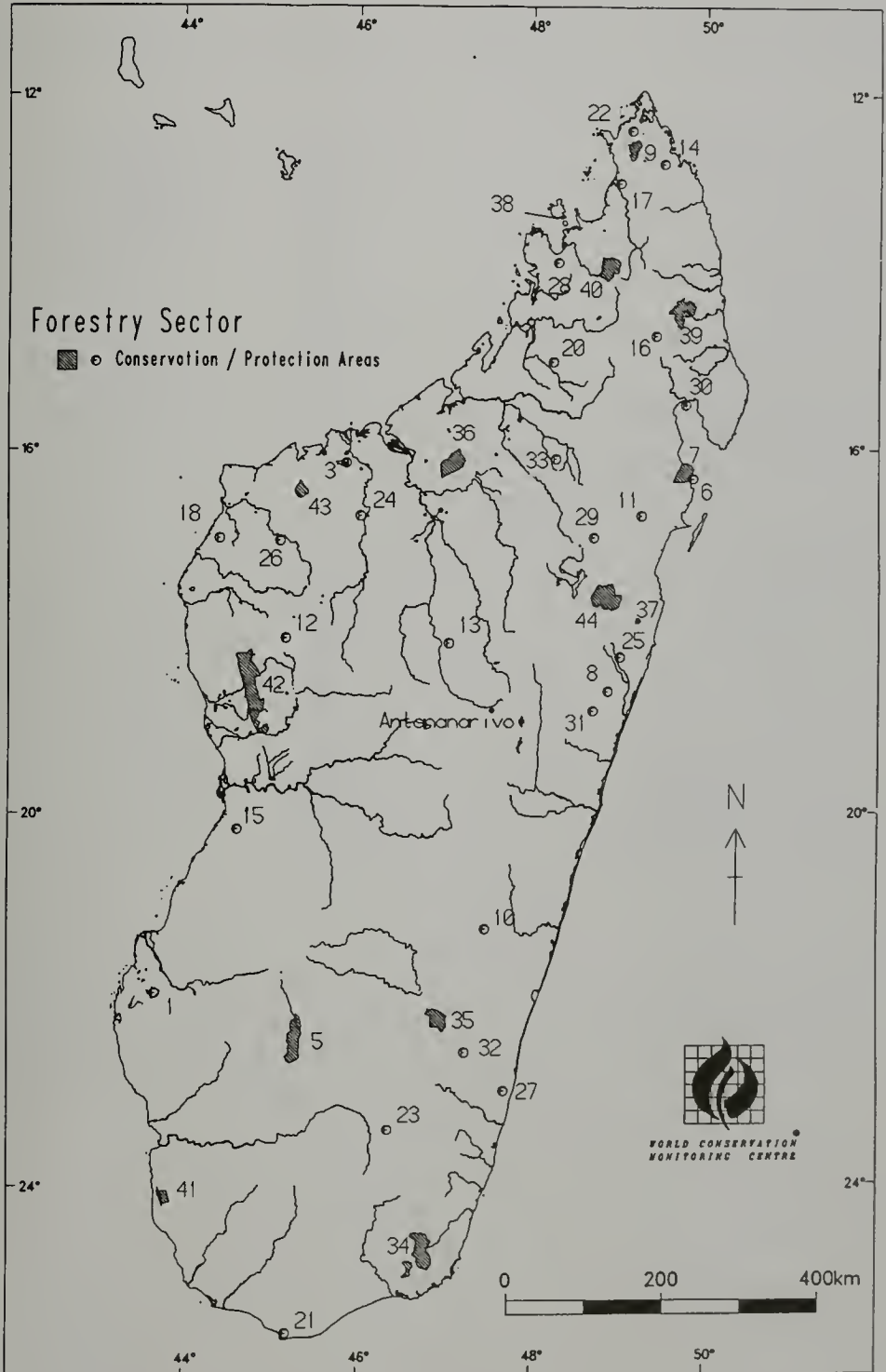
Private Reserves

Analabe	?
Berenty	650

Special Reserves

11 Ambatovaky	60,050	1958
12 Ambohijanahary	24,750	1958
13 Ambohitantely	5,600	1982
14 Analamerana	34,700	1956
15 Andranomena	6,420	1958
16 Anjanaharibe-Sud	32,100	1958
17 Ankarana	18,220	1956
18 Bemarivo	11,570	1956
19 Beza-Mahafaly	580	1978
20 Bora	4,780	1956
21 Cap Sainte Marie	1,750	1962

Fig 5.1 Madagascar: protected ecologically sensitive sites



MADAGASCAR - PROTECTED SITES (cont.)

National/international designations

Name of area and map reference (see Fig. 5.1)	Management area (ha)	Year notified
22 Forêt d'Ambre	4,810	1958
23 Kalambatritra	28,250	1959
24 Kasijy	18,800	1956
25 Mangerivola	11,900	1958
26 Maningoza	7,900	1956
27 Manombo	5,020	1962
28 Manongarivo	35,250	1956
29 Marotandrano	42,200	1956
30 Nosy Mangabe	520	1965
31 Perinet-Analamazaotra	810	1970
32 Pic d'Ivohibe	3,450	1964
33 Tampoketsa d'Analamaitso	17,150	1958

Strict Nature Reserves

34 Andohahela	76,020	1939
35 Andringitra	31,160	1927
36 Ankarafantsika	60,520	1927
37 Betampona	2,228	1927
38 Lokobe	740	1927
39 Marojejy	60,150	1952
40 Tsaratanana	48,622	1927
41 Tsimanampetsotsa	43,200	1927
42 Tsingy de Bemaraha	152,000	1927
43 Tsingy de Namoroka	21,742	1927
44 Zahamena	73,160	1927

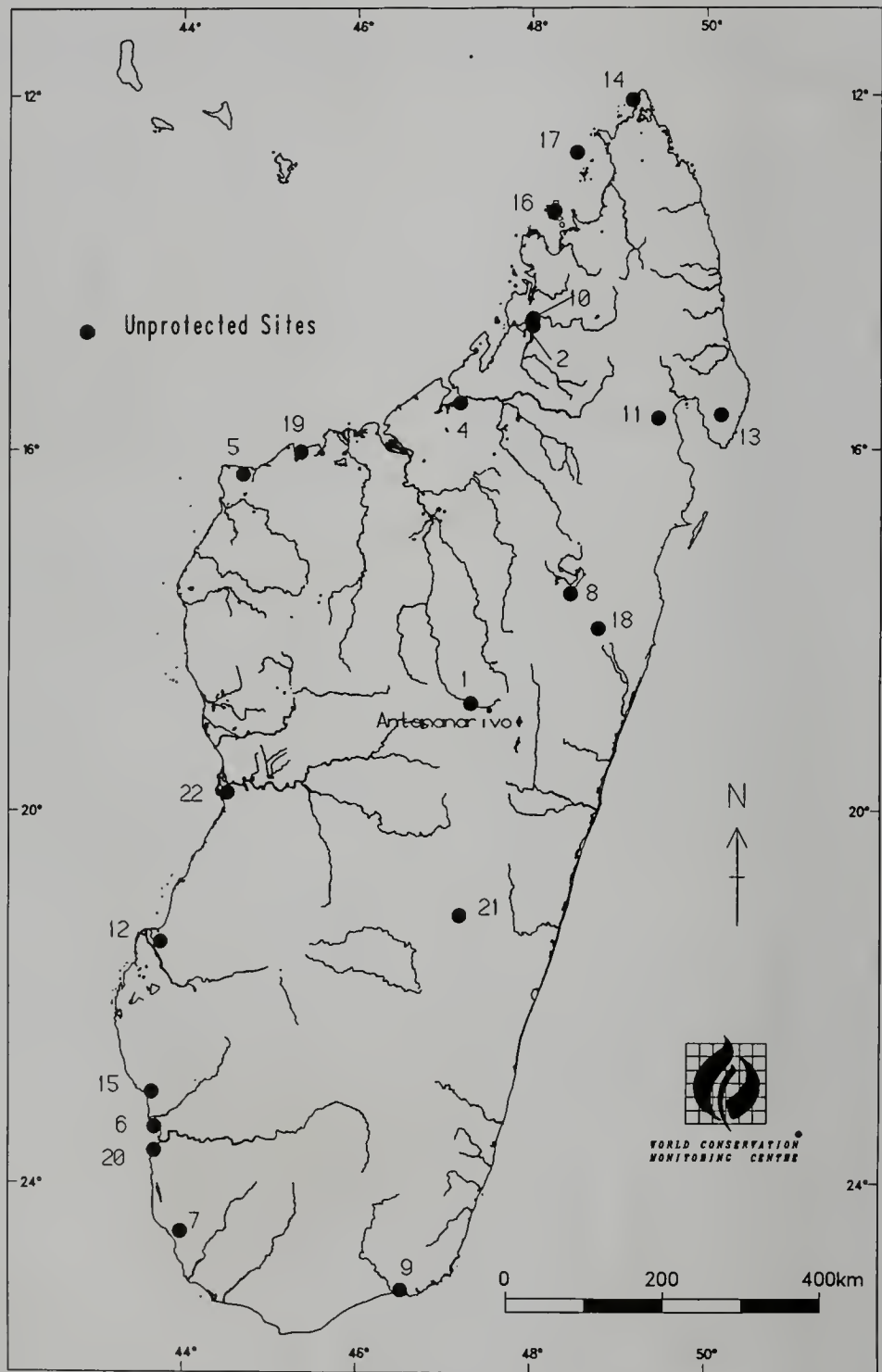
Biosphere Reserve

Réserve de la Biosphère du Mananara Nord	140,000	1990
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MADAGASCAR - UNPROTECTED SITES

Name of area and map reference (see Fig. 5.2)	Management area (ha)
Ambodibonara Mangroves	
Anjorozone Forest	
1 Ankaratra Massif	
2 Antsohihy	
3 Betsibaka	
4 Bombetoka Bay	46,000
Cap Sada	
5 Cap Saint-André	
6 Grand Récif Marine National Park	
7 Hatokaliotsy	21,850
8 Lac Alaotra	35,000
9 Lac Anony	2,350
10 Lac Befotoka	
Lac Itasy	1,221
Loza Mangroves	
11 Maharika Plateau	
12 Mangoky River Estuary	
13 Masoala Peninsular	27,682
14 Montagne des Français	
Morondava Forests	
15 Nord de Toliara PK32	12,500
16 Nosy Bé	
17 Offshore Sand Cays	
Ramomatan	37,567
Rodo Bay	2,220
18 Sihanaka Forest	
19 Soalala National Park	113,000
20 Toliara Coral Reefs	
21 Tsarafidy and Ankazomivady Forests	
22 Tsiribihana River Estuary	

Fig 5.2 Madagascar: unprotected ecologically sensitive sites



MAURITIUS

INTERNATIONALLY DESIGNATED PROTECTED AREAS

Macchabée-Bel Ombre Nature Reserve

IUCN Categories I and IX

20°25'S, 57°26'E (centre) Consisting of a nature reserve of 3611ha and a biosphere reserve of 3594ha, this reserve has a fairly flat topography with a few deep river gorges. It has been identified as the most important forest site for the conservation of threatened birds in Africa and its offshore islands. Between 20% and 25% of the upland evergreen climax forest consists of endemics, some of which are of concern due to a lack of regeneration. Most orchid species are threatened, and some areas of mossy forest have been badly degraded by successive cyclones. Mid-altitude forest occurs, and includes one species of tree *Olex psittacorum* of which only a single specimen is known; another species, *Gaertnera longifolia*, was only known from a single locality until recently. The gorges contain a small stand of *Hibiscus columnaris*, endemic to Mauritius and Réunion and only known from a few scattered individuals. All the rare endemic Mauritian birds occur, including Mauritius kestrel (one of the rarest birds in the world). *Hibiscus columnaris* is being artificially propagated, and a captive breeding programme conducted for several endemic birds. Some areas are leased by deer hunters; the exotic deer have free access to the reserve, and inhibit plant regeneration. Exotic plants and nest predation by introduced rats and macaques are major problems. Other introduced species such as the rose-ringed parakeet and common mynah compete with hole-nesting indigenous birds (Collar and Stuart, 1988; IUCN, 1986; IUCN/UNEP, 1987).

NATIONALLY PROTECTED AREAS

Bois Sec Nature Reserve

IUCN Category IV

6ha

Cabinet Nature Reserve

IUCN Category IV

18ha

Coin de Mire (Gunner's Quoin)

IUCN Category IV

19°56'S, 57°37'E This volcanic 76ha island lies about 4km off the north coast of Mauritius. Its rugged coast rises to 162m, but the rough seas have prevented the formation of reefs. Vegetation includes grass, pines, thorn scrub and coastal communities, with eight Mascarene plant endemics. The island has, however, been overrun by introduced species of weed. The island is a breeding site for three seabirds: white-tailed tropic bird, red-tailed tropic bird and wedge-tailed shearwater. Four species of reptile occur: two skinks and two geckoes, one of which (*Nactus coindemirensis*) is endemic to the island. Three further species occurred before the introduction of exotic mammals such as the black rat (IUCN/UNEP, 1987).

Combo Nature Reserve

IUCN Category IV

This is an important 207ha reserve in the south of the main island (Stuart *et al.*, 1990).

Corps de Garde Nature Reserve

IUCN Category IV

This is an important 90ha reserve in the west of the main island (Stuart *et al.*, 1990)

Gouly Père Nature Reserve

IUCN Category IV

11ha

Ile aux Aigrettes Nature Reserve

IUCN Category IV

20°25'S, 57°43'E This 25ha island consists of coralline dune rock, and has a jagged, eroded coastline. It is the only surviving area of coastal plant communities on calcarenitic substrates, and harbours some 40 native species of plant, ten endemic to Mauritius and a further six to the Mascarenes. The orchid *Oeniella aphrodite* is noteworthy, and requires added protection. However, endemic coastal trees and shrubs have now mostly disappeared due to past human habitation, and introduced rats are plentiful. Access is easy, and illegal wood cutting and introduced plant species are threatening the survival of the island's endemics. It is unpoliced (IUCN/UNEP, 1987).

Ile aux Cocos Nature Reserve

IUCN Category IV

19°43'S, 63°18'E This 15ha reserve comprises a sandy cay lying in shallow lagoon waters 3km off the coast of **Rodrigues Island**. Extensive tidal sandflats occur on protected shores. The island is largely under mixed plantations of *Casuarina equisetifolia* and coconuts, but there are large expanses of grassy sward and dense native *Pisonia grandis* thicket. Small colonies of 400 to 700 noddy and lesser noddy are present, nesting preferentially in *Casuarina* trees and *Pisonia* thickets. The white tern is now almost extinct here. The eggs of nesting birds are extremely vulnerable, and indiscriminate collecting has caused considerable disturbance (IUCN/UNEP, 1987).

Ile aux Sables Nature Reserve

IUCN Category IV

19°42'S, 63°18'E This 8ha area is a sandy cay nearly 4km off the west coast of **Rodrigues Island**, with extensive tidal sandflats on the west side. The islet is mostly covered in *Casuarina* plantations, but supports exotic and native species similar to those found on Ile aux Cocos, plus a few isolated individuals of the native *Pisonia grandis*. There are small colonies of noddy, lesser noddy, roseate tern and a few white tern, and *Casuarina* trees are their favourite nesting sites. The eggs of nesting birds are extremely vulnerable, and indiscriminate collecting has caused considerable disturbance. Surveillance cannot be carried out due to inadequate transport, and an increase in tourism and the availability of illegal boat transport is threatening the reserve's integrity (IUCN/UNEP, 1987).

Ile Plate Nature Reserve

IUCN Category IV

19°53'S, 57°39'E This 253ha reserve comprises a roughly circular islet of volcanic rocks and sand ridges, 116m high. A continuous fringing reef connects the northern points of Ile Plate and **Ilot Gabriel** to form a lagoon. The native terrestrial flora has been almost completely destroyed by cutting, periodic fires and exotic tree plantation. However, the lagoon floor is almost entirely covered by diverse corals, and formations with the beautiful blue coral *Heliopora coerulea* are unique to this area. The region

supports a wide variety of fish (150 species), and the fore-reef slope is particularly interesting for its populations of large fish. The terrestrial fauna is not well known, but a few bird species nest here, and some reptiles occur. Both feral cats and rats inhabit the islet (IUCN/UNEP, 1987).

Ile aux Serpents Nature Reserve

IUCN Category IV

19°49'S, 57°48'E This 31ha dome-shaped volcanic islet rises to 177m. It is guano covered, and bare of vegetation apart from patches of *Portulaca* and *Brachiaria* in rock crevices. About two million birds utilise the islet, including a million sooty tern, 200,000 noddy, 500,000 lesser noddy and 20-40 masked booby; these colonies are some of the largest in the world for these four species. Rock overhangs are particularly favoured as nesting sites. The only reptiles on the island are a skink and the threatened Serpent Island gecko *Nactus serpensinsula*. Access is almost impossible, but considerable deliberate disturbance is caused by people in boats wanting to view large bird flocks taking off (IUCN/UNEP, 1987).

Ilot Gabriel Nature Reserve

IUCN Category IV

19°53'S, 57°40'E This small 42ha volcanic islet comprises a rugged central region, and is covered with a thin, volcanic soil. To seaward are low sandbanks, and long spurs of volcanic rock projecting into the sea. The islet is covered with shrubby vegetation. The presence of two species of reptile *Gongylomorphus bojerii* and *Phelsuma ornata* is noteworthy. The islet does not appear to support many nesting seabirds at present, possibly because of the presence of numerous introduced rabbits and rats (IUCN/UNEP, 1987).

Ilot Marianne Nature Reserve

IUCN Category IV

20°22'S, 57°47'E This tiny 2ha islet is calcarenitic, with an eroded coastline which may be partially submerged during cyclones. There is a low, sparse beach flora, with native halophytic herbs typical of the salt spray zone. There are no nesting bird populations although migratory birds do occur, and the skink *Gongylomorphus bojerii* is present. The waters around the islet support numerous species of mollusc, and it has long been a favourite site for shell collectors. The relatively large distance to the mainland precludes effective control (IUCN/UNEP, 1987).

Les Mares Nature Reserve

IUCN Category IV

5ha

Perrier Nature Reserve

IUCN Category IV

It has been recommended that this 2ha area be maintained as a research area (Procter and Salm, 1974).

Pouce Nature Reserve

IUCN Category IV

69ha

Round Island Nature Reserve

IUCN Category I

19°51'S, 57°47'E This 159ha island is part of a tilted volcanic cone composed mostly of tuff, weathered into an extremely rugged landscape with numerous cliffs, curious horizontally-ridged pillars and gullies up to 15m deep. Much of the natural vegetation is palm savanna, but this has been greatly reduced by feral rabbits and goats, and few of the endemic bottle and hurricane palms survive. Round Island is the only place where they now occur naturally and where palm savanna exists, despite the fact that this vegetation type probably once covered the entire northern plain of Mauritius. The native hardwood flora has also been drastically reduced, and only two species of woody tree, each known from only one specimen, still remain. Reptiles are the most notable element of the island's fauna, with five threatened species; only four of these have survived on Round Island, and two snake species occur that are the sole surviving members of the primitive sub-family *Bolyerinae*. Fairly large populations of four species of seabirds occur, including 120 pairs of Round Island petrel, which have only one other known breeding location. Feral rabbits and goats that destroyed the island's vegetation to an extent that led to massive soil erosion have now been eradicated. The endangered reptile populations are declining, and poaching and DDT poisoning are a threat to the seabirds. Wardening is difficult because of the lack of water and the physical conditions (Bullock pers. comm., 1991; IUCN/UNEP, 1987).

OTHER MANAGED AREAS

Black River Fishing Reserve

20°22'S, 57°20'E This 900ha reserve includes two rivers, and a marine area comprising a lagoon and coral reefs. The shoreline consists of sandy beaches, rocky shores and mangroves. The area supports many commercially valuable species, and it is a known nursery area for mullet, crab and oysters. The use of large nets or gillnets is prohibited, and routine enforcement is carried out. Illegal fishing occurs, and there are hotel developments and boating off shore (IUCN/UNEP, 1987).

Flacq Fishing Reserve

20°09'S, 57°45'E This reserve covers 600ha; it comprises a lagoon, coral reefs, numerous mudflats and sandbanks. Vegetation includes mangroves along much of the coast, and marshy areas, seagrass and algal beds at the lagoon's edge. All commercially exploited fish species are well-represented, many using the reserve as a nursery area. Large net or gillnet fishing is prohibited, and routine patrolling is carried out. Illegal fishing, hotel development and boating occur in the area. (IUCN/UNEP, 1987).

Grand Port-Mahebourg Fishing Reserve

15°23'S, 57°42'E This 2200ha reserve comprises a sand- and rock-bottomed lagoon, coral patches and reefs, with an intertidal zone of sandy beaches and rocky areas. Dense stands of mangroves occur. All commercially exploited fish species are well-represented, and many species spawn in the area. Large net or gillnet fishing is prohibited; routine patrols are carried out, but illegal fishing occurs. The lagoon may silt up during storms (IUCN/UNEP, 1987).

Port Louis Fishing Reserve

20°09'S, 57°23'E This 500ha reserve encloses the bay containing Port Louis harbour, and an estuary including a muddy- to sandy-bottomed lagoon, and mostly dead coral patches. A deep channel leads to the main harbour through the reef. Seagrass communities are extensive in the slightly eutrophic southern parts, and algae occur at the sewage outfalls. Lagoon fish species are present as well as all locally exploited species, and the reserve provides large nursery areas for several of these. Large net and gillnet fishing is prohibited, and routine patrolling carried out; illegal fishing does, however, occur. Effluent from two sewage outfalls flow into the reserve, and solid waste is dumped in one area, affecting coral communities. The harbour causes a certain amount of disturbance (IUCN/UNEP, 1987).

Rivière du Rampart-Poudre d'Or Fishing Reserve

20°05'S, 57°42'E This 3500ha reserve comprises a lagoon with sand- and rock-bottoms, and coral reefs. The shore is mainly rocky with small stretches of sandy beach. Mangroves form dense stands in some areas and cover many of the rocky islets. The reserve is particularly rich in mullet, rabbitfish, goatfish and scavenger fish. Rich oysterbeds are present, and all commercially exploited fish species are fairly well represented. Large net and gillnet fishing is prohibited and routine patrolling carried out; illegal fishing does occur (IUCN/UNEP, 1987).

Trou d'Eau Douce Fishing Reserve

20°16'S, 57°47'E This 700ha reserve includes a strip of shallow water along the east coast, and several bays and estuaries. There are extensive areas of mangroves in the intertidal zone and around the many small islets of the Iles aux Cerfs. The area is rich in seagrass beds. The fauna comprises varied coral communities, and the brackish water provides habitats for oysters. It is a nursery ground for many fish, and is particularly rich in mullet species. Pollutants from a large sugar mill are carried into the reserve via the deep Beau Champ River, and during heavy rains large amounts of silt are deposited. Large net and gillnet fishing is prohibited, and routine patrolling carried out; illegal fishing still occurs (IUCN/UNEP, 1987).

UNPROTECTED SITES**Agalega**

These woodland sites require protection (IUCN, 1987)

Anse de Balaclava Marine Park

This park includes marine habitats and coral reefs.

Baie de l'Arsenal Marine National Park

Recommended

20°02'S, 57°31'E A park covering 100ha has been proposed. This bay has a variety of coastal formations, and a peripheral fringing reef 30-60m offshore, enclosing a brackish lagoon. The reef is cut at frequent intervals by surge channels, bordered by more sheltered fringing reefs. Lagoonal patch reefs occur at a depth of 1-4m. The sheltered reefs support a dense cover of fragile coral colonies which are remarkably

large, intact and diverse, supporting many reef fishes. The seagrass beds attract a variety of marine fauna. The sandy beaches were previously used by nesting turtles. The area is threatened by a plague of sea urchins which are destroying the seagrass beds and some of the reefs. Other reports indicate that a plague of the crown of thorns starfish may be affecting the reefs. The proposed Arsenal/Pointe aux Cannoniers Marine Nature Reserve extends from, and includes, **Baie de l'Arsenal Marine National Park** to Coin de Mire, off the northern tip of the island. Corals and seagrass beds occur, but fishermen may have to be relocated (IUCN/UNEP, 1987; Robertson, 1974; Stuart *et al.*, 1990; UNEP/IUCN, 1988).

Blue Bay/Le Chaland Marine Nature Reserve

Proposed

A managed nature reserve of 390ha has been proposed on Rodrigues island; corals occur, and 91 species of fish have been recorded. Bras de Mer du Chaland supports a fringe of mangroves. There is tourism development in the area, and it is badly littered (UNEP/IUCN, 1988).

Brise Fer Forest

20°22'S, 57°25'E This is situated just east of Piton Brise Fer, on the western edge of the island's central plateau. Mature lower montane evergreen wet forest, mostly of slow-growing hardwoods, occurs on steep slopes and flat valley bottoms. A sample yielded 60 woody species, including three exotics. No utilisation appears to be taking place (Frame, 1987).

Frégate Island Turtle Reserve

Proposed

16°32'S, 59°30'E This is situated west of the **St Brandon Islets**.

Grande Montague Nature Reserve - see Rodrigues Island

Le Morne Brabant

It has been suggested that marine environs be protected in this area, to protect coral reefs.

Pearl (Perl ) Island Turtle Reserve

Proposed

16°31'S, 59°30'E Situated to the west of the main **St Brandon Islets** group, this reserve is important for nesting marine turtles (UNEP/IUCN, 1988).

Rodrigues Island

19°45'S, 63°20'E This island is of volcanic origin; extensive deforestation has taken place, and 35ha of remaining thicket and forest areas in the north, comprising **Grande Montague Nature Reserve** are in urgent need of protection. They contain many endangered endemic forms. The best-developed coral reefs in the Mascarenes occur around Rodrigues. See also **Ile aux Cocos** and **Ile aux Sables** nature reserves (Stuart *et al.*, 1990).

St Brandon Islets (Cargados Carajos Shoals)

16°23'S, 59°27'E This is a major coral reef area encompassing a total of several thousand square kilometres, although the total actual reef area may not exceed 190km². Important nesting sites for marine turtles occur, including around 300 green turtles, and the islands are home to vast numbers of seabirds such as blue-faced booby *Sula dactylatra*, sooty and white terns. The spider shell *Lambis violacea* is reported to be endemic to **Cargados Carajo Shoals**. Guano collection continues to be a threat (Stuart *et al.*, 1990; UNEP/IUCN, 1988).

MAURITIUS - PROTECTED SITES

National/international designations

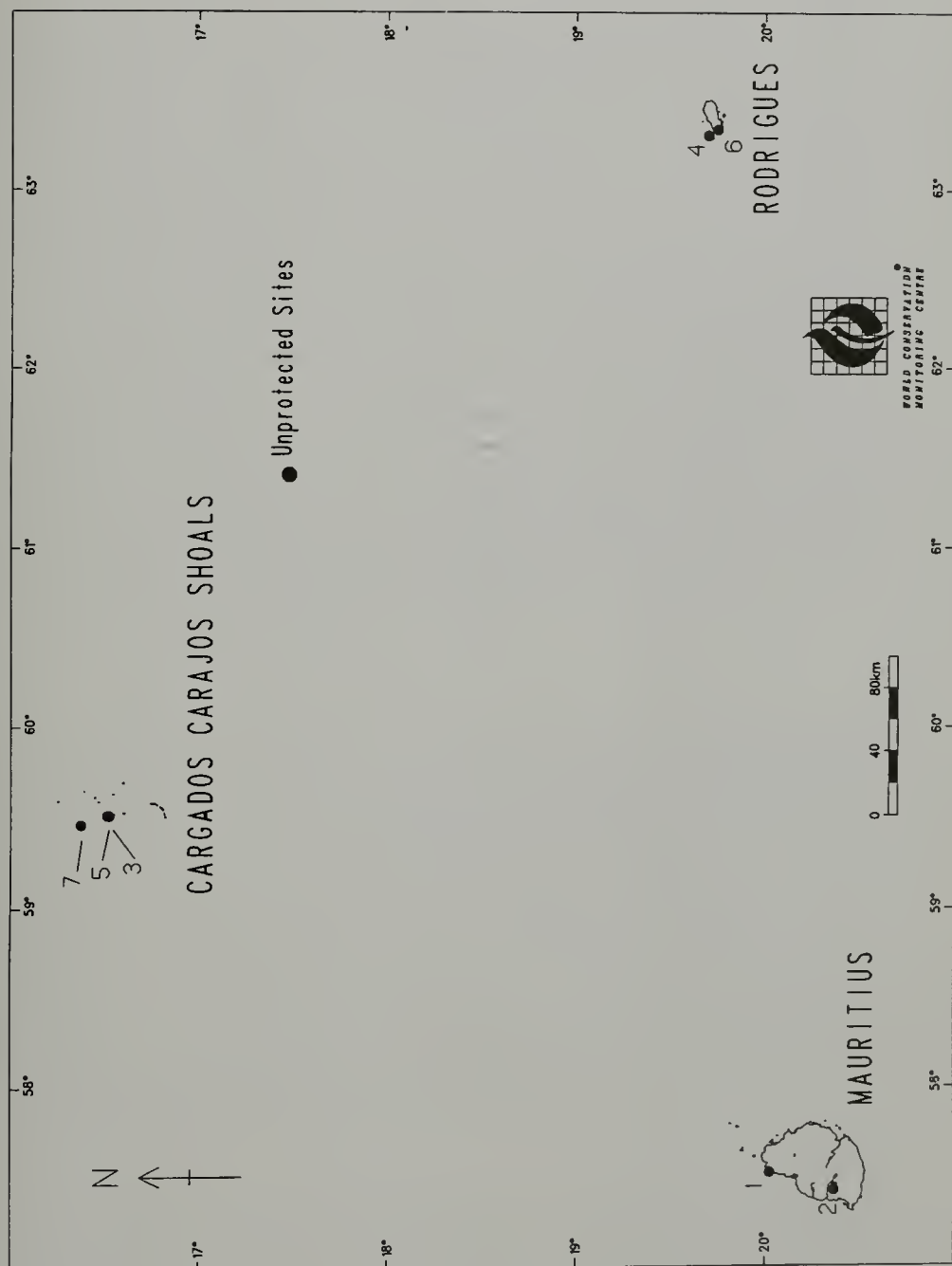
Name of area and map reference (see Fig. 6.1)	Management area (ha)	Year notified
Fishing Reserves		
Black River	900	1983
Flacq		1983
Grand Port-Mahebourg	2,200	1983
Port Louis	500	1983
Rivière du Rampart-Poudre d'Or	3,500	1983
Trou d'Eau Douce	700	1983
Nature Reserves		
1 Bois Sec	6	
2 Cabinet	18	
3 Coin de Mire (Gunner's Quoin)	76	1970
4 Combo	207	
5 Corps de Garde	90	
6 Gouly Père	11	
Grande Montague	35	
Ile aux Cocos	15	1981
Ile aux Sables	8	1981
7 Ile Plate	253	1972
8 Ile aux Aigrettes	25	1965
9 Ile aux Serpents	31	1983
10 Ilot Gabriel	42	1972
11 Ilot Marianne	2	1972
12 Les Mares	5	
13 Macchabée-Bel Ombre	3,611	1951
14 Perrier	2	
15 Pouce	69	
16 Round Island	159	1957
Biosphere Reserve		
Macchabée-Bel Ombre Nature Reserve	3,594	1977

MAURITIUS - UNPROTECTED SITES

Name of area and map reference (see Fig. 6.2)	Management area (ha)
--	---------------------------------

	Agalega	
	Anse de Balaclava Marine National Park	
1	Baie de l'Arsenal Marine National Park	100
	Blue Bay/Le Chaland Marine Nature Reserve	390
2	Brise Fer Forest	
3	Frégate Island Turtle Reserve	
	Le Morne Brabant	
5	Pearl (Perlé) Island Turtle Reserve	
6	Rodrigues Island	
7	St Brandon Islets (Cargados Carajos Shoals)	

Fig 6.2 Mauritius: unprotected ecologically sensitive sites



RWANDA

INTERNATIONALLY DESIGNATED PROTECTED AREAS

Parc National des Volcans

IUCN Categories II and IX

A biosphere reserve of 15,065ha in area, which largely comprises **Volcans National Park** (15,000ha). It is contiguous to **Virunga National Park** (780,000ha) in Zaïre and **Gorilla National Park** (2445ha) in Uganda. These rugged volcanic mountains lie between the altitudes of 2400-4507m, and the forested slopes are important water catchment areas for the surrounding agricultural lands. Vegetation varies considerably with altitude, from lower montane forest (now mainly lost to agriculture), through bamboo and *Hagenia-Hypericum* forest, to *Lobelia* spp. and *Senecio erici-rosenii* at high altitudes. The park is best known for mountain gorillas *Gorilla g. berengei*. Other threatened animals include elephant, and Grauer's swamp warbler *Bradypterus graueri* is one of the 13 or more bird species endemic to the Virunga and Ruwenzori Mountains. The possibility of further reductions in the area of the park for agricultural purposes is a major threat, although this has now been halted. The park may already not be large enough to support viable populations of some species, without the continued existence of neighbouring protected areas in Zaïre and Uganda. Lack of staff and a buffer zone are problems, exacerbated by human population increases on the park periphery. Gorilla poaching occurs, and there are conflicts between gorilla-viewing tourism and wildlife. Other problems include encroachment, illegal wood and bamboo cutting, and feral dogs. Armed political conflict is also threatening the park (CNPPA, 1991; IUCN, 1986; IUCN/UNEP, 1987).

NATIONALLY PROTECTED AREAS

Akagera National Park

IUCN Category II

This area of 312,000ha is bordered to the north-west by **Mutara Hunting Reserve** (30,000ha). Rolling sandstone hills in the west are separated by a steep escarpment from the extensive lakes and swamps of the Kagera valley. Five distinct floras meet in the region, and savanna of various types is predominant; areas of gallery forest and marshes occur. The fauna is diverse, particularly the avifauna (525 species), because of climatic variation and the mixing of east and central African elements. Over 50 mammal species occur, including a wide variety of antelope. Black rhinoceros and elephant have been reintroduced. The park is unfenced, and some 1500 subsistence farming families occupy about 72,000ha. Poaching is a problem, and there are no technical or administrative staff in the park. The Akagera basin is threatened by a hydrological development project. Recent civil disturbances have led to the park being ransacked (CNPPA, 1991; IUCN/UNEP, 1987).

Gishwati Forest Reserve

IUCN Category VIII

1°21'-1°35'S, 29°22'E This reserve covers 21,000ha of montane forest. The area has been heavily grazed by cattle over several decades, with resultant groundcover destruction and erosion (Stuart *et al.*, 1990; Weber and Vedder, 1984).

Mukura Forest Reserve

IUCN Category VIII

Situated to the south of **Gishwati Forest Reserve**, this reserve covers 2100ha; there have been plans to convert the area to managed plantations (Weber and Vedder, 1984).

Mutara Hunting Reserve

IUCN Category VI

This reserve covers an area of 30,000ha, and is contiguous with **Akagera National Park** (Stuart *et al.*, 1990).

Nyungwe Forest Reserve

IUCN Category VI

2°30'S, 29°20'E Covering 90,000ha in the highlands of south-west Rwanda between 1600m and 2700m, this area abuts the northern boundary of **Kibira National Park** in Burundi. It is a major water catchment area and several different forest-types occur, including *Podocarpus* forests, bamboo thickets and extensive marsh complexes. The fauna and flora are extremely rich, with several endemic forms including over 50 endemic woody plants; it is the only area where the endemic Lestrade's duiker is found. Over 200 species of forest bird have been recorded, plus 11 species of primate, including l'Hoeest's guenon, grey-cheeked mangabey and chimpanzee. The establishment of plantations and logging represent major threats to this area, and itinerant gold-mining activities have caused damage. It has been proposed as Rugege National Park (Hughes and Hughes, 1992; Rodgers, 1981; Stuart *et al.*, 1990; Weber and Vedder, 1984).

OTHER MANAGED AREAS

None

UNPROTECTED SITES

Akanyaru Swamp - see **Kanyaru Swamp**

Kanyaru Swamp

2°30'S, 29° 50'E This is an important wetland along the border with Burundi (Stuart *et al.*, 1990).

Lake Bulera

1°30'S, 29°40'E This is an important wetland, under threat (Stuart *et al.*, 1990).

Lake Kivu

2°00'S, 29°15'E This is an important wetland, under threat. Endemic fish occur (Stuart *et al.*, 1990).

Lake Luhondo

This is an important wetland, under threat (Stuart *et al.*, 1990).

Mulindo Swamp

This is an important wetland (Stuart *et al.*, 1990).

Nyabarongo Swamp

This is an important wetland (Stuart *et al.*, 1990).

Rugezi Swamp

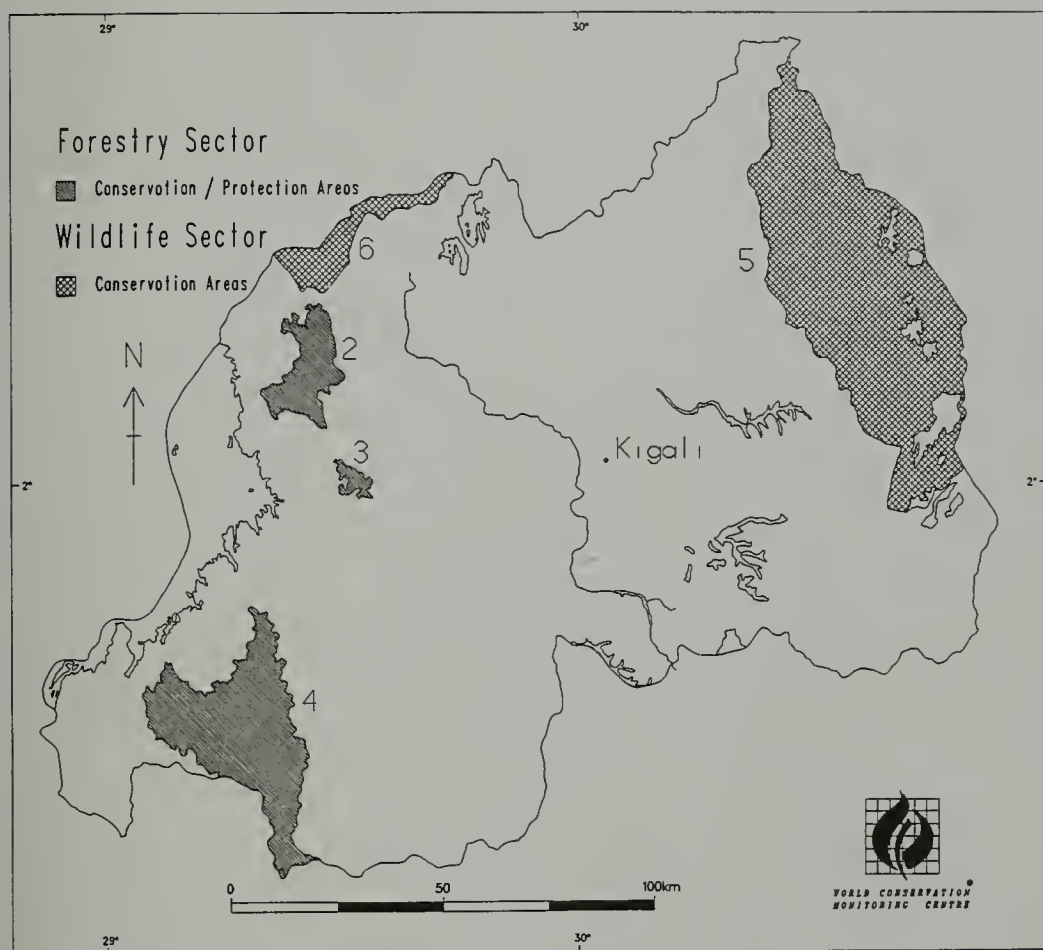
This is an important wetland (Stuart *et al.*, 1990).

RWANDA - PROTECTED SITES

National/international designations

Name of area and map reference (see Fig. 7.1)	Management area (ha)	Year notified
Hunting Reserve		
1 Mutara	30,000	
Integral Forest Reserves		
2 Gishwati	21,000	
3 Mukura	2,100	
4 Nyungwe	97,000	
National Parks		
5 Akagera	312,000	1934
6 Volcans	15,000	1929
Biosphere Reserve		
Parc national des Volcans	15,065	1983

Fig 7.1 Rwanda: protected ecologically sensitive sites

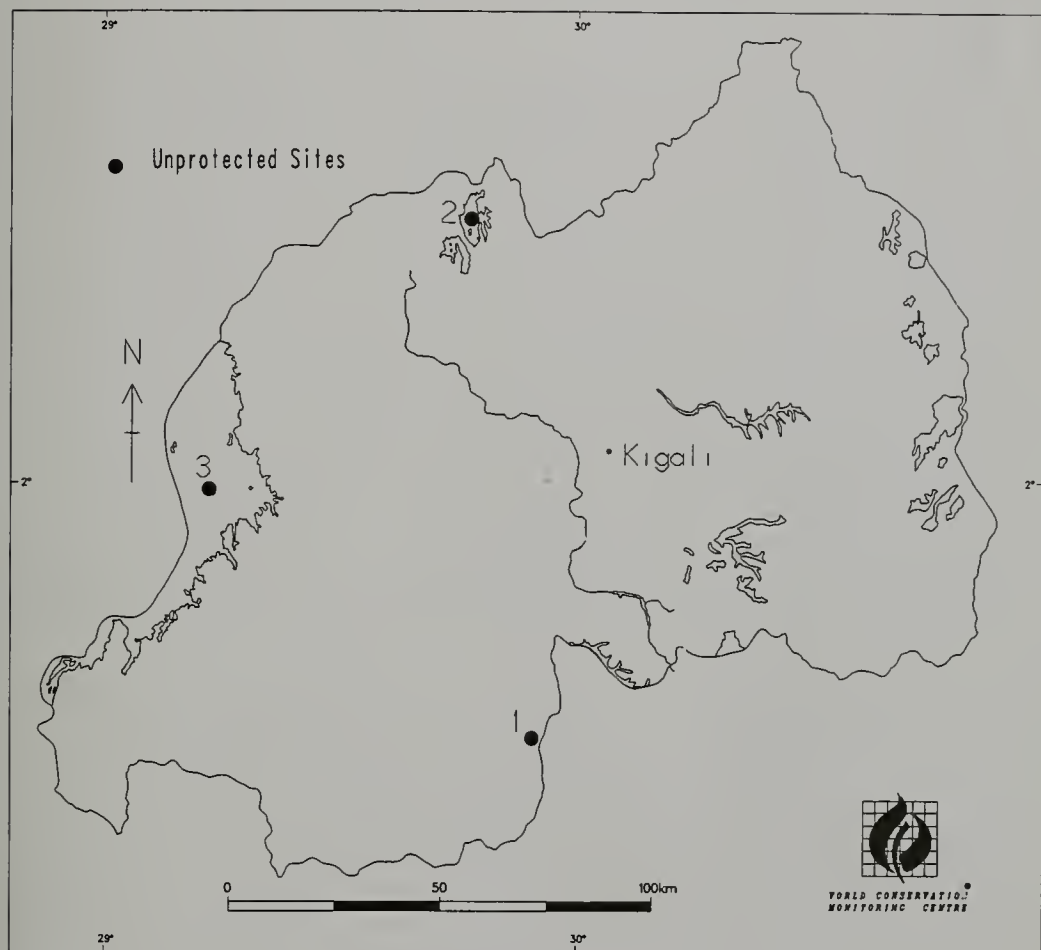


RWANDA - UNPROTECTED SITES

Name of area and map reference (see Fig. 7.2)	Management area (ha)
--	---------------------------------

- | | |
|------------------|--|
| 1 Kanyaru Swamp | |
| 2 Lake Bulera | |
| 3 Lake Kivu | |
| Lake Luhondo | |
| Mulindo Swamp | |
| Nyabarongo Swamp | |
| Rugezi Swamp | |

Fig 7.2 Rwanda: unprotected ecologically sensitive sites



SEYCHELLES

INTERNATIONALLY DESIGNATED PROTECTED AREAS

Aldabra Atoll Strict Nature Reserve

IUCN Categories I and X

9°25'S, 46°25'E The reserve covers 35,000ha (18,800ha land, 2000ha intertidal mangroves and 14,200ha sea), the World Heritage site covering 15,380ha. Aldabra is a classic coral atoll of four main islands narrowly joined to enclose a large shallow lagoon and the entire atoll is surrounded by an outer reef. It has been identified as one of the most important conservation sites in Africa and its related islands (IUCN, 1987). The terrestrial flora is exceptionally rich for a small coral island and the terrestrial fauna is unusual in that reptiles dominate, with the largest population (152,000) of threatened giant tortoise *Geochelone gigantea* and about 1000 nesting green turtles. The avifauna includes Aldabran rail, the only remaining population of this flightless subspecies. The islands are important breeding grounds for thousands of seabirds. Difficulties in patrolling effectively and ease of access bring the threat of illegal capture of animals, disturbance and fire. Rats, cats and goats have been introduced; goat eradication programmes in 1987 and 1988 on two islands eliminated 75%-85% of the goats but cats are proving difficult to remove. The spread of an introduced mealy bug has seriously damaged native vegetation and biological control is being tried. Development is restricted to small-scale tourism, deep-sea fishing and limited exploitation of some natural resources (IUCN/UNEP, 1987).

Vallée de Mai Nature Reserve

IUCN Category IV and X

4°19'S, 55°44'E The reserve covers 18ha and is within **Praslin National Park** (675ha). It is a valley near sea-level which survived untouched until the 1930s and still retains some coco-de-mer palm forest in a near natural state, this species being found naturally on only two islands. The most noteworthy bird (30 pairs in 1984) is the endemic subspecies of black parrot *Coracopsis nigra barklyi*, restricted to Praslin Island and totally dependent on the Vallée de Mai and surrounding palm forest. The reserve also supports a wide variety of reptiles. Collection of coco-de-mer nuts is now controlled by law. Timber exploitation and planting of exotics has occurred in the past but has now ceased and exotic plants are being removed. Much of the reserve has been replanted with endemic palms. Fire may be a hazard and a firebreak has been established. A potential problem is that the area does not include the whole water catchment (IUCN/UNEP, 1987).

NATIONALLY PROTECTED AREAS

Aride Island Special Reserve

IUCN Category I

4°08'S, 55°40'E Most of this 70ha crescent-shaped island is occupied by a rugged hill rising to 134m, the remaining area being flat. Around the island are fairly exposed undamaged fringing reefs which have been proposed for inclusion in a marine park. Vegetation of Aride hill is largely free of exotic plant species and is the most undisturbed of any of the small Seychelles islands. Aride supports over a million pairs of seabirds of 11 species; it has the world's largest colonies of both lesser noddy and roseate tern and is the only place in the Seychelles where red-tailed tropic bird still

breeds. A few hawksbill turtles nest. Skinks are numerous and the main predators of seabirds' eggs and chicks. Aride is unusual in remaining free of rats, cats and dogs although *Mus musculus* are common. There is some turtle poaching and large numbers of eggs are collected, which has affected bird numbers. Two plants, wild pineapple and cactus, are encroaching on sooty tern colonies and the small freshwater swamp is dominated by coco-yam (IUCN/UNEP, 1987).

Baie Ternaie Marine National Park

IUCN Category II

4°38'S, 55°22'E This covers 80ha and is contiguous to the terrestrial **Morne Seychellois National Park** (3045ha). Situated in a sheltered bay, it includes a shallow lagoon inside a continuous fringing reef which provides habitats for numerous reef fishes. Here there are few living corals but deeper reefs fringing the rocky headlands are in good condition, with soft corals anchored on dead *Porites* colonies. A variety of seaweeds occur and hawksbill turtles breed. Lack of trained personnel and equipment means that there is no enforcement of regulations and some coral, shells and turtles are taken. A large National Youth Service camp sited by the bay has effectively closed it to the general public; some fishing by staff and students occurs. Treated sewage from the camp is also discharged into the bay and its effects are not fully known (IUCN/UNEP, 1987).

Cousin Island Special Reserve

IUCN Category I

4°19'S, 55°39'E The reserve includes Cousin Island (28ha), and extends 400m off shore from the high water mark. The island's south and west slopes are rocky and barren down to sea-level while the rest supports dense stands of trees. Sandy beaches make up 80% of the shoreline and a fringing coral reef surrounds the island about 200m off shore. Cousin was set up as a reserve because of its three threatened endemic landbirds: Seychelles warbler (only known from this island), Seychelles fody (on only three islands) and Seychelles turtle dove, an endemic race now extinct by interbreeding with introduced birds. However, by far the largest biomass is the seabirds, including probably the largest breeding colony of white fairy tern (10,000 in 1980) in the Seychelles. Cousin has one of the Seychelles' largest breeding populations of hawksbill turtle, and green turtle also breed occasionally. The island was formerly a coconut plantation with many other plants introduced but native vegetation is now being encouraged. The reefs used to be exploited for shells and fishermen still poach a few turtles. The island is strictly managed by ICBP (IUCN/UNEP, 1987).

Curieuse Marine National Park

IUCN Category II

4°17'S, 55°43'E The reserve of 1470ha total comprises the rugged granitic island of Curieuse (283ha) which rises to 172m in Curieuse peak and extends to the coast of Praslin where it includes the St Pierre Islet and the northern coastline. The marine part of the park includes shallow water reefs, exposed at low tide and some mangroves. Curieuse is significant as one of only two islands where coco-de-mer grows naturally. About 30 hawksbill turtles nest and the marine area has good coral growth and a variety of reef fish. Some areas of the island have been badly burnt; extensive contour drains to combat erosion and *Casuarina* plantations are still prominent. Proposals to

drain the marshes for vegetable farms would remove the most suitable site for setting up a second colony of the endangered Seychelles black paradise flycatcher *Terpsiphone corvina* which has only one viable population. Some illegal hunting of turtles occurs (IUCN/UNEP, 1987).

La Digue Veuve Reserve

IUCN Category IV

4°21'S, 55°50'E Covers 8ha on the low-lying western plateau of La Digue and includes part of a large freshwater marsh. Woodland of takamaka *Callophyllum inophyllum* and badamier *Terminalia catappa* predominates, one of the small remnants of forest which once covered the coastal lowlands. The reserve supports seven to nine pairs (of a total of about 80 individuals) of the threatened Seychelles black paradise flycatcher *Terpsiphone corvina* whose favoured habitat is takamaka, badamier and marshes. It is also a good site for the Seychelles pond turtle. The land is privately owned and it has been recommended that the Seychelles Government should buy it. The marsh is only a part of a larger system and vulnerable to drainage and pesticide usage from outside the reserve's boundaries. The reserve is also the smallest in the Seychelles on one of the most densely populated islands (IUCN/UNEP, 1987).

Port Launay Marine National Park

IUCN Category II

4°39'S, 55°23'E This covers 158ha, contiguous to the terrestrial **Morne Seychellois National Park** (3045ha). This sheltered cove has reefs fringing the rocky shores at either end of the beach, formed of boulder type coral with *Porites* spp. dominant. Reef development is not extensive and living corals are few and not so extensive as in Baie Ternaie. However, the deeper reefs fringing the rocky headlands are in good condition, comprising soft corals anchored on dead *Porites* colonies. Some fishing is carried out by the nearby National Youth Service camp staff and students, and poaching of marine turtles is still a problem. The bay is sheltered from the prevailing winds and frequently used as an anchorage. An area of mangroves receives no formal protection (IUCN/UNEP, 1987).

Praslin National Park

IUCN Category II

4°19'S, 55°44'E The park covers 675ha and contains the 18ha **Vallée de Mai Nature Reserve**. It contains many coco-de-mer, for which the Vallée de Mai is famous, now only found naturally on two islands. The varied vegetation includes lowland forest, intermediate palm forest (unique in having five endemic palm species occurring together) and also successional habitats developed after burning. The national park is primarily managed for tourism, forestry and water catchment protection although the Vallée de Mai is managed as a nature reserve but there are problems associated with the attempt to manage such a small park as a multiple-use management area (IUCN/UNEP, 1987).

St Anne Marine National Park

IUCN Category II

4°35'S, 55°30'E Covers 1423ha and includes all the surrounding reefs and sea between a group of six small rugged granitic islands. Among some of the dead reefs are fairly extensive beds of *Sargassum* seaweeds. Terrestrial vegetation is mainly secondary, with coconut the most common tree, and the islands support a variety of

reptiles and wading birds. The park is also one of the main breeding sites for hawksbill turtle within Seychelles. Much of the coral has been killed by silt from the dredging of the harbour and from airport construction, and some very delicate formations are in need of protection; however, off the north side of Moyenne Island 150 species of fish occur. Formerly shell collecting caused some damage to the coral. Another major problem is persistent poaching by a few families and staff are inadequate and not formally trained (IUCN/UNEP, 1987).

OTHER MANAGED AREAS

Morne Seychellois National Park

IUCN Category VIII

4°39'S, 55°26'E This covers 3045ha on Mahé, contiguous to **Baie Ternaie** (80ha) and **Port Launay** (158ha) **marine national parks**. It comprises a very rugged part of the largest granitic Seychelles island, rising to 905m. Vegetation is diverse and includes all the endemic plants known from Mahé plus the largest known populations of two of the four Seychelles species listed in the IUCN Plant Red Data Book. Most of the populations of two of the threatened bird species limited to Mahé (Seychelles scops owl and Seychelles white-eye), exist in the park and a significant number of white-tailed tropic bird still breed. Past timber extraction and forest fires have done irreparable damage although afforestation since 1950 has made some reparation. Trees were also felled for a powerline and a road passes through the western part. Exotic plant species are encroaching on a large scale. A track and strip of farmland separates the park from Ternay Bluff Marine National Park. Army exercises are carried out here occasionally (IUCN/UNEP, 1987).

UNPROTECTED SITES

African Banks Special Reserve (Amirantes)

Proposed

Ile des Noeufs Special Reserve is situated in the south of the Amirante Islands. Tern eggs are harvested commercially on this island, which is a proposed special reserve to protect colonies of sooty and noddy terns. **Etoile Cay and Boudeuse Cay nature reserves** are situated in the south of the main Amirante island group, whilst the African Banks are two sand cays covering 0.4km² in the north (Stuart *et al.*, 1990; UNEP/IUCN, 1988).

Albatross Rocks-Cocos Island Managed Nature Reserve

Proposed

4°18'S, 55°52'E The proposed **Albatross Rocks Managed Nature Reserve** includes this island, to the north of Felicite island. They are surrounded by spectacular coral reefs (UNEP/IUCN, 1988; Stuart *et al.*, 1990).

Bird and Dennis Islands

Proposed

3°43'S, 55°13'E (Bird) and 3°48'S, 55°40'S (Dennis) These are the only sand cays on the Seychelles Bank. Dennis Island is largely covered by coconut plantations, whilst Bird Island is home to an enormous colony of sooty terns and brown noddies. A profusion of corals occurs (UNEP/IUCN, 1988).

Frégate Protected Area

Proposed

The endemic Seychelles Magpie-Robin *Copsychus sechellarum* and Seychelles Fody *Foudia sechellarum* occur on Frégate, to the east of Mahé.

Ile aux Vaches Marines et Mammelles

Situated close to the southern shore of Mahé Island (Stuart *et al.*, 1990).

Ile des Noeufs - see African Banks Special Reserve (Amirantes)

Proposed

King Ross Nature Reserve (Stuart *et al.*, 1990)

Silhouette Island

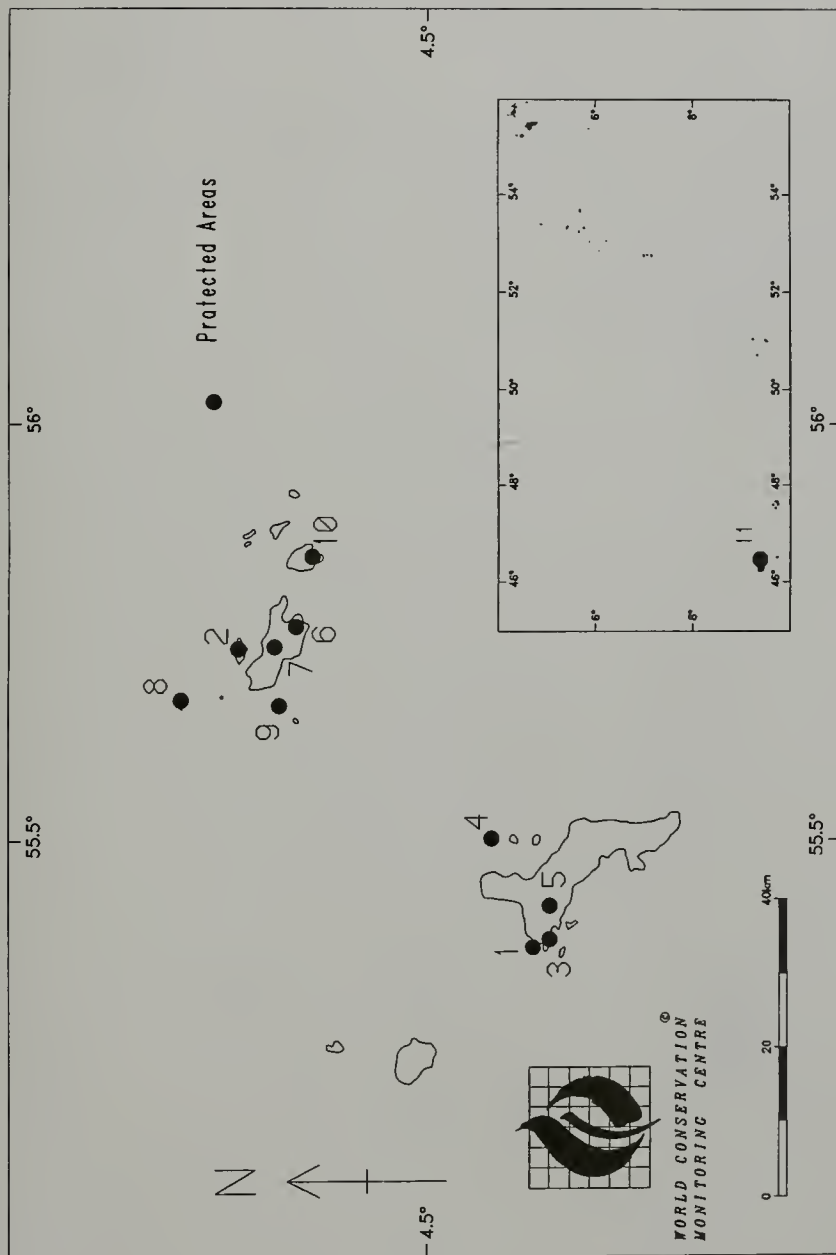
The entire island is an important marine reserve which requires a stronger measure of protection (Stuart *et al.*, 1990).

SEYCHELLES - PROTECTED SITES

National/international designations

Name of area and map reference (see Fig. 8.1)	Management area (ha)	Year notified
Marine National Parks		
1 Baie Ternaie	80	1979
2 Curieuse	1,470	1976
3 Port Launay	158	1979
4 St Anne	1,423	1973
National Parks		
5 Morne Seychellois	3,045	1979
6 Praslin	675	1979
Nature Reserve		
7 Vallée de Mai	18	1966
Reserves		
8 Aride Island Special	70	1973
9 Cousin Island Special	28	1975
10 La Digue Veuve	8	1982
Strict Nature Reserve		
11 Aldabra Atoll	35,000	1976
World Heritage Sites		
Aldabra Atoll	35,000	1982
Vallée de Mai Nature Reserve	18	1983

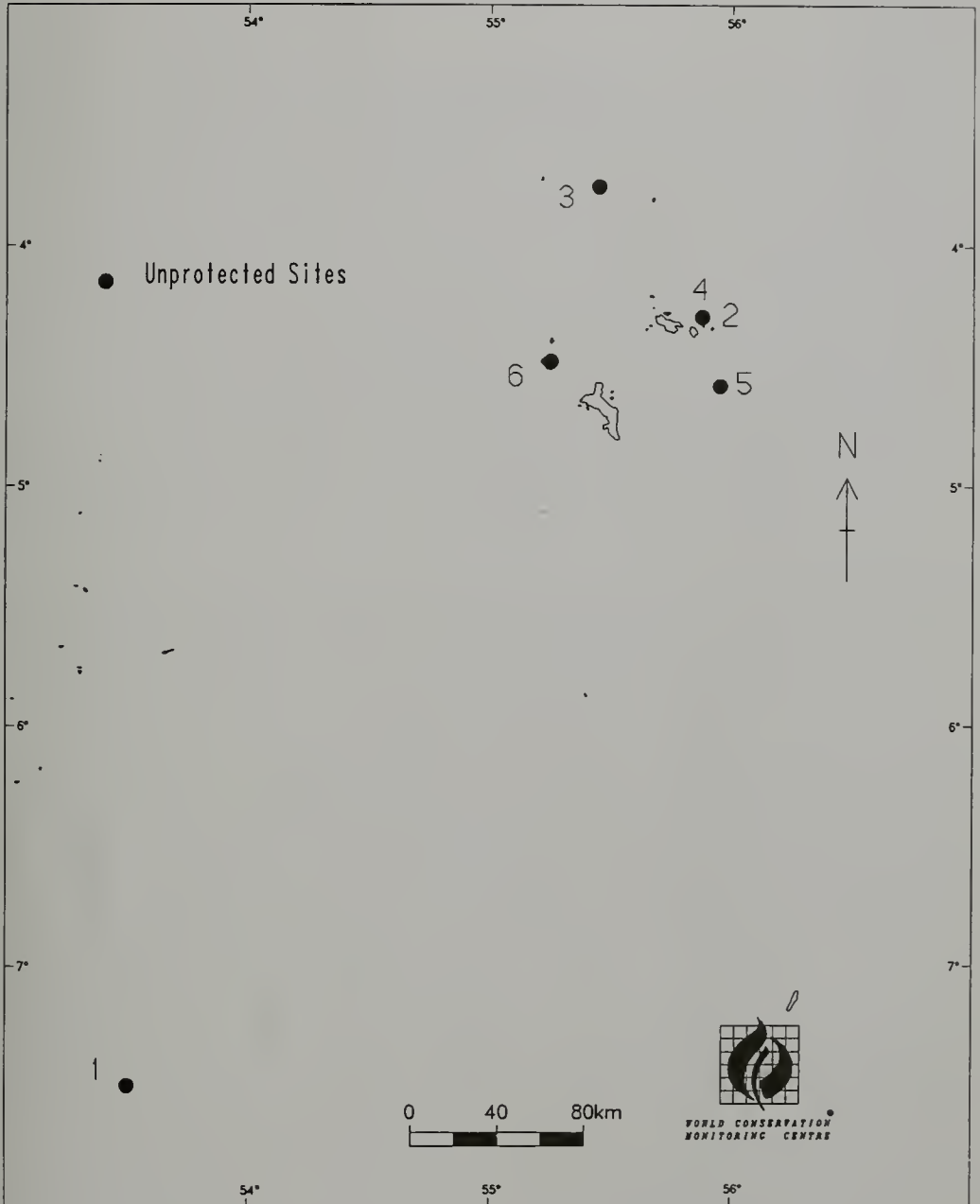
Fig 8.1 Seychelles: protected ecologically sensitive sites



SEYCHELLES - UNPROTECTED SITES

Name of area and map reference (see Fig. 8.2)	Management area (ha)
1 African Banks Special Reserve (Amirantes)/Iles des Noeufs	
2 Albatross Rocks-Cocos Island Managed Nature Reserve	
3 Bird and Dennis Islands	
4 Cocos Island Managed Nature Reserve	
5 Frégate Protected Area Ile aux Vaches Marines King Ross Nature Reserve	
6 Silhouette Island	

Fig 8.2 Seychelles: unprotected ecologically sensitive sites



ZAIRE

INTERNATIONALLY DESIGNATED PROTECTED AREAS

Garamba National Park

IUCN Categories II and X

The park and World Heritage site covers 492,000ha and is surrounded in Zaïre by Azande, Mondo Missa, and Gangala-na Bodio hunting reserves, totalling about 1,000,000ha. It is situated on a vast undulating plateau broken by inselbergs and includes sizeable marshy depressions. The park is particularly interesting due to its position between the Guinean and Sudanese biogeographic realms. Savanna predominates but there is also gallery forest. The park contains what is probably the last viable natural population of white rhinoceros; in 1960 there were 1000 individuals but by 1984 only 15 remained because of intensive poaching. This species is on the IUCN list of the world's 12 most threatened animals. The elephant population is also unique in being intermediate between forest and savanna subspecies but poaching has reduced it by nearly three-quarters. However, support since March 1984 from the IUCN/WWF/FZS/Unesco Garamba Rehabilitation Project and increased staffing has controlled much of the poaching and the rhino population increased to 26 in 1990. A road network and five new patrol posts have improved surveillance (IUCN, 1990; IUCN/UNEP, 1987).

Kahuzi-Biega National Park

IUCN Categories II and X

This World Heritage site of 600,000ha includes some mountains of the Great Rift Valley and Kahuzi volcano (3400m) with very undulating terrain between these and the Zaïre River basin. The park is named after two extinct volcanoes and includes a range of vegetation zones from alpine grassland through montane rain forest (much of which is primary in nature) to lowland equatorial rain forest. It was established to protect 200-300 mountain gorilla and the range of biotypes provides excellent gorilla habitat. The park also supports a number of other threatened species, including chimpanzee *Pan troglodytes*, elephant, the endemic Rockefeller's sunbird *Nectarinia rockefelleri*, African green broadbill *Pseudocalyptomena graueri* and Grauer's swamp warbler *Bradypterus graueri*. However, poaching for subsistence and by organised gangs affects most species and roads have deteriorated so that it is not possible for guards to patrol the park adequately. There are villages in the buffer zone, and agricultural activities, especially tea-growing, take place on the periphery and the whole area has been affected by shifting cultivation in the past. Joint projects between Germany and Zaïre have helped conserve the mountain gorilla, including the installation of more patrol posts and a radio communications system. The gorillas attract many tourists and provide some revenue (IUCN, 1990; IUCN/UNEP, 1987).

Luki Forest Reserve

IUCN Categories IV and IX

This biosphere reserve of 33,000ha is in a low-lying area drained by the Luki River and a dense network of tributaries. Much of the area comprises secondary sub-equatorial rain forest, due to past disturbance, but is still species-rich. The area was heavily logged until 1963 and a small area is cultivated. There is some savanna. The varied fauna includes elephant. Hunting and fishing are prohibited but poaching

has severely reduced many animal populations and surveillance needs to be improved (IUCN, 1990; IUCN/UNEP, 1987).

Salonga National Park

IUCN Categories II and X

The park covers 3,656,000ha (World Heritage site - 3,600,000ha) and comprises a large section of the central basin of the Zaïre River which is very isolated and mainly accessible by water. Many of the watercourses are meandering and have marshy banks. Salonga is the largest tropical forest national park in the world, with semi-deciduous equatorial rain forest covering most of the area. It supports most animals typical of this habitat, including both subspecies of elephant and slender-snouted crocodile. It is one of two or three parks where the threatened Congo peacock *Afropavo congensis*, endemic to eastern Zaïre, is found (Collar and Stuart, 1985). Heavily mechanised forestry is the principal problem, making logging routes through the forest and facilitating access by agriculturalists. There is no reforestation or management. Poaching both by traditional and modern methods has reduced numbers of elephant, pygmy chimpanzee, hippopotamus and grey parrot. Plans exist to establish breeding farms for grey parrot in the buffer zone where traditional fishing, hunting and gathering already occur. An increase in the anti-poaching operations and the blocking of some of the main river access routes are of high priority. About 1500 pygmies live in the park and there are plans to relocate them. Increasing the awareness of local people of the value of the park and involving them in management is considered a priority, as is the improvement of infrastructure and provision of a research station (IUCN, 1990; IUCN/UNEP, 1987).

Vallée de la Lufira

IUCN Category IX

The biosphere reserve of 14,700ha is within **Kundelungu National Park** (760,000ha) and has a core area of 2800ha. The Lufira River is dammed near its source to form a lake which is shallow and almost completely filled with reeds. Most of the valley is very flat so that the river meanders and marshes form in the wet season. Miombo woodland predominates with grassland in areas that flood. The area is particularly noteworthy for its waterbirds, and elephant and lechwe also occur. However, the entire region has been considerably modified by overgrazing by cattle, tree felling for wood and charcoal, fires and fishing. Infilling of the artificial lake by organic deposits has caused the water level to rise and increased evaporation (IUCN, 1990; IUCN/UNEP, 1987).

Virunga National Park

IUCN Categories II and X

This park (780,000ha) and World Heritage site (790,000ha) is contiguous to **Gorilla National Park** in Uganda and **Volcanoes National Park** in Rwanda. It includes all the Zaïre part of Lake Edward and of the Virungas and part of the Ruwenzori range, with altitudes up to 5119m. The park has great biological diversity being at the boundary of several biogeographical zones and including a wide range of altitudes. It is unusual in being set up primarily for research in colonial times and is now important for its mountain gorilla population. The threatened fauna also includes chimpanzee *Pan troglodytes*, elephant and several bird species. Some of the largest wild animal concentrations in Africa occur along the rivers and Lake Edward supports

a variety of fish, particularly cichlids. The elephant population declined drastically in the 1960s through poaching but numbers are now increasing, with over 800 in 1988. A rapid population explosion has occurred on the park's boundaries over the past 40 years and poaching has increased. Killing elephant and gorilla has been stopped but localised poaching is contributing to declines in most species. Within the park are three fishing villages with 20,000 inhabitants. The construction of the proposed Semliki and Rutshuru dams could affect the park's ecosystems. Densities of hippopotamus are so high that they may have to be cropped. Several extensions to the park have been proposed to include valuable habitat (Delvingt *et al.*, 1990; IUCN, 1990; IUCN/UNEP, 1987; Verschuren, 1988).

Yangambi Forest and Floral Reserve

IUCN Categories VIII and IX

The biosphere reserve covers 250,000ha and comprises a strict forest reserve and a monitored floristic zone which are part of the state botanical forest at Yangambi station. It is situated in an area of relatively flat terrain with dense semi-deciduous rain forest and supports the complete fauna typical of this habitat, including several primate species, elephant, hippopotamus, bongo and sitatunga. Several villages have been established and traditional agriculture and hunting are practised (IUCN, 1986; IUCN, 1990; IUCN/UNEP, 1987).

NATIONALLY PROTECTED AREAS

Azande Hunting Reserve	IUCN Category VI
Basse Kando Hunting Reserve	IUCN Category VI
Beni (Oicha) Hunting Reserve	IUCN Category VI
Bili Uere Hunting Reserve 600,000ha	IUCN Category VI
Bushimaie Hunting Reserve 60,000ha	IUCN Category VI
Epulu Hunting Reserve	IUCN Category VI
Fizi Hunting Reserve	IUCN Category VI
Gangala-na Bodio Hunting Reserve	IUCN Category VI
Iles de Kifuabire Hunting Reserve	IUCN Category VI
Kibale-Ituri Hunting Reserve	IUCN Category VI

Kundelungu National Park

IUCN Category II

This covers 760,000ha and includes a biosphere reserve of 14,700ha in the **Vallée de la Lufira**. The park is divided in two by an escarpment up to 400m high; the higher Kundelungu section is mainly plateau while the lower part comprises the Lufira valley (see above). A tributary of the Lufira, the Lofoi, has falls which are reputed to be the highest in Africa (384m) with a single fall of 347m. Vegetation is predominantly open savanna with gallery forests along watercourses which includes afro-montane species above 1500m. The park is particularly rich in ungulates, with at least 15 species. It also supports threatened species such as leopard and cheetah and is in the only region of Zaïre in which zebra and cheetah occur. Birds include wattled crane (of special concern). However, intense poaching occurs and particularly affects elephant, sable, cheetah and zebra. There are illegal settlements, some cattle grazing and fires; there is also mineral exploitation. Fire plays a part in maintaining some of the ecosystems but its role is not yet fully understood (IUCN, 1990; IUCN/UNEP, 1987).

Lac Mokoto Hunting Reserve

IUCN Category VI

Loma Hunting Reserve

IUCN Category VI

Lualaba Hunting Reserve

IUCN Category VI

Luama Hunting Reserve

IUCN Category VI

4°06'–4°55'S, 27°40'–28°31'E 340,000ha of Guineo-Congolian forest-savanna mosaic at an elevation of around 600m, on the southern forest boundary west of the Kilinguye River. About 25% is covered by forest, the rest by savanna, *Papyrus* swamp and gallery forest. A wide diversity of flora and fauna occurs, and there is potential for tourism. There is considerable human settlement and the people use the area for subsistence hunting (Stuart *et al.*, 1990).

Luama/Shaba Hunting Reserve

IUCN Category VI

Lubudi-samppa Hunting Reserve
9200ha

IUCN Category VI

Maika-Penge Hunting Reserve
900,000ha

IUCN Category VI

Maiko National Park

IUCN Category II

The reserve covers 1,083,000ha and is located in a fairly mountainous region between the central Zaïre River basin and the mountains along the west side of the Rift Valley. The central part is almost flat. Almost all the area is covered with dense humid equatorial forest, much of which is primary and transitional between lowland and montane forest. The park is important for its population of mountain gorillas and supports other threatened species such as elephant, leopard *Panthera pardus* and Congo peacock *Afropavo congensis*, endemic to eastern Zaïre. Poaching, illicit fishing, gold mining and tree felling occur and are difficult to control because of the size of

the park, the nature of the terrain, the presence of a well-used path through the park and human pressure on the boundaries. Because there are rebel forces in the region the park authorities do not control the whole area and they also face hostility from local people. There is a lack of infrastructure and insufficient patrolling (IUCN/UNEP, 1987).

Mangai Hunting Reserve IUCN Category VI
36,000ha

Mondo Missa Hunting Reserve IUCN Category VI
1,000,000ha

Mont Hoyo Hunting Reserve IUCN Category VI

Mwene IUCN Category VI

Rubi Tele - see Rubitele Hunting Reserve

Rubitele Hunting Reserve IUCN Category VI
2°30'N, 26°00'E Covering about 908,000ha of dense Guineo-Congolian forest, gallery forest and savanna, the reserve was established in 1930. Fauna includes elephant, okapi, sitatunga, bongo, buffalo and chimpanzee. It is an important reserve, situated near the northern boundary of the forest and, if managed, has good tourism and sustained utilisation potential (IUCN, 1990; Stuart *et al.*, 1990).

Rutshuru Hunting Reserve IUCN Category VI
1°00'S, 29°30'E A triangular area of 100,000ha of savanna-forest mosaic, adjacent to **Virunga National Park** on the eastern forest boundary, acting as a buffer-zone between **Virunga National Park** and the Ugandan border. Established in 1953 (IUCN, 1990; Stuart *et al.*, 1990).

Sud-Ouest de Lubero Hunting Reserve IUCN Category VI

Swa-Kibula Hunting Reserve IUCN Category VI
140,000ha

Upemba National Park IUCN Category II
The park covers 1,173,000ha in the Lake Upemba depression and includes many lakes, swamps and the Kibara and Bianco Plateaux, parts of which are highly eroded with spectacular gorges. About 40% of the park comprises lowland aquatic habitats with grassy savannas fringing lakes and swamps. River courses are lined by gallery forest, dominated by bamboo and palms in the highlands. The fauna is very diverse, with many ungulates, and includes threatened species such as elephant, leopard *Panthera pardus*, cheetah *Acinonyx jubatus* and slender-nosed crocodile *Crocodylus cataphractus*; the park also covers most of the range of the black-lored waxbill. During the political unrest of the early 1960s many of the larger animals were shot,

reducing populations considerably, and poaching is still a problem. Low-lying areas are under pressure from local populations. Fire is important in maintaining some habitats and research is needed into how best to manage such areas (IUCN/UNEP, 1987).

OTHER MANAGED AREAS

Alundas-Tutshokwea Hunting Reserve

Bombo-Lumene Game Reserve

About two-thirds of this reserve of 240,00ha is a hunting area with, in the centre, an strict reserve. It is on part of the Bateke plateau and includes some very deep valleys. Savanna is most widespread and has vestiges of forest, especially along rivers. It is the only reserve which protects white-headed robin-chat, which has a limited range. The fauna also includes buffalo, bush pig, several small antelope species and possibly hippopotamus. However, heavy poaching occurs and funds for management are negligible (IUCN/UNEP, 1987).

Bomu Nature Reserve

This reserve is predominantly an area of Congo woodland savanna and supports a number of species, including elephant, buffalo and hippopotamus. Poaching is a problem (IUCN/UNEP, 1987).

Botende Hunting Reserve

0°51'-0°55'S, 18°05'-18°10'E Included within the Congo Basin forests and covering an area of 982ha, this reserve was originally classified as Botende Classified Forest in 1959; it was upgraded in 1960. Lake Tumba itself (0°45'S, 18°00'E) covers 76,500ha at an altitude of 350m, and contains five endemic fish species. The surrounding forest is inundated twice a year by the seasonally flooded Congo River, resulting in a unique ecosystem adapted to annual flooding. The threatened long-snouted and Nile crocodiles occur. Over 119 bird species have been recorded, and mammals include *Cercopithecus ascagnus*, Mona monkey, *Cercocebus aterrimus*, chimpanzee and elephant. (Frame, 1987; IUCN, 1990; Stuart *et al.*, 1990).

Bukama Hunting Reserve

Eaux Delcommune Nature Reserve

The fish fauna in this reserve is notable. However, illegal fishing occurs.

Epi Hunting Reserve

Gungu Hunting Reserve

380,000ha

Hippo/Kolwezi Hunting Reserve

Iles aux Singes

Kalemie Hunting Reserve

Kalule Hunting Reserve

Kiziba-Baluba Hunting Reserve

Kolwezi Hunting Reserve

Lac Fwa Nature Reserve

The fish fauna in this savanna reserve is notable. However, illegal fishing occurs.

Lac Kwada Hunting Reserve

63ha

Libenge Hunting Reserve

Lueba-Izeba Hunting Reserve

Lwadekere Hunting Reserve

Mitwaba Hunting Reserve

Mole Hunting Reserve

32,400ha

Mufufya Hunting Reserve

Mulumbu Hunting Reserve

Mwanza Hunting Reserve

Mwekaji Hunting Reserve

Mwene Musona Hunting Reserve

Sakanya Hunting Reserve

Sandua Hunting Reserve

Sefu-Kiongo Hunting Reserve

Semliki-Kasenye Hunting Reserve

Shaba Elephant Reserve

This reserve is an area of congo-type wooded savanna which supports elephants and various antelope species. Poaching is a problem.

Tshikamba Hunting Reserve

Ubundu Hunting Reserve

UNPROTECTED SITES

Abumonbazi (Mobaye)

3°30'-4°00'N, 21°00'-22°00'E An area of uncertain size, situated in the north-west near the Central African Republic at altitudes between 500m and 600m. Covered by a variety of Guineo-Congolian forest types, which are commercially exploited in certain areas. There is a diverse forest fauna, including okapi. The area is inhabited and forms part of the watershed of the Zaïre River. It is strongly recommended for protection (IUCN, 1990; Stuart *et al.*, 1990).

Alimbongo Forest

Near Alimbongo; patches of montane forest, of special interest (Frame, 1987).

Congo Basin

All lowland equatorial rain forest of the Congo River drainage in Zaïre, exact boundaries of large representative areas as yet undetermined. Includes **Lake Tumba** in western Zaïre, where the surrounding forests are inundated by floods twice a year, resulting in a superbly adapted flora and fauna (Frame, 1987).

Idjwi Island, Lake Kivu

2°01'S, 29°00'E Covering 4100ha, the central massif of Idjwi Island consists of montane forest between 1460m and 2260m, known as Bushenyi forest. In 1985, 2300ha and 600ha consisted of primary and secondary forest, respectively. A relatively rich avifauna occurs, including the Kungwe Apalis *Apalis argentea eidos*, the most important locality for this rare species. Threats to the forest include agricultural clearance by the dense surrounding human population. See also **Lake Kivu** (Frame, 1987; IUCN, 1990; Stuart *et al.*, 1990).

Itombwe Mountains (Uvira Mtns)

3°30'S, 28°55'E These mountains run along the Albertine Rift on the west side of northern Lake Tanganyika. Forests cover the mountains and the areas around Lake Lungwe, giving a total of 650,000ha, including 150,000ha of bamboo and 50,000ha of gallery forest; they are recognised as an important centre of plant endemism. This region is critically important for montane avifauna, among the richest in Africa, supporting two endemic birds species and several rarities; 32 of the 36 Albertine Rift bird endemics occur in these mountains, and the very rare endemic Congo peacock *Afropavo congensis* is found, as is the African green broadbill *Pseudocalyptomena graueri*. There is also a scattered gorilla population, and four endemic amphibians.

The region is settled (Collar and Stuart, 1988; Frame, 1987; Howard, 1988; IUCN 1987 and 1990; Stuart *et al.*, 1990).

Ituri Forests

In north-eastern Zaïre, south of the Uele District; north of the equator, between 27°E and 28°E. The western area is around the Epulu and Ituri rivers, and the eastern area is south of Irumu, southwards to the **Virunga National Park** borders. Altitude is 700-1500m. This is an area of between 6,000,000ha and 7,000,000ha of lowland evergreen rain forest, with some forest-savanna mosaic. Dominant trees are *Cynometra alexandri*, *Brachystegia laerrentia* and *Gilbertiodendron dewevrei*. The fauna is rich, including endemics such as the okapi *Okapia johnstoni*, aquatic civet *Osbornictis piscivora*, and 13 species of primate. Two endemic birds occur, as well as numerous rarities. It is the home of the Mbuti pygmies, but human population is very low. Large-scale timber extraction is a threat, as is charcoal production. The regions of Epulu and Ituri River have been recommended as primary protection areas (Collar and Stuart, 1988; Frame, 1987).

Kabobo Mountain

4°50'S, 29°00'E Situated west of Lake Tanganyika, in the east of Zaïre, between 1500m and 2700m. One endemic bird species, *Apalis kaboboensis*, as well as several endemic subspecies occur. An endemic race of western black-and-white colobus *Colobus polykomos prigoginei* is found here. The area is heavily settled, and is being rapidly degraded by deforestation and erosion (Collar and Stuart, 1988; Frame, 1987; IUCN, 1990; Stuart *et al.*, 1990).

Kyamasumba-Kolwezi Forest

10°23'S, 25°17'E Situated on the Shaba Plateau, at an elevation of about 1000m. The mosaic of dense dry Zambesian miombo forest ("muhulu") contains elements of Guineo-Congolian forest, and is considered to be biologically and scientifically important (IUCN, 1990; Stuart *et al.*, 1990).

Lake Edward Forests

0°15'S, 29°15'E The forest west of Lake Edward, which includes Mount Tshiaberimu and the transitional forest west of Lutuguru. At an altitude of above 1500m, this region supports several threatened and vulnerable bird species, including Prigogine's greenbul *Chlorocichla prigogine*, *Phyllastrephus hypochloris*, pygmy honeyguide *Indicator pumilio* and Congo peacock *Afropavo congensis* (Collar and Stuart 1988; Frame, 1987; Hughes and Hughes, 1991; Stuart *et al.*, 1990).

Lake Kivu Forests

2°05'S, 28°45'E The undifferentiated Afro-montane forests west of Lake Kivu and south to Masisi, part of which are included within **Kahuzi-Biega National Park**, are important for gorillas and numerous rare and threatened species of bird, and are being destroyed outside of that area. Deforestation is taking place at a rapid rate. The forest reserves on the small **Shushu Islands** are in need of protection, as is montane forest in Bushenyi forest, on Idjwi Island. The lake itself supports 16 fish species, including

six species of endemic *Haplochromis* (Collar and Stuart, 1988; Hughes and Hughes, 1991; IUCN, 1990; Stuart *et al.*, 1990).

Lake Mai Ndombe

2°00'S, 18°20'E Covering 230,000ha at an altitude of 300m in Bandundu Region, the lake is surrounded by *Raphia* swamp forest and periodically inundated and terrestrial forests. There are records of 41 species of fish, including three endemics. Forest elephant and hippopotamus occur (Burgis and Symoens, 1987).

Lake Moero

9°00'S, 28°45'E Situated on the border of Zambia (**Lake Mweru** in Zambia), this large lake covers about 458,000ha. There are records of 146 species of fish and of both the slender-snouted and Nile crocodiles; there is a wealth of birdlife, including shoebill stork. Hippopotamus, sitatunga, red lechwe, possibly black lechwe, puku and elephant occur in the region (Burgis and Symoens, 1987).

Lake Nagarenke

4°09'S, 15°35'E A small area of Guineo-Congolian lowland forest to the east of and close to Kinshasa, situated around a small lake of about 2ha. Rare trees, small mammals and birds occur, and the area is recommended for protection as an educative and potential tourist site (IUCN, 1990; Stuart *et al.*, 1990).

Lake Tanganyika

3°21'-8°51'S, 29°04'-31°12'E This slightly brackish lake of 3,294,480ha (1,350,736ha in Tanzania) is the second-deepest in the world, at 1470m. It is ancient, and contains a higher proportion of endemic species than any other African lake; 193 species of fish occur, of which 98% of the cichlids and 57% of the non-cichlid species are endemic. The only protected area of the lake shore is within **Mahale Mountains National Park** in Tanzania (Hughes and Hughes, 1991).

Lake Tumba - see Botende Hunting Reserve

Lendu Plateau

2°05'N, 30°50'E A large area of high ground in north-east Zaïre, west of Lake Albert, Mobutu and bordered to the north by the Ugandan border. Threatened and rare birds occur, and a survey of the area is required. The area is unprotected (Collar and Stuart, 1988; Stuart *et al.*, 1990).

Lomako Reserve

Proposed

The reserve is approximately 1°00'N, 20°50'E, situated in Guineo-Congolian forest between the Lomami and Lualaba rivers, at 350-400m. An endangered endemic race of pygmy chimpanzee occurs, as do Allen's swamp monkey *Allenopithecus nigroviridis*, *Cercocebus aterrimus*, elephant and sitatunga; there are threats from logging (Frame, 1987; IUCN, 1990; Stuart *et al.*, 1990).

Lomami-Lualaba Rivers

1°30'-2°30'S, 25°00'-26°00'E The forested area between the rivers has endemic subspecies of primate, viz. *Cercopithecus mitis heymansi*, *C. wolfi elegans* and *Colobus rufomitratatus parmentieri*; chimpanzee and *Colobus angolensis* also occur. The area is used by subsistence hunters (IUCN, 1990; Stuart *et al.*, 1990).

Luapula Floodplain

10°00'S, 28°30'E This unprotected area is in the south-east of the country, near the Zambian border. Of the 120 species of fish recorded, 33 are endemic to the Luapula system. The avifauna is rich, and larger mammals include hippopotamus, black lechwe, Lichtenstein's hartebeest, roan and sable antelopes, waterbuck, eland, puku, reedbuck, buffalo and elephant. The area is lightly settled, and undeveloped.

Lukemie-Sankuru Area

Lowland forest situated in Kasai (Stuart *et al.*, 1990).

Mai Mpili-Lidji

4°22'S, 15°26'E This small area of lowland forest in the vicinity of Kinshasa is recommended for protection (Stuart *et al.*, 1990).

Malebo Pool

4°20'S, 15°30'E Situated on the border with the Congo, this lake is situated on the Zaire River and covers 500ha. Over 235 species of fish have been recorded, of which seven appear to be endemic. Hippopotamus, bushpig, sitatunga, water mongoose and otter occur (Burgis and Symoens, 1987).

Maniema

2°30'-3°30'S, 26°30'-28°00'E Situated in southern Kivu between 600m and 1400m, dominated by Guineo-Congolian rain forest. Fauna includes the endemic *Colobus rufomitratatus lulindicus* and *Colobus angolensis cordieri*. The area is rich in minerals, particularly cassiterite. It is recommended for protection (IUCN, 1990; Stuart *et al.*, 1990).

Marine National Park

Proposed

5°45'-6°05'S, 12°45'-13°00'E 76,850ha (including 11,050ha of coastline), between sea-level and 110m. The extensive mangrove areas are characterised by species of *Avicennia*, *Rhizophora*, *Conocarpus* and *Hibiscus*. Mammals occurring include *Trichechus senegalensis*, hippopotamus, sitatunga, common reedbuck, buffalo and primates. The area may be used as a nesting ground by marine turtles. There are possibilities for tourism, and it is strongly recommended as a protected area (IUCN, 1990).

Marungu Mountains Reserve

Proposed

7°25'S, 29°45'E Part of the Haute Katanga, these highlands lie to the west of the southern half of **Lake Tanganyika**. Two main land masses are separated by the low-lying Mulobozi River, rising to 2460m, in the larger southern area. Grassland and

scrub are the dominant vegetation forms, but montane and riverine forest with high endemism do exist, with over 300 endemic species having been recorded. The Marungu sunbird *Nectarinia prigoginei* is endemic. The area is considered to be a vital water catchment, and is under severe threat from timber-felling and erosion (Collar and Stuart, 1988; Frame, 1987; IUCN, 1987; Stuart *et al.*, 1990).

Mayombe, Mayumbe Forests

Coastal rain forest, a protected nucleus of which exists in **Luki Forest Reserve** and **Bombo-Lumene Nature Reserve**. The dominant tree is *Terminalia superba*. More of this threatened forest type needs to be protected, as it has been almost completely destroyed by exploitation (Frame, 1987; Stuart *et al.*, 1990).

Mitumba Mountains

0°00', 29°20'E These lie between Butembo, Lubero, Kabasha and **Virunga National Park**. They support transitional and montane rain forests, containing a gorilla population. A few minor reserves already exist (Frame, 1987).

Mount Hoyo

1°15'N, 30°00'E Covering 20,000ha, at an altitude of about 500m, adjacent to **Virunga National Park**. Covered in evergreen Guineo-Congolian forest, it is notable for the presence of okapi, flycatcher *Terpsiphone bedfordi* and for exceptional cave-dwelling fauna. The area is inhabited by pygmies (IUCN, 1990; Stuart *et al.*, 1990).

Ngiri

1°00'N, 18°30'E Situated between the Zaïre and Oubangui rivers near the Congo border at elevations between 350m and 400m, the area is recommended for protection. Buffalo and hippopotamus occur, as does Allen's swamp monkey *Allenopithecus nigroviridis* and a rich avifauna (IUCN, 1990; Stuart *et al.*, 1990).

Okapi National Park

Proposed

1°00'-3°00'N, 28°00'-30°00'E A large area of about 1,372,625ha, consisting of four forest types situated in the Guineo-Congolian zone, within **Ituri Forests** between 500m and 1000m. Together with a buffer zone, the area is considered to be a very high conservation priority. Okapi, bongo, golden cat, elephant, giant forest hog, six duiker species (including Hamlyn's duiker) and 13 species of primate occur, as well as several rare and/or threatened bird species, including one endemic (IUCN, 1990; Stuart *et al.*, 1990).

Semliki River Area

1°00'N, 30°10'E Covers between 10,000ha and 15,000ha along the Semliki River. Adjacent to **Virunga National Park** (Puemba River) and the Ugandan border, comprising gallery and semi-deciduous *Cynometra* rain forest. The yellow papyrus warbler occurs. Settlement is limited along the Semliki River. The presence of game such as lion, hippopotamus, kob, buffalo, waterbuck and elephant, the Geti waterfalls and Sinda canyons give the area some tourism potential (Frame, 1987; Hughes and Hughes, 1991; IUCN, 1990).

Shushu Islands

2°00'S, 29°00'E Two small islands in **Lake Kivu**, the larger of which measures 500m by 200m, attaining a height of 40m above the lake surface. Covered by undifferentiated Afro-montane forest dominated by *Newtonia buchanani*, *Albizia grandibracteata* and *Ficus* and *Phoenix* species. An endemic subspecies of blue monkey *Cercopithecus mitis schoutedeni* occurs. The islands are inhabited on a temporary basis, and should be managed together with the rest of the protected areas on and around Lake Kivu (IUCN, 1990; Stuart *et al.*, 1990).

Uvira Reserve

Proposed

Watalinga Forest

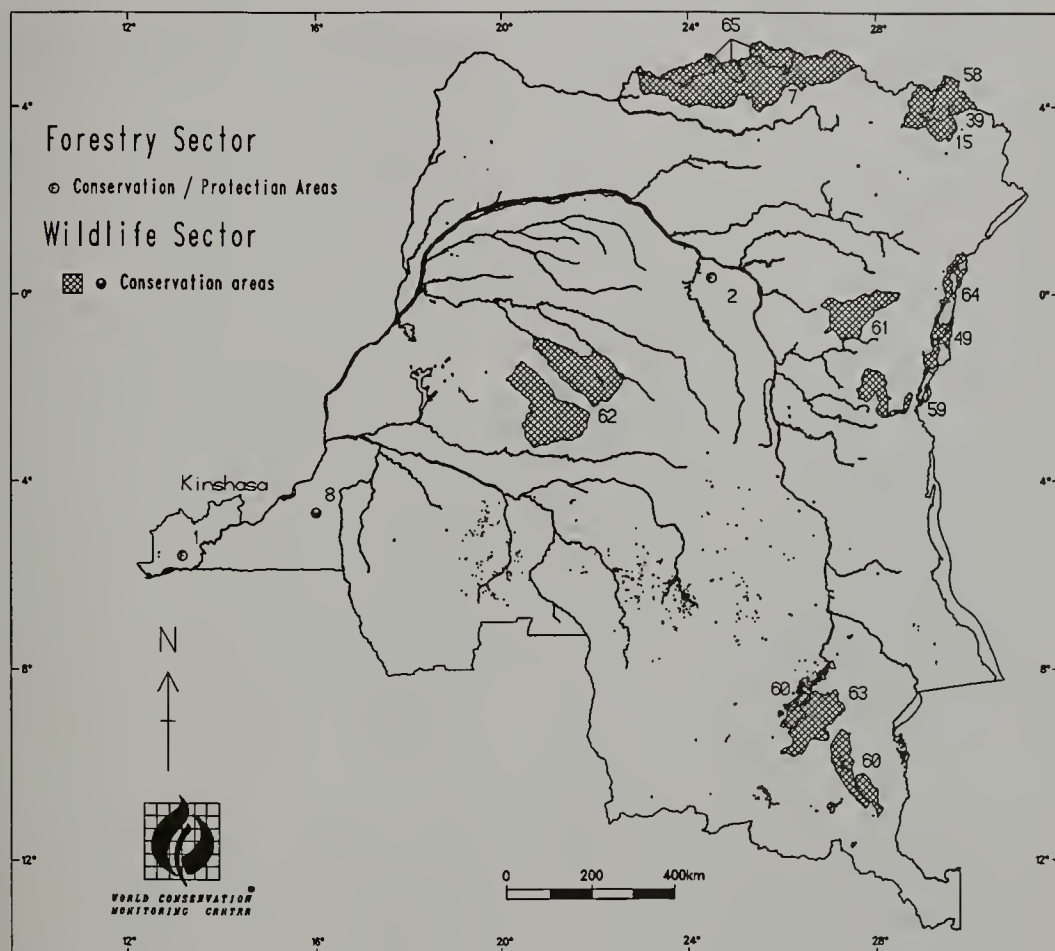
0°33'N, 29°55'E The triangular area on the northern slopes of the Rwenzori Mountains, and the plain below. A portion is within **Virunga National Park**, connecting the latter to the Ituri lowland forest. Transitional forest, between lowland and montane rain forest (Frame, 1987).

ZAIRE - PROTECTED SITES

National/international designations

Name of area and map reference (see Fig. 9.1)	Management area (ha)	Year notified
Forest Reserves		
1 Luki	33,000	1979
2 Yangambi	250,000	
Hunting Reserves		
3 Alundas-Tutshokwea		
4 Azande		
5 Basse Kando		
6 Beni (Oicha)		
7 Bili-Uere	600,000	
8 Bombo-Lumene	240,000	
9 Botende	982	
10 Bukama		
11 Bushimaie	60,000	
12 Epi		
13 Epulu		
14 Fizi		
15 Gangala-na Bodio		
16 Gungu	380,000	
17 Hippo/Kolwezi		
18 Iles aux Singes		
19 Iles de Kifuabire		
20 Kalemie		
21 Kalule		
22 Kibali-Ituri		
23 Kiziba-Baluba		
24 Kolwezi		
25 Lac Kwada	63	
26 Lac Mokoto		
27 Libenge		
28 Loma		
29 Lualaba		
30 Luama	340,000	
31 Luama/Shaba		
32 Lubudi-samppa	9,200	
33 Lueba-Izeba		
34 Lwadekere		
35 Maika-Penge	900,000	
36 Mangai	36,000	
37 Mitwaba		

Fig 9.1 Zaire: protected ecologically sensitive sites



ZAIRE - PROTECTED SITES (cont.)

National/international designations

Name of area and map reference (see Fig. 9.1)	Management area (ha)	Year notified
38 Mole	32,400	
39 Mondo Missa	1,000,000	
40 Mont Hoyo		
41 Mufufya		
42 Mulumbu		
43 Mwanza		
44 Mwekaji		
45 Mwene		
46 Mwene Musona		
47 Rubi Tele		
48 Rubitele		
49 Rutshuru	100,000	
50 Sakanya		
51 Sandua		
52 Sefu-Kiongo		
53 Semliki-Kasenya		
54 Sud-Ouest de Lubero		
55 Swa-Kibula	140,000	
56 Tshikamba		
57 Watalinga		

National Parks

58 Garamba	492,000	1938
59 Kahuzi-Biega	600,000	1975
60 Kundelungu	760,000	1970
61 Maiko	1,083,000	1970
62 Salonga	3,656,000	1970
63 Upemba	1,173,000	1939
64 Virunga	780,000	1925

Nature Reserves

65 Bomu
66 Eaux Delcommune
67 Lac Fwa
68 Ubundu

Shaba Elephant Reserve

ZAIRE - PROTECTED SITES (cont.)*National/international designations*

Name of area and map reference (see Fig. 9.1)	Management area (ha)	Year notified
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Biosphere Reserves

Réserve floristique de Yangambi	250,000	1976
Réserve forestière de Luki	33,000	1979
Vallée de la Lufira	14,700	1982

World Heritage Sites

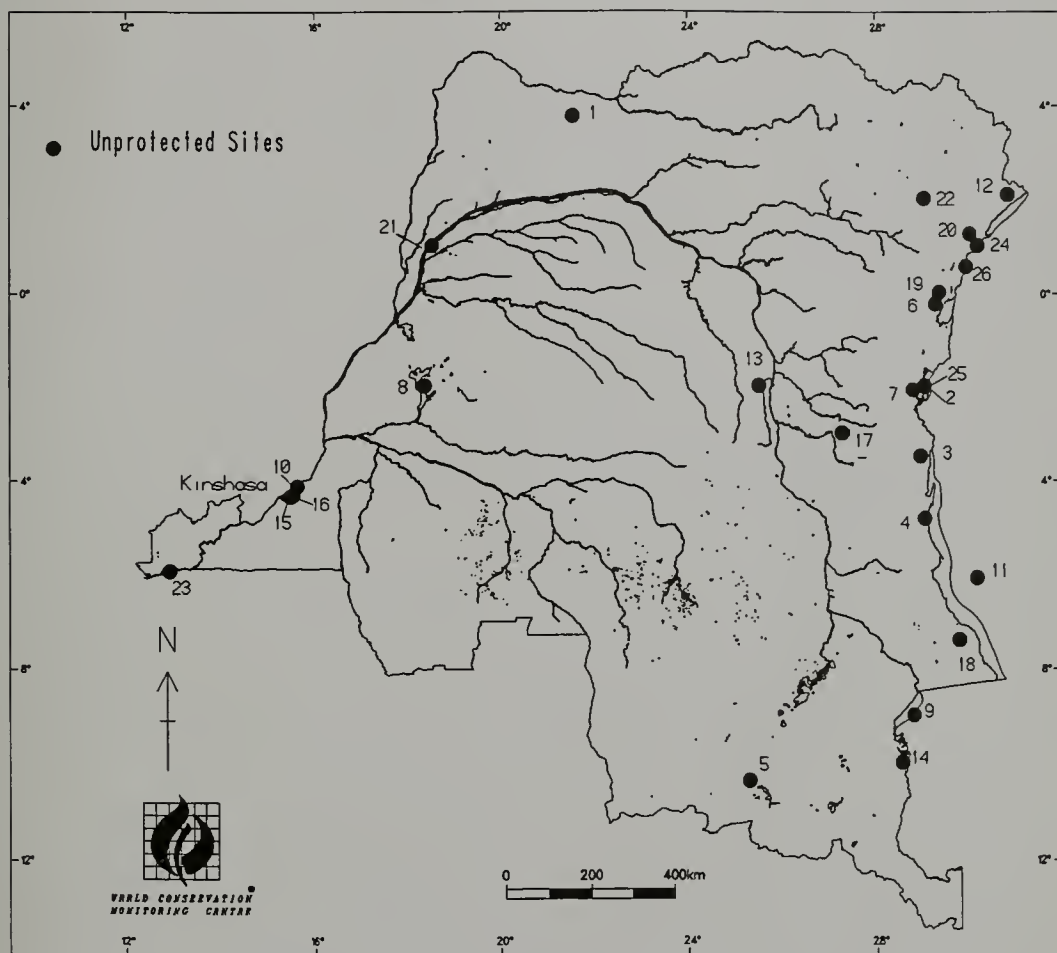
Garamba National Park	492,000	1980
Kahuzi-Biega National Park	600,000	1980
Salonga National Park	3,600,000	1984
Virunga National Park	790,000	1979

ZAIRE - UNPROTECTED SITES

National/international designations

Name of area and map reference (see Fig. 9.2)	Management area (ha)
1 Abumonbazi (Mobaye) Alimbongo Forest Congo Basin	
2 Idjwi Island, Lake Kivu	4,100
3 Itombwe Mountains (Uvira Mtns) Ituri Forests	650,000
4 Kabobo Mountain	
5 Kyamasumba-Kolwezi Forest	
6 Lake Edward Forests	
7 Lake Kivu Forests	
8 Lake Mai Ndombe	230,000
9 Lake Moero	
10 Lake Nagarenke	
11 Lake Tanganyika	
12 Lendu Plateau Lomako Reserve	
13 Lomami-Lualaba Rivers	
14 Luapula Floodplain Lukemie-Sankuru Area	
15 Mai Mpili-Lidji	
16 Malebo Pool	500
17 Maniema	
18 Marungu Mountains Reserve Mayombe, Mayumbe Forests	
19 Mitumba Mountains	
20 Mount Hoyo	20,000
21 Ngiri	
22 Okapi National Park	1,372,625
23 Marine National Park	76,850
24 Semliki River Area	
25 Shushu Islands Uvira Reserve	
26 Watalinga Forest	

Fig 9.2 Zaire: unprotected ecologically sensitive sites



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