Biodiversity in Sub-Saharan Africa and its Islands

Conservation, Management and Sustainable Use

Occasional Papers of the IUCN Species Survival Commission
No. 6

IUCN - The World Conservation Union

IUCN Species Survival Commission

Role of the SSC

The Species Survival Commission (SSC) is IUCN's primary source of the scientific and technical information required for the maintenance of biological diversity through the conservation of endangered and vulnerable species of fauna and flora, whilst recommending and promoting measures for their conservation, and for the management of other species of conservation concern. Its objective is to mobilize action to prevent the extinction of species, sub-species and discrete populations of fauna and flora, thereby not only maintaining biological diversity but improving the status of endangered and vulnerable species.

Objectives of the SSC

1. To participate in the further development, promotion and implementation of the World Conservation Strategy; to advise on the development of IUCN's Conservation Programme; to support the implementation of the Programme' and to assist in the development, screening, and monitoring of projects for conservation action.

2. To maintain an international network of independent volunteer members selected for their expertise in species conservation and to provide a forum for the exchange of views and scientific information on species and populations of conservation concern.

3. To cooperate with the World Conservation Monitoring Centre (WCMC) in developing and evaluating a data base on the status of and trade in wild flora and fauna, and to provide policy guidance to WCMC.

4. To provide advice, information, and expertise to the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and other international agreements affecting conservation of species or biological diversity.

5. To carry out specific tasks on behalf of the Union, including:

   - coordination of a programme of activities for the conservation of biological diversity within the framework of the IUCN Conservation Programme.
   - promotion of the maintenance of biological diversity by monitoring the status of species and populations of conservation concern.
   - development and review of conservation action plans and priorities for species and their populations.
   - promotion of implementation of species-oriented conservation action plans and response to related issues.
   - provision of guidelines, advice and policy recommendations to governments, other agencies and organizations with respect to conservation and management of species and their populations.
   - periodic evaluation of the status of species and biological diversity conservation initiatives.

This publication was produced by IUCN - The World Conservation Union, with the collaboration of the World Wide Fund for Nature (WWF), Conservation International (CI), the World Resources Institute (WRI), the International Council for Bird Preservation (ICBP), and the World Conservation Monitoring Centre (WCMC).

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A Contribution to the Biodiversity Conservation Strategy Programme

Occasional Papers of the IUCN Species Survival Commission
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IUCN - The World Conservation Union

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Foreword

It gives me great honour to write this short Foreword for "Biodiversity in Sub-Saharan Africa and its Islands." This publication represents the first time that the work of the various Specialist Groups in the IUCN Species Survival Commission (SSC) has been drawn together for the African continent The result is that we now have a much clearer basis on which to make decisions about allocating resources to biological diversity conservation on the continent. As a member of the SSC for 20 years and as Director of an IUCN member organisation, I warmly applaud this initiative and hope that the SSC will see fit to apply this model in other regions of the world.

This publication will only have a major impact if people take it seriously. I recommend that it be priority reading for government officials in natural resource management agencies, as well as for those working for development assistance agencies and non-governmental organisations in the African continent I would encourage readers to study the first four general chapters, and then the country chapters of their choice.

I would also like to take this opportunity to thank those who compiled this volume, and those who took the time to provide extensive comments on earlier drafts. I am sure that all will be happy with the final product

Eric L. Edroma
Director of National Parks
Uganda

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Finally, Simon Stuart and Richard Adams would like to express particular thanks to their respective wives, Ann and Gwyneth, for their patience during this long and exhausting project.

Abbreviations Used in the Text

AWF	African Wildlife Foundation
BMZ	Bundesminister für Wirtschaftliche Zusammenarbeit (West German Government)
BP	British Petroleum
CARE	Care and Relief Everywhere
CIDA	Canadian International Development Agency
CI	Conservation International
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSSL	Conservation Society of Sierra Leone
DANIDA	Department of International Development Cooperation, Denmark
DDA	Swiss Development Corporation
EAWS	East African Wildlife Society
EEC	European Economic Community
EWCO	Ethiopian Wildlife Conservation Organisation
EWT	Endangered Wildlife Trust
FAO	Food and Agriculture Organisation of the United Nations
FDA	Forestry Development Authority, Liberia
FFPS	Fauna and Flora Preservation Society
FINNIDA	Finnish International Development Agency
FZS	Frankfurt Zoological Society
GACON	Ghana Association for the Conservation of Nature
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit, West Germany
IBRD	International Bank for Reconstruction and Development (World Bank)
ICBP	International Council for Bird Preservation
IFAW	International Fund for Animal Welfare
IIED	International Institute for Environment and Development
ISF	IUCN Sahel Fund
ITTA	International Tropical Timber Agreement
ITC	International Trade Centre of the United Nations
IUCN	The World Conservation Union
IZCN	Institut Zaïrean pour la Conservation de la Nature
JWPT	Jersey Wildlife Preservation Trust (linked to WPTI)
KCS	Kalahari Conservation Society, Botswana
KWS	Kenya Wildlife Services
MAB	Man-and-the-Biosphere (UNESCO)
MBG	Missouri Botanical Garden
MFCPG	Madagascar Fauna Captive Propagation Group
NCF	Nigerian Conservation Foundation
NCS	National Conservation Strategy
NFINP	Netherlands Foundation for International Nature Protection
NGO	Nongovernmental Organisation
NORAD	Norwegian Agency for International Development
NMK	National Museums of Kenya

NSS	National Strategy for Sustainability
NYZS	New York Zoological Society
OAU	Organisation of African Unity
OCFSFA	Organisation pour la Conservation de la Faune Sauvage en Afrique
ODA	Overseas Development Administration (U.K. Government)
ORSTOM	Office de la Recherche Scientifique et Technique Outre-Mer (France)
OTA	United Congress Office of Technology Assessment
PTES	People's Trust for Endangered Species
PZBM	Parc Zoologique et Botanique de Mulhouse
RSPB	Royal Society for the Protection of Birds
RSNC	Royal Society for Nature Conservation
SADCC	Southern African Development Coordinating Conference
SIDA	Swedish International Development Agency
SIF	Seychelles Island Foundation
TANAPA	Tanzania National Parks
TFAP	Tropical Forestry Action Plan
TROPENBOS	Tropical Forests, Netherlands
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNSO	United Nations Sudano-Sahelian Office
USAID	United States Assistance for International Development
WCI	Wildlife Conservation International (part of NYZS)
WCS	World Conservation Strategy
WCSZ	Wildlife Conservation Society of Zambia
WHF	World Heritage Fund of UNESCO
WPTI	Wildlife Preservation Trust International (linked to JWPT)
WRI	World Resources Institute
WSM	Wildlife Society of Malawi
WSSA	Wildlife Society of Southern Africa
WTO	World Tourism Organization
WWF	World Wide Fund for Nature
WWT	Wildfowl and Wetlands Trust
ZNCT	Zimbabwe National Conservation Trust
ZSL	Zoological Society of London

Fig 1.1 The limits of the Afrotropicai realm, the biogeographic region covered in this book.

Section 1: An Overview of Biodiversity Conservation in Africa

Chapter 1: Introduction

The purpose of this document is to draw attention to the serious consequences of the loss of biological diversity in sub-Saharan Africa, including offshore islands in the Atlantic and Indian Oceans. The scope of the document is limited to the Afrotropical biogeographic region (see Fig 1.1). It is very important that the purposes, character and limitations of the document are clearly understood at the outset and borne in mind during reading. These features are as follows.

Purpose

To outline what needs to be done to halt the rapid depletion of Africa's living natural resources, and to set these actions in the context of the economic and social development of the continent.

Audience

The primary target audience is people responsible for the management of wildlife and protected areas, and non-governmental organisations operating in Africa. It is recognised that many other people and agencies may refer to the document, but in doing so they should bear in mind its intended primary readership.

Character

The document contains a strategy that is broadly-based and outlines actions that are necessary at political, economic, social, ecological, biological and developmental levels. It also identifies critical parts of the African continent where action to save species and ecosystems is particularly urgent.

The focus of the document is primarily on the conservation of wild species and natural ecosystems: it is primarily about conservation strategy but it must inevitably touch on poverty, politics, economic development, war, geography, education and a host of other human concerns. It tries to put conservation in its human context and recognises that solutions to conservation problems have to be integrated with solutions to many other problems. More important, it tries to show that in many instances conservation requirements can be successfully integrated with agricultural, economic and other forms of development, rather than necessarily being in conflict with them.

The technical contents of the document are not original: they are drawn from a large number of reports and publications that have been produced over the years by IUCN and other conservation organisations. The problem with much of this material, in which problems are analysed and workable solutions identified, is that it is scattered and effectively lost in a large number of documents, many of which have never been published or widely circulated. These are more easily available to the conservation scientist in a developed country than to government officials responsible for conservation action in developing countries. This document attempts to bring under one cover the essence of previous recommendations relating to the conservation of biodiversity in Africa. It attempts to do so in a readable and non-technical manner and as briefly as possible, given the complex nature of the subject.

Limitations

It is an interim assessment. Our theoretical understanding of conservation issues is continually being modified as information expands, and the situation "on the ground" is changing even more rapidly under the influence of a multitude of factors - climatic, economic, demographic, agricultural, moral, social and so on. No strategy can ever be fully up-to-date.

It is incomplete in that its coverage of some topics, including genetic diversity (especially in relation to wild relatives of domestic animals and crops) and some types of wildlife resource (notably plants, marine species and ecosystems, and invertebrates) is weaker than others. The review of current conservation activities in each country is also incomplete, especially in terms of the activities being carried out by national governments. This is partly due to the limited time and resources available for completing the document, and partly to the state and availability of knowledge in dif-

ferent topic areas.

The strategy does not represent the final prescription for each African country to solve its conservation problems. Rather, it is a starting point from which countries should be able to assess their own priorities. The country chapters in particular need to be seen in this light. It is important to realise that the data and recommendations contained in the documents have been formulated in a "bottom-up" approach, in particular through the IUCN networks in Africa, most especially through its member organisations and governments, and the members of its Species Survival Commission (SSC) and Commission on National Parks and Protected Areas (CNPPA). The SSC has taken the lead in assembling this document and putting it out for review through these networks.

Summary

The bulk of the document in fact consists of individual country profiles. The reader will probably find it most helpful to read the first four (relatively short) chapters, then select the appropriate country profiles(s) from chapters 6-53. Chapter 2 describes what biodiversity is, what its status is in Africa and what the current threats to it are, and why it should be conserved. Chapter 3 then goes on to outline actions at all levels that would promote the conservation of biodiversity, and chapter 4 gives an overview of the key areas for biodiversity conservation efforts in Africa and provides a framework for establishing priorities for conservation in the continent.

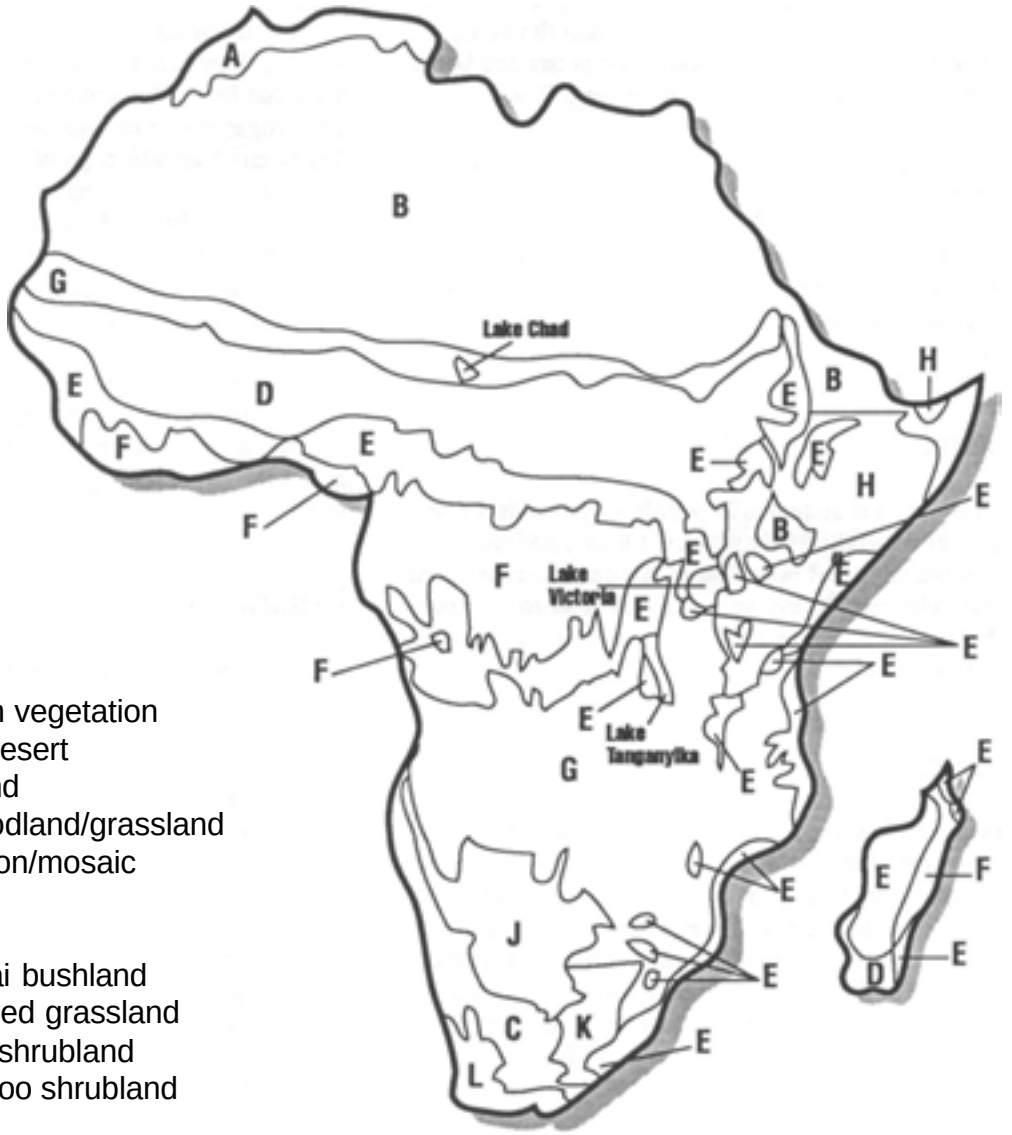


Fig 2.1 The vegetation zones of Africa.

Chapter 2: Biodiversity and its Status in Africa

2.1 Summary

This chapter defines biodiversity, outlines in broad terms its status in Africa and the threats which currently menace it, and makes a case for its conservation.

2.2 What is Biodiversity?

Biodiversity is the term used to describe the total variety of living organisms (plants, animals, fungi, and microbes) that exist on our planet Biologists have found it convenient to consider biodiversity from three different angles: genetic diversity; species diversity and ecosystem diversity.

Genetic diversity refers to the variety of genes (biochemical units of hereditary information). It is therefore a measure of variability, both within and between species.

Species diversity is considered here as a measure of the total number of species in a given area. The world's species diversity is usually estimated at between 5 and 30 million species, though only about 1.4 million of these have actually been named by scientists.

Ecosystem diversity relates to the variety of habitats (e.g. forests, wetlands, coral reefs, rivers, savannas, deserts) within which species occur. Ecosystems are by definition composed of complex, interdependent groups of species (plus non-biological components), and they contribute to the maintenance of the natural cycles of water, oxygen, carbon, nitrogen, sulphur, and other elements as well as to the flows of energy upon which all life depends.

The relationships between genetic, species and ecosystem diversity are complex, and it is important to remember that these are essentially different ways of looking at the same thing. It is impossible to intervene at any one level without affecting the others. For instance, most species will only be guaranteed survival in the long term if the genetic diversity within their populations is maintained at a sufficient level to guard against the repeated inheritance of genetic weaknesses that manifest themselves as, for example, decreasing immunity to diseases and increasing congenital abnormalities. These problems impair the capacity of the species to adapt to changing environmental conditions and, ultimately, to survive. In general, genetic diversity can be maintained if the populations of a species can be kept above a minimum critical size, which can vary from a few hundred to a few thousand individuals depending on the species.

It will therefore be evident that the maintenance of this so-called "minimum viable population" (MVP) will require the maintenance of sufficient habitat to support the population, which in turn requires the continued survival of larger systems such as water catchment areas. Species diversity can thus be seen to be dependent on the maintenance of ecosystem diversity. Conversely, ecosystems may require the existence of a particular species, a "keystone species", if the ecosystem is to survive. Many stone buildings are held up by structural arches, each arch being constructed with a keystone at the top which holds up the entire arch, thus holding up the building. In a similar way, an ecosystem may rely on the presence of a particular species. These species play a critical role in the structuring of the ecosystems in which they live, and without them the ecosystems are liable to instability and, ultimately, will change to a different equilibrium which is usually less biologically diverse and therefore less able to sustain human life. One example of a keystone species in Africa is the aardvark *Orycteropus afer,* which plays a crucial role in maintaining the diversity of savanna habitats by its excavation of holes that serve as dens and burrows for the reproduction and protection of a large variety of savanna species.

Hopefully it can be readily seen that there is an important connection between biodiversity and human well-being. Human dependence on climate, nutrient cycles and ecosystem stability is clearly very great, given that humans require food from species that are part of the earth's biodiversity and which are dependent on other species and ecosystems for stability.

The scientific understanding of biodiversity is still at an early stage. However, the above example demonstrates that the genetic, species and ecosystem aspects are very closely inter-connected. Action is therefore needed at all three of these levels if biodiversity is to be conserved and if the benefits it provides to human life are to continue to be available. While there is clearly a need for better scientific understanding of biodiversity, the principles involved in its conservation are not new. Biodiversity conservation is essentially an umbrella term for traditional species and ecosystem conservation and the need to manage the human use of species and ecosystems in a sustainable way, in a way which harvests the species at a rate lower than (or not exceeding) the intrinsic rate of increase of the population of the species in question.

Country	Mammals	Birds	Reptiles	Amphibians	Freshwater Fish	Swallowtail Butterflies	Plants
Angola	275	872			268	27	5,000
Benin	187	630			150	23	2,000
Botswana	154	569	158	38	81	9	2,000
Burkina Faso	147	497			120	8	1,096
Burundi	103	633				15	2,500
Cameroon	297	848				39	9,000
Cape Verde	9	103					700
Central African Republic	208	668			400	24	3,600
Chad	131	496			130	7	1,600
Comoros	17	99	26	2	16	3	935
Congo	198	500			500	37	4,000
Djibouti	22	311				6	534
Equatorial Guinea	141	392				13	
Ethiopia	265	836			100	15	5,770
Gabon	190	617			200	25	7,000
Gambia	108	489			80	9	530
Ghana	222	721			180	27	3,600
Guinea	188	529			250	17	
Guinea-Bissau	109	376			90	8	1,000
Ivory Coast	226	683			200	24	4,700
Kenya	314	1,067	191	88	180	30	7,500
Lesotho	54	288			8	7	1,700
Liberia	193	590			130	23	
Madagascar	105	250	259	144		13	11,000
Malawi	187	630	124	69	600	22	3,600
Mali	136	647	16		160	6	1,600
Mauritania	61	550			15	6	1,100
Mauritius	4	102	19	2		2	900
Mozambique	205	666	170	62		16	5,500
Namibia	190	640		32	97	9	3,159
Niger	131	473			140	6	1,178
Nigeria	274	831			200	30	4,614
Reunion	2	33	6			2	720
Rwanda	147	669				18	2,150
São Tomé & Principe	7	124					700
Senegal	166	625			140	10	2,100
Seychelles	2	126		12			1,200
Sierra Leone	178	614			130	21	2,000
Somalia	173	639				12	3,000
South Africa	283	774	301	95	220	15	20,300
Sudan	266	938			120	20	3,200
Swaziland	46	477			45	9	3,000
Tanzania	310	1,016	273			34	11,000
Togo	196	630			160	25	2,300
Uganda	311	989			300	31	5,000
Zaire	409	1,086			700	48	11,000
Zambia	228	732	152	83	156	23	4,600
Zimbabwe	194	635	155	120	132	12	4,200

Table 2.1: Approximate numbers of species of selected groups of animals and plants in African countries.

2.3 What is the Current Status of Biodiversity in Africa?

The short answer to this question is "diverse". Africa embraces a very wide range of habitats and ecosystems, with varying degrees of species diversity within them. Some ecosystems are impoverished relative to their recent past and the diversity of species is greatly depleted in certain areas. The species diversity aspect can be most easily quantified and is therefore used in the examples which follow. Species diversity within habitats varies greatly and is very much higher in lowland equatorial rainforest than anywhere else. In general, species diversity is well correlated with the annual amount of rainfall, with wetter areas tending to be richer in species. Other factors affecting species diversity include the shape of the landscape (topography), drainage, vegetation, and soil type.

The number of species within any given African country therefore depends partly upon the rainfall received, but also on the degree of topographical and habitat variation within each country. Countries with extensive mountain ranges and those with a wide variety of habitats support many more species than do those that show much less environmental variation. In view of these factors, it is not surprising that Zaïre is probably the richest nation in Africa in terms of species diversity (it includes extensive lowland rainforests, northern and southern savannas, large areas of wetlands and lakes, and mountains), though South Africa has a much richer flora, mainly due to the unique Cape flora. Other countries that exhibit great variation in habitats, and are hence internationally important for biodiversity, are Cameroon, Kenya, Nigeria, South Africa, Tanzania and Uganda.

Biologists have attempted to describe the regional variation in habitats and species in a number of ways. The one used most frequently at the moment is a series of biogeographic divisions known as phytochoria, based on plant distribution. The countries with the highest biological diversity in Africa tend to have the greatest numbers of phytochoria within their borders. The distribution of the African phytochoria are shown in Figure 2.2 and this forms the basis of the biogeographic affinities recorded in each of the country sections in Section 2, as well as of the discussion in Chapter 4.

In Table 2.1 the approximate numbers of species of plants, mammals, birds, reptiles, amphibians, freshwater fish and swallowtail butterflies are given for each African country for which data are available. In most cases, these figures refer to the numbers of species that scientists consider are likely to occur in each country, though in some, the currently known species totals are given. Complete species lists are not currently available for any African country, nor indeed for any country in the world. It should be remembered that most of the species diversity in the world consists of invertebrates, in particular insects, but these are so poorly known that they are not included in Table 2.1.

In terms of global efforts to preserve biodiversity, and to stem the tide of mass extinctions of species, countries such as Zaïre, Cameroon and Tanzania are clearly the highest priorities. However, there are three principal reasons why it would be unwise to concentrate all efforts on just a few countries.

First, as will be shown in the next section, the proper management of biodiversity is essential for the long-term development of *all* African nations. To ignore some countries, because they contain lower levels of biodiversity, is tantamount to saying that the ecological, economic and social consequences of the destruction of their resource bases is of less importance than more biologically diverse nations. The conservation of biodiversity is an urgent priority for every African nation.

Second, species and habitat richness are not the only criteria by which international priorities for the conservation of biodiversity should be set. In several parts of Africa, there are areas in which concentrations of species exist which occur nowhere else (these are termed "endemic" species). The country in Africa with by far the highest levels of endemism is Madagascar, although it is not especially rich in species. The same is true for oceanic island countries, such as Comoros, Mauritius, São Tomé and Príncipe, and Seychelles. For forest species on the mainland, the following areas are of particular importance for endemism: the lowland forests of Ivory Coast and Liberia; the montane and lowland forests of Nigeria, Cameroon and Gabon; the forests of the western escarpment of Angola; the lowland and montane forests of eastern Zaïre, western Uganda and Rwanda; and the coastal forests of Kenya and the forests of eastern Tanzania. The unique fynbos of South Africa contribute significantly to the high species diversity of that country, especially its flora. For wetlands, centres of endemism are less clear-cut, but areas of international importance clearly include the Inner Niger Delta in Mali, the seasonally inundated floodplains of northern Central African Republic and southern Chad, the Sudd region of southern Sudan, the Lakes Victoria and Kyoga in Uganda, the swamps of western Tanzania, southern Zaïre and various parts of Zambia, and the Okavango region of northern Botswana The great lakes of East and Central Africa are remarkable for their huge number of endemic fish species. Important centres of endemism for arid-land species exists in Somalia, Ethiopia and Namibia. In addition, the Ethiopian Highlands are the centre of a wide variety of endemics from several different habitats. As can be seen from the above list, a decision to concentrate all resources on the few countries with the highest species and ecosystem diversities would mean that several of the areas with the highest species endemism would be ignored.

Third, the countries exhibiting the highest degree of species and ecosystem diversity do not represent a good cross-section of Africa as a whole. The species composition of countries such as Zaïre, Cameroon, Nigeria and even

Uganda are in fact quite similar, but several parts of Africa are not represented in the list of most diverse countries, for instance most of West Africa, the Sahel, the Horn of Africa, and parts of southern Africa. Even if it were possible to reach an agreement that countries with maximum species diversity and/or endemism should be given higher priority for conservation, this group would not be a very representative cross-section of the continent. Also, it should be recognised that the loss of any biological resources could have more serious effects ecologically in countries with low biodiversity (as has already happened in the Sahel) compared to those that are more diverse.

2.4 What are the Threats to Biodiversity in Africa?

Biodiversity is under threat in Africa for exactly the same underlying reason as elsewhere in the world: the conflict between supply and demand, in terms of there being a limited supply of the earth's resources and an increasing demand on them to meet the needs of a growing population and the growing aspirations of that population. In most places, a greater demand is placed upon species and ecosystems than they are able to meet by themselves at natural rates of increase.

2.4.1 Population Pressures

Small populations of people, living at low densities by means of traditional patterns of agriculture, pastoralism and hunter-gathering, have for many centuries been able to use natural resources sustainably, simply by not removing the natural product faster than it can reproduce itself. Limited medical knowledge and services have ensured that the human population rarely grew fast enough to overtake the rate of natural replenishment of resources. Although this type of lifestyle is sometimes described in a way that makes it sound like a Utopia from days gone by, it was very far from that since these societies often suffered through ecosystem variability and contact with other species, with consequent very high mortality rates. A number of changes, all undeniably good and beneficial to people, have altered the picture rapidly during this century. For example, the coming of better health care has accelerated population growth, which has led to a need for rapidly expanded agriculture, education and so on. These kinds of developments, while removing one group of problems, present governments and people with a fresh set.

2.4.2 Food Production Methods

Population pressure on the environment is growing at a rate which has not allowed food production technology, whether based on traditional or modern methods, to keep pace, except by means which then leave the land unusable for years or even generations. Additionally, people have in some cases retained farming or stockraising methods which have not been appropriate for the changing environment: for example, in some areas the rapid increases in cattle herds following tsetse fly eradication have not been accompanied by increased slaughter for meat, with the result that savanna and woodland has been overgrazed and is in danger of desertification. As people, particularly in rural areas, have been increasingly thrown on the capacity of natural ecosystems to support them, they have used methods of food production, such as slash-and-burn in forested and heavily-wooded areas, which have met short-term survival needs but which, in doing so, have so rapidly exploited the local ecosystems that natural rates of replenishment have been outstripped and the species and habitat diversity is greatly reduced. Throughout most of Africa, people now live in relationships with nature that cannot be sustained in the long term.

2.4.3 Foreign Debt Servicing

High levels of foreign debt, with a mean of 58% of GNP for sub-Saharan Africa and in one case reaching as much as 241%, has put pressure on governments to engage in a variety of agricultural and industrial practices which involve harvesting resources at unsustainable rates, with inevitable subsequent ecosystem devastation.

2.4.4 Commercial Land-use Practices

Habitat clearance and alteration is the most important single threat, a sizeable proportion of it being for short-term gains rather than sustainable use: deforestation for the timber trade, mining and oil extraction, and cash-crop production are examples of activities which can and have contributed to irreversible habitat destruction. This has probably already resulted in the extinction of many species, particularly invertebrates, most of which are unknown to science. The destruction of habitats such as wetlands, forests, and coral reefs has a direct impact on ecosystem diversity and an indirect impact on species diversity, with severe reductions in those species that are dependent on the habitats in question.

2.4.5 Over-Harvesting

Intense harvesting can result in extremely rapid declines in species populations. It is usually possible to harvest a "sustainable yield" of a species, that is an offtake which is at least equalled by the natural rate of increase of the population being harvested. This amount will vary according to the fertility of the species under local conditions, the generation time of the species, the size of the population and so on.

Clearly more can be harvested from numerically stronger populations, and the more over-harvesting occurs, the less will be the sustainable harvest unless there is a period of non-harvesting which will allow the species to regain its numbers. A classic example of over-harvesting is that of the black rhinoceros, which in less than 20 years has been reduced from 70,000 to about 3,500 individuals. However, less public but nevertheless devastating examples are widespread: overgrazing in the Sahel and in parts of Botswana demonstrate how such over-harvesting can deplete a species (be it large mammal or grass) so far that the ecosystem dynamics change and prevent the natural re-establishment of the species in that locality. In some instances of over-harvesting of economically valuable species, the bulk of the economic benefits do not accrue to the country but tend to be amassed by traders (often illegal) outside the African continent. The conflict between maximum immediate use and steady but sustainable offtake in the long term is the dominant issue for both commercially valuable and simply useful species.

2.4.6 Inviable Populations of Species

For species that have been severely reduced in numbers, survival might be difficult to ensure, even if apparently adequate conservation measures are introduced. This is because the species exist in tiny, fragmented, inviable populations which may be below the minimum viable population size. Such populations are extremely vulnerable to extinction through random environmental catastrophes such as fire, disease, cyclones, outbreaks of poaching or breakdowns of law and order. Even if such populations survive these risks, they can be subject to severe losses in genetic diversity, with such associated symptoms as decreasing vigour and fertility. Very small populations are at great risk from demographic effects such as all the animals being of one sex. The rapid disappearance of fauna from the Sahel over the last 20 years can be attributed in part to the problems associated with small, inviable populations of animals.

2.4.7 Climatic Changes

Biodiversity is also under threat, at least in parts of Africa, from a variety of climatic changes, in particular decreased rainfall. The reasons for such changes are undoubtedly complex, but there is some evidence that the worst effects of them could be reduced if action were taken to control habitat degradation, especially in the rainforests of equatorial Africa and in semi-arid grasslands. Such action is in any case recommended to secure the biodiversity of these regions. In almost all cases, the changes in land-use required to minimise further undesirable effects of climatic change are consistent with the actions needed to conserve biodiversity.

2.4.8 Introduction of Alien Species

For the islands around Africa, introduced species such as rats, cats, goats, deer and many plants represent a particularly uncontrollable threat to biodiversity. Island ecosystems are extremely fragile, and introduced species can upset natural ecological balances permanently, sometimes resulting in mass extinctions. The islands of R6union, Mauritius and Rodrigues have suffered from a devastating wave of extinctions in historic times, much of which can be attributed to introduced species. Once established, such alien species are often impossible to eradicate, the removal of rabbits on Round Island off Mauritius being a notable and worthy exception.

2.5 Why Should Biodiversity be Conserved?

There are two principal (and linked) arguments in support of the conservation of biodiversity. Firstly, from a moral perspective, mankind has control of the renewable resources of the earth and should treat these resources wisely and with respect. Secondly, because these resources make numerous and valuable contributions to the well-being of humans (more so in Africa than in many other parts of the world), it is essential for mankind's health and survival that we maintain them in a healthy condition. Hopefully, the connection between these lines of argument should be very clear: if mankind abuses the earth's resources, in the end (and often in the short term as well) mankind is the loser. The moral argument works out in practice as being in mankind's best interests. The world press is replete with horror stories of the disastrous environmental impacts of ill-conceived industrial projects, short-term gain agriculture, careless waste disposal and so on. Whatever the aesthetic or moral response to these situations, it is essential that governments, industry, commerce and people alike all recognise that the destruction of species and ecosystems - in other words, the reduction of biodiversity - has human and economic costs.

Although the moral imperative may often not be warmly supported (which, of itself, might indicate why the destruction of biological resources has become such a major problem), the functional arguments related to human survival and economy often carry great force in a world where governments and other institutions are struggling with the problems of burgeoning populations, economic inequalities, shifting political alliances and increasingly stretched resources. The role that living natural resources can play in development is often appreciated in government departments dealing with national parks and wildlife, but not by government economic planners, who tend to see conservation as an isolated, low-priority sector rather than an issue which has relevance across all sectors and is of considerable economic signifi-

cance. This message still needs to be brought fully to the attention of the critical ministries of finance and planning, which often unintentionally promote policies that are detrimental to the conservation of biodiversity and hence to their nations' long-term sustainable development. The following list gives an idea of the wide array of benefits that biodiversity provides, over and above the moral and aesthetic arguments advanced above.

Ecological stability. The preservation of ecosystem diversity ensures the continuation of the processes that underpin the maintenance of all forms of life. These processes include:

- maintenance of water cycles (including the protection of water catchments and the buffering against extreme conditions of flood and drought);
- regulation of climates at both the macro- and micro-climatic levels (including effects on temperature, rainfall and air turbulence);
- control of erosion of both soil and coastline;
- maintenance of essential nutrient cycles (including oxygen, carbon, nitrogen and sulphur, as well as maintenance of the oxygen/carbon dioxide balance in the atmosphere);
- photosynthetic fixation of energy, whereby energy from the sun is transferred through green plants to the ecosystem as a whole.

African examples of what happens when ecological diversity is reduced can be found on a large scale in the Sahel zone, Lesotho, and in parts of the Ethiopian highlands.

Consumptive use. Many examples of this have been described for Africa, of which the following are but a few.

- Wood and dung provide over 90% of total domestic energy needs in Tanzania and Malawi.
- In Botswana, over SO species of wild animal provide an average of more than 90 kg of protein per person per year (in some areas amounting to 40% of the diet).
- In Ghana, about 75% of the population depends upon wild sources of protein supply, including fish, snails, rodents and insects.
- In Zaïre, game accounts for as much as 75% of animal protein consumed.

There are many further examples of the use of wildlife resources for everything from medicines to house construction. In most cases, these uses occur without the products ever being formally marketed and therefore their value seldom appears in national income accounts. This invisibility heightens the urgency of the need to identify more clearly the impact of these uses and other activities on species, habitats and ecosystems, so that effective management of the resources involved may be developed to prevent over-use and destruction, which will then lead to increased pressure on other, already-stretched, resources.

Commercial use. This often involves the same actual uses as described under "Consumptive use" above, but refers to the commercial harvesting and sale of the resources. This is therefore more often included in national income accounts. A very wide range of commercially-harvested products is marketed in Africa, including meat, fur and leather, honey, vegetables, fruit, timber, spices, medicinal and ornamental plants, dyes, aviary birds, ostrich feathers, turtle shells and so on. The contribution of these varied products to both the internal and export economies of African countries is clearly great. Many of the industries dealing in these products are controlled by people far-removed from the source commodity. The proper management of the resources from which these products come is therefore vital to the continued contributions of commercial harvesting to economic development and human well-being.

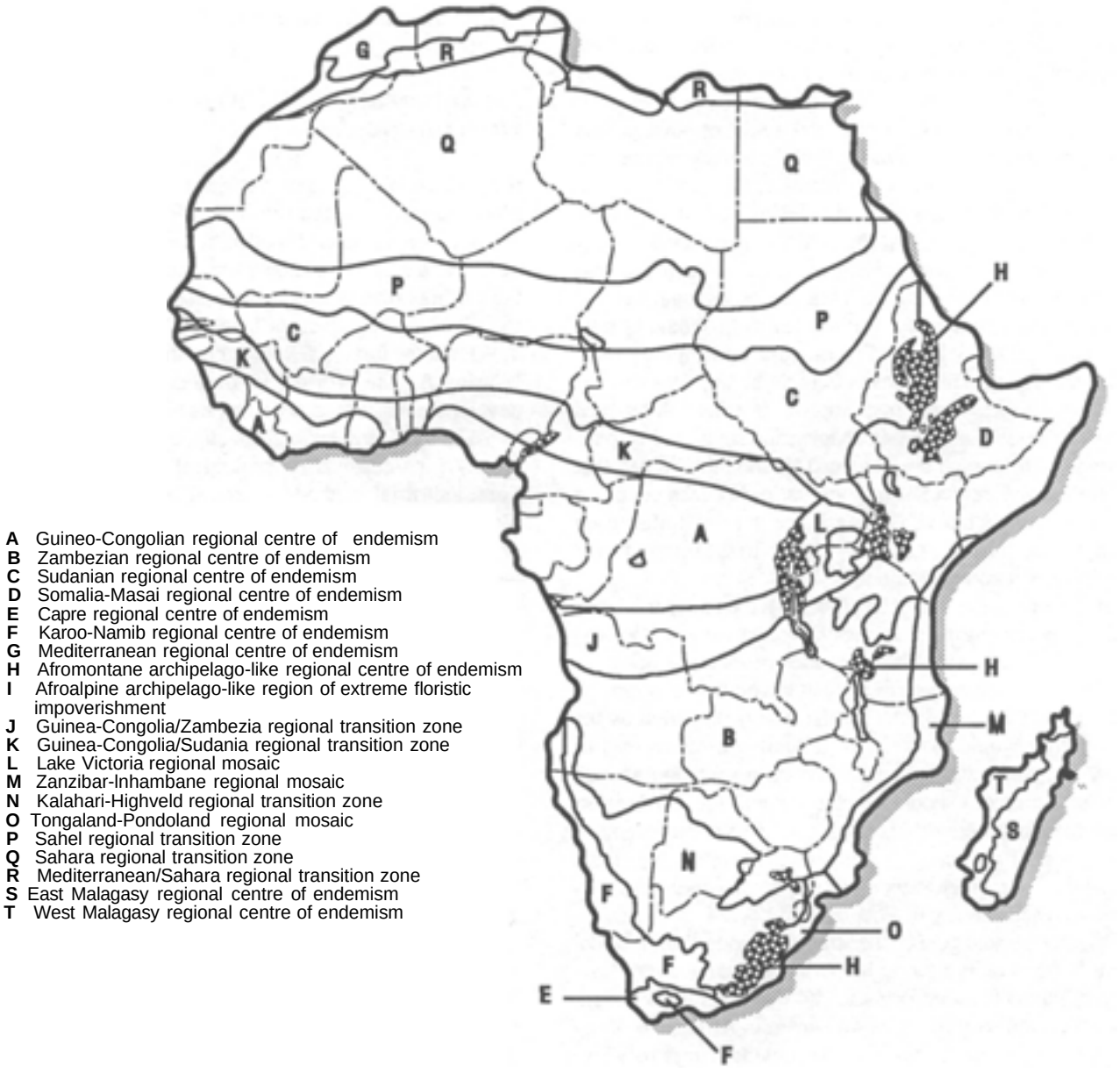
Recreational use. This includes tourism and the pursuit of activities such as hunting and fishing for pleasure rather than necessity. The geography and wildlife of Africa attracts many visitors from other parts of the world, and this is a major foreign exchange earner for a number of countries, most notably Kenya. Clearly, activities such as big-game-hunting, photographic safaris and even simple trekking and camping depend on the continued existence of the species, habitats and ecosystems which are the focus of these pursuits. Proper management of the natural resources involved is essential for the economies of many areas and, if economic development proceeds, more people in Africa will have the time and resources to explore the natural environment for pleasure, thus providing economic benefits to local people. However, touristic activities must also be carefully regulated to ensure that they do not undermine the commodities on which they are based.

Scientific importance. Our understanding of biodiversity is still insufficient to guarantee proper conservation, and only by further scientific research are we likely to learn improved methods for managing it. There are also certain to be new uses to which species, habitats and ecosystems can be put, and these are likely to be revealed by research. If diversity is reduced by destruction of habitats and ecosystems, an unknown potential for both a better understanding of the world and for learning how to use its resources wisely is irretrievably lost.

From the above examples, it should be clear that the conservation of biodiversity is not a narrow sectoral activity running counter to the interests of economic development. Rather, such conservation emphasises the responsible management of the capital resource base upon which much economic development ultimately depends, an argument which sounds remarkably consistent with the moral argument proffered at the beginning of this section.

2.6 Conclusion

This chapter has defined biodiversity, provided an overview of its status in Africa, established a case for its conservation and outlined the principal threats to it. The remaining chapters of Section 1 outline the action which should enable such conservation to occur, and review the key areas for conservation measures.



A Guineo-Congolian regional centre of endemism
B Zambezian regional centre of endemism
C Sudanian regional centre of endemism
D Somalia-Masai regional centre of endemism
E Capre regional centre of endemism
F Karoo-Namib regional centre of endemism
G Mediterranean regional centre of endemism
H Afromontane archipelago-like regional centre of endemism
I Afroalpine archipelago-like region of extreme floristic impoverishment
J Guinea-Congolia/Zambezia regional transition zone
K Guinea-Congolia/Sudania regional transition zone
L Lake Victoria regional mosaic
M Zanzibar-Inhambane regional mosaic
N Kalahari-Highveld regional transition zone
O Tongaland-Pondoland regional mosaic
P Sahel regional transition zone
Q Sahara regional transition zone
R Mediterranean/Sahara regional transition zone
S East Malagasy regional centre of endemism
T West Malagasy regional centre of endemism

Fig 2.2 The phytochoria of Africa. Phytochoria are biogeographic units based on plant distribution.

Chapter 3: Action Required to Conserve Biodiversity in Africa

One of the problems involved in outlining action required to conserve biodiversity is that it cannot be confined to specific areas of responsibility. Many of the necessary actions involve a range of people and agencies such as senior government officials, non-governmental organisations (NGOs hereafter), protected area managers, scientists, park rangers, local community leaders, citizens and a host of other people and organisations. Thus, although the following actions are broadly grouped into areas representing the economic and social aspects of conservation, the design and management of protected areas systems, the integration of biodiversity conservation into broader land-use issues, sustainable harvest management, and the building of institutional capacities, these actions interact at various levels. It should also be emphasised that local conditions vary enormously over Africa, and recommendations that might be high priorities in some countries are totally inappropriate in others. After each recommendation made in this chapter, the suggested responsibilities for follow-up are indicated. It should be noted that the detailed governmental structure varies between countries and the names of the various agencies indicated after each recommendation serve merely as a guide to the different sectors in which action is required.

In the previous chapter (section 2.4), the major threats to biodiversity are outlined. One way of organising an "action" chapter would be to use the categories of threat as headings and simply list the necessary actions to counter each type of threat However, this would involve much repetition as the same actions would recur under a number of categories of threat. The approach here has thus been to group actions together: the reader should be able without too much effort to see the links between actions and the various types of threat. Most of the actions recommended here are inevitably of a general nature. However, more specific actions are suggested for each country in Chapters 6-53.

The immediate goal of the strategy proposed in this document is for conservation to be on the agenda at every level of every government department and every non-governmental organisation working in development in Africa. The long-term goal is that the behaviour of people (whether they live in Africa or live elsewhere but still have an impact on its environment) be changed so that they become conservers, rather than "over-users" of the continent's living natural resources. This is a long-term aim which requires careful planning and long-term committment, and the means required to achieve it are extremely complex. Some of the approaches proposed here will take literally decades to bear fruit, while some are more immediate and specific.

3.1 Integration of Environment and Development

It is still widely held that conservation activities must necessarily be in direct opposition to economic development in general, and the interests of rural communities in particular. While some conservation programmes may have been at fault in this regard, more recent approaches, as presented in the "World Conservation Strategy" by IUCN, UNEP and WWF and as further developed by the same organisations in "Caring for the World", involve seeing conservation and development as necessary supports to one another.

The long-term ecological, climatic and economic stability of Africa depends on ecologically sound land-use practices, industrial methods, waste disposal techniques and the like being adopted over large areas of the continent. Such practices are the foundation for economic development; they will ensure that achievements in economic development can be maintained in the long term. The exact mechanisms whereby conservation and development can be fully integrated within each country should be fully explored in each nation's National Strategy for Sustainability, but action is needed at both policy and field levels and this first section outlines some of the possibilities.

The theme of integration is fundamental to this strategy. However, this strategy does not explore all the social and economic aspects of biodiversity conservation in depth, since these are covered much more thoroughly in the forthcoming "Caring for the World", to be published by IUCN in collaboration with UNEP and WWF in 1991. Some 41 action items are listed below, each of which is taken from "Caring from the World", to which the reader is referred. However, more information is provided on the National Strategies for Sustainability in section 3.1.41 below, since these should be the unifying mechanism for all the other activities proposed in this strategy.

3.1.1 Adopt Sustainability as a Goal of Economic and Development Policy

3.1.2 Ensure that Decisions on Budgets, Economic Policies and Investments Take Full Account of their Effects on the Environment

3.1.3 Shift the Emphasis of Environmental Policy towards Anticipation and Prevention

3.1.4 Incorporate Sustainability in the Mandates and Policies of Sectoral Agencies

3.1.5 Establish or Upgrade the Capacity to Analyse the Environmental Implications of Policy

3.1.6 Establish in Law the Commitment to Principles and Policies of Sustainable Development

3.1.7 Reexamine Existing Legal Enforcement and Implementation Mechanisms

3.1.8 Recognise the Legitimacy of Local Approaches to Conservation and Resource Management

3.1.9 Increase the Accountability of Administrations with Respect to the Environment

3.1.10 Make Fully Liable those who Deplete Resources or Damage Ecosystems or Human Health

3.1.11 Include Environmental and Future User Costs in the Prices of Energy, Raw Materials and Manufactured Goods.

3.1.12 Use Taxes and Other Economic Instruments to Provide Incentives for Conservation and Sustainable Use

3.1.13 Review Property Rights to Common-Property Resources to Ensure they Provide for Sustainability

3.1.14 Broaden the Scope of National Development Plans and Decentralise the Planning Process

3.1.15 Establish the Legal Obligation to Subject Proposed Major Development Projects, Policies, Laws, Programmes, and Products to Environmental Impact Assessment

3.1.16 Adopt an Ecosystem Approach to Land-use Planning; and Employ Regional Land-use Plans to Anticipate and Minimize Conflicts and Integrate Sectoral Decisions

3.1.17 Strengthen Governmental Institutions and Build Partnerships with Local Governments and the Non-governmental Sector

3.1.18 Encourage the Development of NGOs; and Recognize their Rights to Information, to be Consulted, to Participate in Decision-making, and to Legal Remedies when Health or Environment is Damaged or Threatened

3.1.19 Guarantee Freedom of Information on Environmental Matters as a Fundamental Right of the Citizen

3.1.20 Monitor through Environmental and Resource Accounting the Chief Indicators of Sustainable Development

3.1.21 Put a High Tax on Resources, Especially Energy, Levied at the Point of Extraction or Import

3.1.22 Give Priority to Ways of Helping Lower-income Countries to Adopt Energy-efficient Methods through Capital Aid and Technical Assistance, Including Training in Designing Energy-efficient Systems for Agriculture, Industry and Construction

3.1.23 Join and Support "Green Consumer" Movements

3.1.24 Double the Supply of Family Planning Services in the 1990s, Particularly the Supply of Contraceptives and Information on Contraception

3.1.25 Increase the Education, Health Care, Incomes and Security of the Poorest Families by Directing Development Efforts to Meet their Needs

3.1.26 Increase Awareness about the Global, National and Local Significance of Population Issues for Sustainable Development through Information and Education Programmes

3.1.27 Integrate Population Issues in National Development Policies and Planning

3.1.28 Improve Monitoring and Evaluation of Population Policies and Family Planning Programmes

3.1.29 Set Up a Debt Retirement Fund to Retire Enough of the Lower-income Countries' Debt to Restore Economic Progress

3.1.30 Link Sectoral Adjustment Loans to Debt Reduction

3.1.31 Expand the Size and Scope of Debt Swaps

3.1.32 Remove Trade Barriers to Commodities, Processed Materials and Manufactured Goods from Lower-income Countries

3.1.33 Redirect Development Assistance to Achieve Sustainability

3.1.34 Take Full Account of the Environmental Impacts of Structural and Sectoral Adjustment Programmes

3.1.35 Provide New and Improved Funding and Delivery Mechanisms for Development Assistance

3.1.36 In All Funding Programmes, Place Greater Emphasis on Small Projects with Maximum Grassroots Participation

3.1.37 Develop Partnerships between the NGOs of Lower-income and High-income Countries

3.1.38 Develop a "Foreign Policy for the Environment"

3.1.39 Establish or Strengthen Regional Organisations for Sustainable Management of Transboundary Ecosystems

3.1.40 Incorporate Sustainable Development in the United Nations System

3.1.41 Develop and Implement National Strategies for Sustainability

If African countries are to integrate environment and development activities successfully, then the formulation and implementation of National Strategies for Sustainability (NSSs) is probably essential. So far, the term "National Conservation Strategies" (NCSs) has been used, but it recommended that the name be changed to demonstrate the broader implications of this process. The NSS is of itself no guarantee of improved conservation activity, but is a vital tool for co-ordination of conservation and its integration across sectors of government. Its preparation can act as an important forum for the drawing together of many agencies and government departments and for consciousness-raising in sectors where environmental issues have previously been very low on the agenda or have been seen as irrelevant.

Most, if not all, of the recommendations made in this strategy should be incorporated as part of each country's NSS. The World Conservation Strategy (WCS) was published in 1980 and it charted a new way forward for conservation and sustainable development, and how these might be integrated with each other. Each NSS aims to put the principles of the WCS into practice for the country in question. To date, five African countries have prepared NSSs, and they are under development in another five: details of national activity in relation to NSSs are provided in Table 3.1. From this table it is clear that the NSS process in Africa as a whole is at a very early stage of development The first generation of NSSs have been pioneering documents, and it is not surprising that they have often been incomplete in certain ways. In particular, the early NSSs have been weak in their treatment of the conservation of biodiversity. It is noteworthy that in those NSSs now under development, the need to address biodiversity as one of the central elements of each strategy is clearly acknowledged.

The following aspects of the conservation needs of biodiversity should be important characteristics of any NSS:

(a) A detailed description of biodiversity in the country, with a clear account of the key habitats and species, the benefits they provide (including socioeconomic benefits), the major threats to them, and broadly based recommendations for improved management

(b) An analysis of current obstacles to, and opportunities for, conservation in the country.

(c) Clear recommendations for establishing an inter-sectoral approach to conservation (in other words, conservation is not merely the province of wildlife and national parks departments, but should also be a major consideration of ministries covering agriculture, fisheries, energy, finance, planning, foreign affairs, and the like).

(d) Clear recommendations for integrating conservation and development (this means not simply adding a conservation component to existing development initiatives, but

Country	NSS Progress				
	Completed	In Preparation	Under Discussion	Suspended	No Progress
Angola					✔
Benin					✔
Botswana		✔			
Burkina Faso					✔
Burundi					✔
Cameroon					✔
Cape Verde					✔
Central African Republic			✔		
Chad		✔			
Comoros					✔
Congo					✔
Djibouti					✔
Equatorial Guinea					✔
Ethiopia		✔			
Gabon					✔
Gambia					✔
Ghana			✔		
Guinea					✔
Guinea-Bissau		✔			
Ivory Coast				✔	
Kenya			✔		
Lesotho					✔
Liberia					✔
Madagascar	✔				
Malawi					✔
Mali			✔		
Mauritania		✔			
Mauritius					✔
Mozambique					✔
Namibia			✔		
Niger			✔		
Nigeria	✔				
Reunion					✔
Rwanda					✔
São Tomé & Principe					✔
Senegal				✔	
Seychelles				✔	
Sierra Leone				✔	
Somalia				✔	
South Africa	✔				
Sudan					✔
Swaziland					✔
Tanzania			✔		
Togo			✔		
Uganda				✔	
Zaire					✔
Zambia	✔				
Zimbabwe	✔				
Totals	5	5	8	6	24

Table 3.1 Progress with the development of National Strategies for Sustainability in African countries (current as of July 1990).

rather adopting policies and practices that contribute to long-lasting and sustainable conservation and development at the same time).

(e) Statement of a national objective on the level of biodiversity that it is desired to maintain, including the number and identities of the species for which explicit conservation measures are to be implemented, the areas of land which are to be legally protected for conserving biological resources and the measures designed to maintain biodiversity in other areas.

An NSS should be the foundation of each country's national development programme, and should form an integral part of government policy, with full political support from the highest levels of central government to the village level. Each NSS should be prepared by country nationals (with outside technical assistance if requested), and should give the government a coherent and realistic framework in which to plan and implement conservation activities. Many of the activities outlined elsewhere in this document should normally be included as part of each country's NSS.

Recommended activities

• All African countries that have not already done so should be encouraged to prepare NSSs to assist with their development strategies. *[President's Office; Prime Minister's Office; Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Ministry of Energy]*

• All African countries that have prepared NSSs (or equivalent strategies) should review them to see if they satisfactorily address the need to conserve biodiversity, as outlined above; if necessary, changes might be made to provide more comprehensive coverage. *[Ministry of Agriculture; Department of Wildlife and National Parks; Department of Fisheries; Department ofForestry; Ministry ofEnergy]*

For further details on the NSS process, the reader is referred to the chapter on national and subnational strategies in "Caring for the World".

3.2 Development and Management of a Protected Areas System

3.2.1 Complete the Establishment of a Representative Network of Effective Protected Areas

The conservation of biodiversity depends to a large extent on the effectiveness of Africa's protected area system. Protected areas form a reservoir for many species and can act as sources from which populations outside the reserves can be sustained. In the long term, species can even recolonise parts of their former ranges from secure refuges within protected areas. Protected areas are not necessarily total exclusion zones in which all uses of species and ecosystems are prohibited. IUCN has defined a set of protected area categories (see Table 3.2), in which varying degrees of human use are permitted. The "national park", in which all consumptive uses are prohibited, should not be seen as the ideal state of protection. Rather, an appropriate form of protected area should be designed for each situation, depending upon factors such as the social and economic needs of the local people, the particular needs of the species and ecosystems in each area, tourist and sport-hunting potential, and research importance.

In order to protect populations that are large enough for long-term viability of almost all the species in Africa, the continent's protected area system needs to be composed of sizeable areas of all the natural habitats within each nation. Particular attention needs to be paid to placing protected areas within sites of high species diversity and endemism. In general, the continent's protected area system is least complete in the lowland rainforests of West and Central Africa, and in the mountain regions throughout the continent. Specific sites for new and expanded protected areas are given in the country sections.

Protected areas will only be effective in the long-term if appropriate management plans are drawn up for them and put into operation. Such management plans must consider the human, biological, financial and organisational needs of each reserve. In some cases it is necessary to rehabilitate existing protected areas as well as to establish new ones.

Recommended activities

• Determine whether the biodiversity within each habitat in each country, especially in centres of endemism and areas of high diversity, has an adequate conservation status, and hence what additions are required to the national reserve system. This means that a national systems plan should be developed for each country. The six recommendations listed next are all aspects of such a plan. *[Department of Wildlife and National Parks; Universities]*

• Determine whether existing protected areas are large enough to fulfil their protective role, and whether enlargements might be needed in certain cases. *[Department of Wildlife and National Parks; Non-governmental Organisations]*

• Take steps to establish these new and enlarged protected areas. *[Department of Wildlife and National Parks; Non-governmentalOrganisations;DevelopmentAssistanceAgencies]*

While all protected areas control human occupancy or use of resources to some extent, considerable latitude is available in the degree of such control. The following categories are arranged in ascending order of degree of human use permitted in the area.

1. 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.

2. 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.

3. Natural monument/natural landmark.
To protect and preserve nationally significant natural features because of their special interest or unique characteristics.

4. 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.

5. 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.

6. Resource reserves.
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.

7. 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.

8. 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).

Table 3.2 IUCN management categories and objectives for protected areas.

• Identify protected areas that are in need of rehabilitation, and take the necessary steps to improve the effectiveness of the management of these areas. *[Department of Wildlife and National Parks; Non-governmental Organisations; Development Assistance Agencies]*

• Prepare criteria for establishing a marine and coastal protected area system around Africa, and take steps to establish the component reserves of this system. *[Department of Wildlife and National Parks; Department of Fisheries]*

• Ensure that up-to-date and adequate management plans are prepared for each protected area, and that these are fully implemented. *[Department of Wildlife and National Parks; Non-governmental Organisations; Development Assistance Agencies]*

• Ensure that sufficient funds are available for the effective management of each protected area, and that the necessary infrastructure for each area is in place. *[Ministry of Finance; Department of Wildlife and National Parks; Development Assistance Agencies]*

• Disseminate widely in Africa the following IUCN publications: "Managing Protected Areas in the Tropics"; "Review of the Protected Areas System in the Afrotropical Realm"; "Directory of Afrotropical Protected Areas"; and "Action Strategy for Protected Areas in the Afrotropical Realm"; also the following Peace Corps publication: "Conservation and Wildlife Management in Africa". *[Department of Wildlife and National Parks; Non-governmental Organisations; Development Assistance Agencies]*

• Ensure that local people receive an appropriate proportion of the profits from conservation activities (e.g. from protected areas, sport-hunting fees, etc.). *[Local Governments; Department of Wildlife and National Parks]*

• Participate in UNESCO's Man-and-the-Biosphere Programme (MAB), thus promoting the concept of biosphere reserves that integrate the needs of development and conservation. *[Ministry of Agriculture; Local Governments; Department of Wildlife and National Parks; Department of Forestry; Non-governmental Organisations; Development Assistance Agencies]*

3.2.2 Improvement of Wildlife Management

Many species can be effectively conserved through proper management of their habitats and protected areas. However, others, especially the larger and commercially more valuable ones, often require more intensive management techniques. In many African countries, the expertise to perform these techniques is not yet available. In some others it is in short supply. Important management skills that most countries should develop are:

(a) Animal capture and translocation.
(b) Management of crop-raiding animals.
(c) Veterinary diagnosis and management of diseases.
(d) Operation of culling programmes.
(e) Development and management of village-level wildlife utilisation schemes.
(f) Aerial and ground census techniques.
(g) Management of sport-hunting and associated industries, including taxidermy.

More sophisticated techniques that should be developed where appropriate are:

(a) Implementation of re-introduction programmes.
(b) Implementation of extermination programmes of damaging introduced species.
(c) Genetic and demographic management of small populations.
(d) Development and management of crocodile and ostrich farms.
(e) Contraceptive administration to prevent over-population of certain species.

Recommended activities

• Each country should make an assessment of the sorts of wildlife management skills it needs, and the relative priority that should be accorded to their development *[Department of Wildlife and National Parks]*

• Undertake training programmes to develop priority wildlife management skills. *[Department of Wildlife and National Parks; Non-governmental Organisations; Development Assistance Agencies]*

3.3 Biodiversity Conservation as a Component of Land-use

3.3.1 Adoption of Land-use Practices Around Protected Areas to Promote the Conservation of Biodiversity

The protected area system represents one of Africa's main lines of defence for its biodiversity. However, if the people of Africa are to continue to derive benefits from biodiversity, and thus support its conservation, then steps are needed to improve its management outside the protected areas as well as within them.

The integrity of protected areas depends in particular upon the management of the natural resources in the surrounding area. A well managed utilisation area, sometimes

referred to as a "buffer zone", allows many species to range beyond the borders of a reserve, and hence to occur in larger and more viable populations. These areas also allow local people to make direct use of the resources that are protected in the reserves, and thus reduces conflicts between human and conservation needs by maintaining both the viability of the species and its availability for human consumption. The correct management of a buffer zone requires careful planning, and different procedures may need to be adopted in different habitats (i.e. rainforests react differently to local utilisation than deserts). One approach to buffer zones which might be adopted in African countries is the Biosphere Reserve concept, as devised by the UNESCO Man-and-the-Biosphere Programme (MAB).

Recommended activities

• Ensure that wherever possible, all reserves have defined utilisation areas around them, with carefully formulated management plans. *[Ministry of Agriculture; Local Governments; Department of Wildlife and National Parks; Department of Forestry; Non-governmental Organisations; Development Assistance Agencies; Ministry of Energy]*

• Ensure that each management plan takes full account of both human and conservation needs, and that all authorised utilisation is at a sustainable level. *[Local Governments; Department of Wildlife and National Parks; Department of Forestry; Non-governmental Organisations; Development Assistance Agencies; Ministry of Energy]*

• Where appropriate, develop integrated Biosphere Reserves, following the MAB approach. *[Ministry of Agriculture; Local Governments; Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Non-governmental Organisations; Development Assistance Agencies; Ministry of Energy]*

3.3.2 Adoption of Wider Land-use Policies to Promote the Conservation of Biodiversity

This section refers to land-use practices over a broad area, beyond the special topic of land-use practices in buffer-zones around protected areas. Land-use is not restricted to agricultural or livestock practices, but relates to many industrial and urban activities as well. For instance, mining, oil exploitation, timber production, urban growth, transport and waste disposal all affect biodiversity. However, in the African context, the need to provide for biodiversity conservation within agricultural and pastoral settings is particularly urgent

Recommended activities

• Ensure that agricultural developments include measures to conserve biodiversity, such as the maintenance of hedges, coppices, ponds and small lakes, and the use of environmentally friendly pesticides and fertilisers. *[Ministry of Agriculture; Local Governments; Non-governmental Organisations; Development Assistance Agencies]*

• Review ownership and usership rights of biodiversity in agricultural and pastoral areas, and if necessary modify them to ensure that they provide for wise management and sustainable use. *[Ministry of Agriculture; Department of Wildlife and National Parks; Department of Forestry; Department of Fisheries; Local Governments]*

• Conduct environmental impact assessments on all commercial, industrial and other developments, and prevent or modify proposals which have unacceptable impacts on the biodiversity of the area. *[Local Governments; Department of Forestry; Development Assistance Agencies; Private Sector Corporations; Ministry of Industry]*

• Avoid pollutant methods of waste disposal by the development of effective recycling, fertiliser manufacture etc. *[Ministry of Agriculture; Local Governments; Development Assistance Agencies; Private Sector Corporations; Ministry of Energy; Ministry of Industry]*

3.4 Sustainable Harvest Management

As discussed in Chapter 2, the people of Africa make extensive use of the continent's biodiversity, and this is one of the reasons why it must be conserved. Biodiversity will only remain for the benefit of future generations if it is used sustainably now, and if degraded ecosystems and depleted populations of species are allowed to recover. One of the highest priorities in Africa is the development of local level projects which promote conservation and development through the sustainable harvest of wild species. A major aim of such projects should be to enlist the support of rural people in Africa for conservation efforts, because they receive substantial and tangible benefits from from such activities.

Recommended activities

• Support and implement land-use policies which feature the sustainable use of wildlife as a component of conservation and development efforts. *[Ministry of Agriculture; Department of Wildlife and National Parks; Local Governments; Department of Fisheries; Non-governmental Organisations; Development Assistance Agencies]*

• Develop and implement demonstration projects to test out ideas in the field. *[Ministry of Agriculture; Local Governments; Department of Wildlife and National Parks; Depart-*

merit of Fisheries; Department of Forestry; Non-governmental Organisations; Development Assistance Agencies]

• Ensure that local people are able to earn sustainable benefits from conservation, and are protected against paying unreasonable costs of conservation measures. *[Ministry of Agriculture; Department of Wildlife and National Parks; Department of Fisheries; Non-governmental Organisations; Local Governments; Development Assistance Agencies]*

• Involve rural people in the design of projects, not just in their implementation. *[Local Governments; Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Non-governmental Organisations; Development Assistance Agencies; Ministry of Energy]*

• Grant ownership or usage rights of wildlife in areas outside nationally managed protected areas to the local communities, together with appropriate incentives and disincentives to ensure that any such usage is carried out at a sustainable level (this also involves legal action: see section 3.5.3). *[President's Office; Prime Minister's Office; Department of Wildlife and National Parks; Ministry of Energy; Ministry of Justice]*

• All government sectors should ensure that their policies and activities use wildlife resources only in a sustainable manner, and that no actions are taken that unnecessarily reduce biodiversity. This includes those sectors that impact directly on biodiversity (e.g. agriculture, forestry, fisheries), and those that have impacts in other ways (e.g. transport, defence, urban planning, energy supply etc.). *[Ministry of Agriculture; Local Governments; Department of Fisheries; Department of Forestry; Ministry of Energy; Ministry of Industry]*

• Carry out the necessary studies to determine to what extent the use of living natural resources is already an important economic activity in each country and thus ensure that the government agencies responsible for the management of these resources receive a level of support that is consistent with their economic contribution to the country. *[Ministry of Finance; Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Development Assistance Agencies; Ministry of Energy; Ministry of Industry]*

• Regulate commercial and industrial uses of biological resources so as to ensure sustainable offtake, active renewal of harvested species, and pollution prevention. This should be done through a combination of legislation and economic incentives. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Private Sector Corporations; Ministry of Energy; Ministry of Industry; Ministry of Justice].*

3.5 Development of Institutional and Technical Capacities in Conservation

3.5.1 Development of Strong Conservation Agencies

In order to manage its biodiversity effectively, each African nation requires strong conservation agencies with competent staff at all levels. Training has been a major focus of the continent's conservation efforts for many years, but is still being carried out at too slow a rate to meet the many urgent needs.

Recommended activities

• Develop strong conservation authorities at the national and local levels, with staff trained in wildlife and protected area management, including all specialisations that the country might require. *[President's Office; Local Governments; Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry]*

• Ensure that natural resource management agencies have the support to enable them to carry out their assigned responsibilities. *[President's Office; Prime Minister's Office; Ministry of Finance; Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Development Assistance Agencies]*

• Introduce measures that allow natural resource management agencies to keep a higher proportion of the revenues they earn (from tourism, hunting, etc.), including foreign currency receipts. Such increased revenues could then be used to improve the management and conservation of the nation's natural resources at a local level. *[Ministry of Finance; Department of Wildlife and National Parks]*

• Assess staffing needs of natural resource management agencies, and thereby determine the forms of training most urgently needed in staff expansion programmes. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry]*

• Develop clear and attractive career structures in the conservation sector, in order to be able to recruit dedicated and highly motivated staff at all levels within the conservation authorities, and provide adequate salaries and opportunities for advancement within the system. *[Department of Wildlife and National Parks]*

• Develop the role of wildlife and conservation departments as consultants to other government departments, particularly those involved in planning or development of energy supply, agriculture, fisheries, forestry, urban growth, and waste disposal. *[President's Office; Prime Minister's Office; Depart-*

merit of Wildlife and National Parks]

• Arrange secondment of professional staff in natural resource management agencies to NGOs for short-term consultancies (a few months at a time) in order to increase the input of local expertise to NGOs, improve collaboration between governments and NGOs and increase the attractiveness of careers in government service through the salary supplements provided by NGO consultancies. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Non-governmental Organisations]*

• Sponsor workshops and seminars designed to bring professional staff together on a regular basis. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry]*

• Ensure that conditions for field staff provide for adequate salaries, living standards, fringe benefits and status. *[Ministry of Finance; Department of Wildlife and National Parks]*

• Ensure that field service staff are properly supported with the necessary material resources, for example vehicles, fuel, maintenance services, radios, weapons and so on. *[Department of Wildlife and National Parks; Non-governmental Organisations; Development Assistance Agencies]*

• Ensure that recruitment policies of conservation agencies feature the employment of local people as a top priority, including seasonal or part-time employment where appropriate. *[Department of Wildlife and National Parks]*

• Promote courses and training seminars, and ensure staff attendance at such meetings; encourage application and adaptation of the lessons learnt at such gatherings. *[Department of Wildlife and National Parks]*

• Broaden the existing curricula at the Garoua and Mweka Colleges to provide courses on social and economic aspects of biodiversity management. *[Department of Wildlife and National Parks; Non-governmental Organisations; Development Assistance Agencies; Ministry of Education; Universities]*

• Develop further national and regional training institutes for senior and middle-level professional staff on the management of biological resources. *[Department of Wildlife and National Parks; Non-governmental Organisations; Development Assistance Agencies; Ministry of Education]*

• Develop suitable in-service training programmes with an emphasis on practical field techniques for field and technical staff. *[Department of Wildlife and National Parks; Non-governmental Organisations; Development Assistance Agencies]*

• Encourage and promote the teaching of biodiversity conservation and management in African universities (there being a particularly urgent need for such courses in francophone Africa). *[Ministry of Education; Universities]*

• Encourage universities in developed countries to sponsor short courses in conservation for African countries. *[Ministry of Education; Universities]*

• Promote means of disseminating appropriate scientific and technical literature to the staff in African conservation authorities who need to apply the research findings in practice. *[Ministry of Education; Universities]*

• Ensure that key published materials are made available in the French language and in more local languages as the need arises. This, like many other expensive items, could be funded by international donor agencies. *[Non-governmental Organisations; Development Assistance Agencies; Ministry of Education; Universities]*

• Provide training in monitoring and research activities, so as to increase national research and academic capacities. Section 3.S.4 indicates some important areas in which such activities are a priority. *[Department of Wildlife and National Parks; Non-governmental Organisations; Development Assistance Agencies; Universities]*

• Develop institutional capacity and expertise for *ex situ* conservation programmes where these prove to be necessary, with emphasis on managing botanic gardens and zoos for maintaining viable populations of species threatened with extinction in the wild. *[Zoos; Botanic Gardens]*

3.5.2 Public Awareness Programmes and Education

Public awareness programmes are a major investment, and their success not only depends on a complex range of factors but is also difficult to evaluate in the short term. Most successful campaigns are multi-level, multi-media, carefully matched to the known cultural values of the target group, long-term, and carefully evaluated and re-evaluated at every stage of development and use. The leaflet dissemination approach is entirely naive as a behaviour-change strategy. If public awareness programmes are not to be a waste of money they need to involve the following features:

(a) clear identification of target audience;

(b) desired outcomes stated clearly in terms of observable behaviours in the target audience;

(c) a clear relationship between the goals of the pro-

gramme and the known values of the target audience.

(d) use of media which are known to be effective and which are known to be meaningful to the target audience.

(e) a planned evaluation strategy which addresses durability of changes as well as short-term effects.

(f) full participation by representatives of the target group in developing the programme.

The following defined target groups represent the highest priority for conservation awareness programmes in Africa:

(a) Decision-makers, with a particular emphasis on senior officials in finance and planning ministries, prime ministers' offices and presidents' offices. Such people should be informed of the important contributions of biodiversity to the national economy, and therefore of the importance of introducing appropriate changes to ensure that these contributions can continue to be made on a long-term basis. This target audience is particularly important, because if senior decision-makers make appropriate changes in government policy, the necessary behavioural changes by the other target groups can become more rational.

(b) Local people living near critical sites for biodiversity. Such people need to learn of the uniqueness of the areas in which they live, and the importance of the biodiversity in their areas on an international, national, as well as local level.

(c) Industries that over-exploit biodiversity. Such industries need to learn of the unsustainability of their practices, and the serious economic and ethical consequences, for themselves as well as others, of resource depletion.

(d) Young people. The long-term commitment of Africa's people to the wise management of their living natural resources depends upon today's young people. The establishment and continued operation of wildlife clubs is therefore of particular importance.

In all cases, separate programmes will need to be developed for each target group. Together, they can be seen to comprise part of a comprehensive programme, which, it is hoped, will raise the political profile of conservation in Africa.

Education services need to be encouraged to recognise their vital role in conservation. At primary and secondary levels much can be done to sensitise children and young people to the need for wise treatment of wildlife resources. In higher education and professional training for many different spheres of activity, there is a need for conservation issues to be incorporated in curricula in order to move away from the sectoral approach that prevents much effective conservation at present

Recommended activities

• Teacher training institutions should examine ways of incorporating conservation education into teacher training courses. It is important that such courses make use of local examples, requirements and traditions. *[Ministry of Education; Universities]*

• Primary and secondary school curricula should include conservation-related topics. *[Ministry ofEducation]*

• Higher education institutions and professional training bodies should evaluate the relationship between their subject-matter and conservation issues and should develop and include courses on conservation in their curricula. In particular, courses on agriculture, forestry, economics, civil engineering and building, transport studies, urban planning and public administration should have a strong orientation towards environmental issues and conservation. *[Ministry of Education; Universities]*

3.5.3 Legal Support for Biodiversity Conservation

In order to conserve biodiversity and use it in a rational manner and, in particular, implement the international conservation conventions to which it is a Party, each African state needs an adequate legislative framework.

Legislation should, at a minimum, provide for the following:

(a) Species. Appropriate protection should be provided for endangered species, and for species for which the country has a particular responsibility (such as species which are endemic, or largely so, and migratory species). Special attention should be given to species protected under international conventions. Protection should include prohibitions of taking, posession and trade and, where possible, the protection of critical habitats of the species concerned. With regard to international trade and the implementation of CITES, rational legislation should provide for appropriate controls on the import and export of all CITES listed species, and not only of indigenous species as it is often the case. Appropriate protection should also be given to species which are subject to exploitation for their trophies, skins or other products. Such prohibition should include taking and trade restrictions and, for CITES species, rules to ensure compliance with CITES requirements. In each country, the competent authority should be empowered by law to designate as a protected species any species of animal, including invertebrates, and plant.

(b) **Protected areas.** The establishment of a system of protected areas should be in accordance with the obligations contained in the relevant international conventions. Provision should also be made for the establishment of buffer zones. The government department in charge of protected areas should have the necessary authority and means to enforce protective rules and to manage these areas with a view to ensure the conservation of the biodiversity therein.

(c) **Conservation outside protected areas.** There should be a legal requirement for all government departments to take full account of biodiversity conservation needs as they develop and implement policies within their sectors (e.g. planning, agriculture, forestry, fisheries, energy production, mining, transport, etc.), through environmental impact assessments or similar procedures.

Recommended activities

• For those countries that have specific conservation legislation, to review its effectiveness in the light of the above guidelines.

• For countries that have no such legislation, to develop it in line with the above guidelines.

• In addition, each country should review the impact of all their legislation on the environment.

3.5.4 Scientific Activity

3.5.4.1 Implementation of National Biological Surveys

Conservationists are keenly aware that knowledge of Africa's rich biological resources is still very limited. Consequently, each year a number of biological surveys are carried out with a view to increasing the knowledge of what exists where, and what management and conservation measures might be needed. At present, these surveys tend to be somewhat wasteful of resources, since they usually focus on narrow groups of species, even though other species of conservation importance might exist within the study area. There is therefore a need for broadly-based, long-term, ongoing biological surveys in all African countries, as part of each nation's effort to plan the conservation and best use of its natural resources. National biological surveys should be a feature of each country's National Strategy for Sustainability.

Recommended activities

• Establish national biological surveys, making full use of indigenous expertise from national universities, museums and conservation authorities. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Non-governmental Organisations; Development Assistance Agencies; Universities]*

• Develop cooperative linkages between universities in the developed world and their counterparts in Africa to support and develop national biological survey programmes. *[Universities]*

• Develop a national capability in each country to undertake such surveys and to identify key groups of species. *[Department of Wildlife and National Parks; Department of Fisheries; Department ofForestry; Non-governmental Organisations; Development Assistance Agencies; Universities]*

• Develop mechanisms for the rapid assessment of biodiversity in key areas (though censuses of some highly visible environmental indicator species), as well as the more lengthy process of undertaking a detailed inventory of species and ecosystems in each country. *[Universities]*

• Develop regional cooperation for sharing the more specialised areas of expertise, especially in the taxonomy of plants and invertebrates. *[Department of Wildlife and National Parks; Department ofForestry; Universities]*

• Undertake long-term monitoring of critical sites to obtain information on changing conservation status and needs. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Non-governmental Organisations; Development Assistance Agencies; Universities]*

• Include in surveys an assessment of actual and potential economic contributions of species and ecosystems. *[Department of Wildlife and National Parks; Department of Fisheries; Department ofForestry; Non-governmental Organisations; Development Assistance Agencies; Universities]*

• Document, as a matter of urgency, all traditional uses of wildlife resources, giving highest priority to retrieving knowledge that seems likely to be rapidly lost. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Non-governmental Organisations; Development Assistance Agencies; Universities]*

• Incorporate the results of the survey in a national database on natural resources. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Universities]*

• Ensure that the results of all survey work are shared with those responsible for the management of natural resources in all countries within the region. *[Department of Wildlife and National Parks; Department of Fisheries; Department of*

Forestry; Non-governmental Organisations; Development Assistance Agencies; Universities]

• Make it a priority to survey sensitive habitats, in particular coral reefs, caves, small potentially unusual forest patches, and wetlands. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Non-governmental Organisations; Development Assistance Agencies; Universities]*

3.5.4.2 Development of Appropriate Scientific Research Programmes

A detailed scientific research programme should be closely coupled with the biological surveys. Scientific research should be targeted on the resolution of important problems that have a bearing on management decisions. Africa is in a position to make a major contribution to the growing science of conservation biology. The following is a far from exhaustive list of research topics that are a high priority in African nations, which should involve, as much as possible, their national universities.

• The effects of habitat fragmentation on biodiversity. *[Department of Wildlife and National Parks; Department of Forestry; Universities]*

• The effects of logging and firewood collection in rainforest, Guinea savanna and miombo woodlands on biodiversity. *[Department of Wildlife and National Parks; Department of Forestry; Universities]*

• The effects of different fire regimes on biodiversity. *[Department of Wildlife and National Parks; Universities]*

• An investigation into what constitutes sustainable use for a variety of important species and ecosystems and the extent to which such uses could contribute to conservation and economic development *[Department of Wildlife and National Parks; Universities]*

• Investigations of potential new uses of animals and plants. *[Universities]*

Other important areas for research will no doubt become clear as the national biological surveys continue.

3.5.5 International Cooperation

3.5.5.1 Strengthening of Regional Cooperation in the Development of Conservation Activities

On a continent where finance is usually very limited, the success of conservation programmes can often be greatly enhanced by sharing of ideas, information and expertise. Some of the possibilities for regional cooperation are mentioned elsewhere. There are many opportunities for regional cooperation in conservation activities in Africa.

Recommended activities

• Ideas, information, and expertise in conservation need to be shared among nations at senior policy, professional and research levels. This already happens among the SADCC countries (Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, and Zimbabwe). *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Universities]*

• Study and working tour arrangements between countries should be developed **as** means of sharing conservation information and skills. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Universities]*

• Interchanges of expert staff between national management agencies is needed, particularly to address specific problems. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry]*

• There should be free exchange of data, public information, and expertise regarding conservation activities. Again, the setting up of information systems on an inter-country basis could be an important focus for international donor organisations. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry; Development Assistance Agencies; Universities]*

• Ensure that permission to attend seminars, have study leave, and other means of international contact be given to qualified staff at all levels. *[Department of Wildlife and National Parks; Department of Fisheries; Department of Forestry]*

• Set up scholarship funds to provide support for students wanting to attend the regional training institutes at Garoua (Cameroon) and Mweka (Tanzania). *[Department of Wildlife and National Parks; Non-governmental Organisations; Development Assistance Agencies]*

• Develop, as appropriate, bilateral or multilateral agreements governing the conservation of shared or migratory natural resources. In particular, this might include marine species, and riverine and wetland ecosystems that are shared by several countries. *[Department of Wildlife and National Parks; Department of Fisheries; Ministry of Foreign Affairs]*

• Designate, where appropriate, jointly managed protected

Country	African	Ramsar	World Heritage	CITES	Bonn	ITTA	Whaling	Regional Seas
Angola								
Benin	✔		✔	✔	✔			
Botswana	✔			✔				
Burkina Faso	✔		✔	✔	✔			
Burundi	✔		✔	✔				
Cameroon	✔		✔	✔	✔	✔		✔
Cape Verde			✔					
Central African Republic	✔		✔	✔				
Chad	✔	✔		✔				
Comoros	✔							
Congo	✔		✔	✔		✔		
Djibouti	✔							
Equatorial Guinea								
Ethiopia	✔		✔	✔				
Gabon	✔	✔	✔	✔		✔		
Gambia	✔	✔	✔	✔				✔
Ghana	✔	✔	✔	✔	✔	✔		✔
Guinea	✔		✔	✔				✔
Guinea-Bissau		✔		✔				
Ivory Coast	✔		✔			✔		✔
Kenya	✔	✔		✔			✔	
Lesotho	✔							
Liberia	✔			✔		✔		
Madagascar	✔		✔	✔				✔
Malawi	✔		✔	✔				
Mali	✔	✔	✔		✔			
Mauritania	✔	✔	✔					
Mauritius	✔			✔				
Mozambique	✔		✔	✔				
Namibia								
Niger	✔	✔	✔	✔	✔			
Nigeria	✔		✔	✔	✔			✔
Reunion		✔	✔	✔	✔			✔
Rwanda	✔			✔				
Sao Tome & Principe								
Senegal	✔	✔	✔	✔	✔		✔	✔
Seychelles	✔		✔	✔			✔	✔
Sierra Leone	✔							
Somalia	✔			✔	✔			✔
South Africa	✔	✔		✔			✔	
Sudan	✔		✔	✔				✔
Swaziland	✔							
Tanzania	✔		✔	✔				
Togo	✔			✔		✔		✔
Uganda	✔	✔	✔					
Zaire	✔		✔	✔				
Zambia	✔		✔	✔				
Zimbabwe			✔	✔				

Table 33 The African parties to various international conventions.

areas along common boundaries to conserve shared resources, possibly using the concept of an "International Peace Park" as already implemented in several parts of the world. *[President's Office; Prime Minister's Office; Department of Wildlife and National Parks]*

• Promote regional agreements to cooperate in the control of illegal harvesting of species and their products. One such agreement is the OCFSA (Organisation pour la Conservation de la Faune Sauvage en Afrique), signed by Central African Republic, Chad, Sudan and Zaïre. *[President's Office; Prime Minister's Office; Department of Wildlife and National Parks; Ministry ofForeign Affairs]*

• Promote regional agreements that encourage the free exchange of captive animals and living plant material in support of carefully planned captive breeding and captive propagation programmes. *[Department of Wildlife and National Parks; Department ofFisheries]*

3.5.5.2 Fuller Implementation of Existing International Conventions Relating to Biodiversity

There are several existing international conventions that relate to the conservation of biodiversity. These should be ratified by all African states which have not yet done so. In addition, Parties to these conventions should enact appropriate legislation and ensure, to the maximum extent possible, that such legislation is effectively enforced. These conventions are listed in Table 3.3, and the African countries that are parties to them are indicated. The following conventions are important and potentially useful for African nations:

• African Convention on the Conservation of Nature and Natural Resources (the "African Convention")
• Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the "Ramsar Convention").
• Convention Concerning the Protection of the World Cultural and Natural Heritage (the "World Heritage Convention").
• Convention on International Trade in Endangered Species of Wild Fauna and Flora ("CITES").
• Convention on the Conservation of Migratory Species of Wild Animals (the "Bonn Convention").
• International Tropical Timber Agreement ("ITTA").

In addition, coastal African nations should adhere to the appropriate Regional Sea Convention. For West and Central Africa, this is the:
• Convention for Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region.

For East Africa, this is the:
• Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region, and its protocol concerning protected areas and wild fauna and flora in the eastern African region.

For the Horn of Africa, this is the:
• Regional Convention for the Conservation of the Red Sea and Gulf of Aden.

Finally, Sahelian and West African nations might also consider joining the Convention on the Conservation of European Wildlife and Natural Habitats (the "Bern Convention"), which is not restricted in membership to European countries; Senegal is already a party to the Bern Convention.

All these conventions represent useful tools which are available to African nations as part of their overall effort to conserve biodiversity.

The African Convention has not so far produced tangible results, but amendments aimed at improving its effectiveness were adopted by the Council of Ministers of the OAU in 1986. These amendments, however, need to be formally adopted by a diplomatic conference and then ratified by the Parties to the Convention before they come into force. African nations should do all they can to speed up the process and convene the conference at the earliest possible date. It should be noted here that effective conventions place specific obligations on their Parties. For instance, the Bonn Convention requires its Parties to negotiate Agreements for the conservation and management of migratory species listed in Appendix II of the Convention. Parties to the Bonn Convention should give high priority to concluding these agreements.

3.5.5.3 Implementation of the Tropical Forestry Action Plan

Another important mechanism for international collaboration is the Tropical Forestry Action Plan (TFAP), prepared jointly by FAO, the World Bank, the United Nations Development Programme (UNDP), and the World Resources Institute (WRI). It aims to increase public awareness of tropical forest issues, and to mobilize financial resources with a view to halting tropical deforestation. It has identified action needed in five sectors: forestry and agriculture; forest-based industries; fuelwood; conservation; and institution-building. Under the TFAP, countries can request reviews of their forestry sectors, and the TFAP then attempts to secure funding for projects arising from recommendations made in the country-level reviews. The TFAP attempts to use 8 % of the funds it raises on tropical forest conservation. The TFAP is a potentially useful mechanism by which international assistance to forest conservation programmes might be increased. Information on the current rate of progress with the country-level reviews is provided in Table 3.4.

Country	Planning Phase Completed	Missions Carried Out	Reviews Ongoing	Review Request Received	Inquiry Made	No Progress
Angola				✔		
Benin						✔
Botswana						✔
Burkina Faso			✔			
Burundi			✔			
Cameroon	✔					
Cape Verde						✔
Central African Republic			✔			
Chad					✔	
Comoros						✔
Congo			✔			
Djibouti						✔
Equatorial Guinea			✔			
Ethiopia			✔			
Gabon			✔			
Gambia				✔		
Ghana		✔				
Guinea		✔				
Guinea-Bissau					✔	
Ivory Coast			✔			
Kenya				✔		
Lesotho			✔			
Liberia				✔		
Madagascar			✔			
Malawi				✔		
Mali			✔			
Mauritania		✔				
Mauritius						✔
Mozambique			✔			
Namibia						✔
Niger			✔			
Nigeria				✔		
Reunion						✔
Rwanda			✔			
Sao Tome & Principe						✔
Senegal			✔			
Seychelles						✔
Sierra Leone	✔					
Somalia		✔				
South Africa						✔
Sudan	✔					
Swaziland						✔
Tanzania	✔					
Togo			✔			
Uganda					✔	
Zaire		✔				
Zambia			✔			
Zimbabwe				✔		

Table 3.4 The status of Tropical Forestry Action Plan country-level reviews (current as of May 1990).

Recommended Activities

• All countries in Africa should request reviews of their forestry sector under the TFAP. *[Department ofForestry]*

• African countries should support international efforts to steer the TFAP towards greater involvement with conservation activities, and increased participation by local NGOs in the TFAP process. *[Department ofForestry]*

3.5.5.4 Adoption of an International Convention on the Conservation of Biodiversity

The conservation conventions which are at present in force, as well as each country's attempt to conserve and manage biodiversity within its territory, should be considered as a part of a larger international effort. On the one hand, many of the threats to biodiversity are international in scope. These include the trade in wild species and their products, the clearance of important habitats in Africa for cash crops to satisfy the demand in Europe and North America and environmental degradation by activities such as mining and oil exploration. On the other hand, the conservation of biological diversity will cost money; since major areas of biodiversity however are located in some of the least affluent countries in the world, it is obvious that their conservation will be impossible without a considerable contribution from more developed nations.

It is in this contect that UNEP and IUCN have been working to prepare a "Convention on the Conservation of Biological Diversity." As currently drafted, the proposed convention recognizes that the conservation of biodiversity is a common responsibility of the countries where the resources are located and of the world community as a whole. It therefore sets forth as a basic principle that biological diversity constitutes a heritage: "the guardianship of which should be the concern of all; the benefits of which should be available to all; and the conservation costs of which should be shared equitably by all."

As a consequence, the proposed draft lays down the obligations that, to the maximum extent possible, states shall ensure the conservation of biological diversity within their territory. This obligation, however is matched by the institution of a financial mechanism to assist states in meeting their commitment. The mechanism includes payments from the users of biodiversity; a special fund; and contributions from the fund to conservation projects according to agreed criteria and priorities.

Africa as a whole could be a major beneficiary from this Convention, if it is formally adopted.

Recommended activities

• To take a full part in the negotiations that will be needed before the convention can be adopted. *[President's Office; Prime Minister's Office; Ministry ofForeign Affairs]*

• African nations are encouraged to act as formal sponsors of the convention. *[President's Office; Prime Minister's Office; Ministry ofForeign Affairs]*

• Once adopted, all African nations are encouraged to sign, ratify and implement this convention. *[President's Office; Prime Minister's Office; Ministry ofForeign Affairs]*

Chapter 4: Key Areas for the Conservation of Biodiversity in Africa

4.1 The Distribution of Biodiversity in Africa

The Afrotropical Realm possesses a very wide range of natural habitats and climatic regions. This has led to a similar richness in numbers and variety of plant and animal species, although, interestingly, the continent tends to have rather fewer species overall than other equivalent parts of the world, notably South America and Asia.

This diversity is not evenly distributed over the continent: some habitats are naturally richer in species than others, and in addition areas with essentially similar physical conditions (climate, soil type, topography) may have different numbers of species, as well as a different species composition. The importance of any given area in terms of biological diversity is a reflection not only of its overall richness, that is the number of species present there, but also of its uniqueness in terms of the number of localised species present, particularly those endemic to the area. The latter is in large part a reflection of geological and evolutionary history, as the longer a habitat has existed in a given area in isolation from any other area of similar habitat, the greater the proportion of endemic species there is likely to be.

In very general terms, for terrestrial ecosystems the warmer and wetter an area is, the more diverse it will tend to be. In Africa, therefore, the richest habitat overall is almost certainly the lowland equatorial rainforest. However, this habitat is not uniformly rich: in the central African equatorial forests, the areas to the east and west appear to be richer in species than the centre of the Zaïre basin, despite its having an essentially similar climate. This is interpreted to be a result of the climatic history of the area: the currently existing rainforests of the central region are believed to be fairly recent (perhaps as young as 10,000 years old), since immediately prior to this the climate in the area was too dry to support rainforest. The forests in the eastern and western parts may be much older. Since the climate is believed to have remained warm and wet during the generally drier phases the area could have supported rainforest species for a much longer time. In addition, the areas have most certainly been isolated from each other for a large part of at least the last million years and *different species have evolved in the two* blocks. These two areas are thus considered as centres of endemism for rainforest species. In contrast the central Zaïrean forests have a fauna and flora believed to consist very largely of species which have immigrated there from the east and west in the last ten thousand years or so, there having been insufficient time for a significant number of species to have evolved there. Since not all species from the adjacent areas have spread into the central region during this time, the latter is comparatively impoverished.

The whole of the Afrotropical Realm can be viewed as a series of centres of endemism which have evolved their own distinctive faunas and floras through isolation from other areas with similar climates, surrounded by transition zones where species from adjacent centres of endemism intermingle. Because isolation of one area from another is never complete, and because the African continent has undergone great changes in climate and topography through time, this view is a great simplification of the real situation. Many species, including some of the most characteristic and familiar members of the African fauna and flora occur in several centres of diversity or have distributions which cut across this pattern. Nevertheless it provides a very useful framework for viewing the biological diversity of the continent and for indicating where efforts should be concentrated to work most efficiently for the conservation of that diversity. The model most frequently adopted is that based on the distribution of plant species. Within this, seven regional centres of endemism are recognized in Africa south of the Sahara, with a further two on Madagascar. These areas, along with a further eight transition zones and regional mosaics, are known as phytochoria (see Fig. 2.2). The distribution of animal species, where this has been studied (butterflies, mammals, birds) accords reasonably well with the divisions used for plants.

4.2 The Conservation of Biodiversity in the Afrotropical Realm

It is a reasonable premise that conservation efforts in the Afrotropical Realm should seek to conserve the maximum number of species. It would theoretically be possible to map the distribution of every surviving wild species in the region and use this information to identify a network of sites and areas that would include viable populations of all these species. *In* practice, of course, *this is not possible: the* distribution of only a fraction of African species is known in any detail, and a very large number of species, particularly invertebrates, have yet to be scientifically described, let alone mapped. Furthermore, it would be impossible to safeguard

Fig 4.1 Centres of endemism for birds in continental Africa. The shading indicates all areas where three or more restricted-range endemic species occur. See text for further detail. Data provided by ICBP.

all such sites and areas immediately. It is vital, therefore, that some method be devised for setting priorities, that identifies the most important areas where conservation action should be concentrated. A first step towards this is to ensure as much as possible that the unique fauna and flora of each of the centres of diversity is adequately protected. All things being equal, priority should be given to those species seriously threatened with extinction and to those with very limited ranges, since the latter can be regarded as permanently at risk from habitat changes. Areas with a large number of local endemic species should thus be regarded as priorities for conservation efforts.

It is also possible to map particularly well known groups across the whole continent, to be used as indicators of areas of high endemism and diversity. This operates on the assumption that the patterns of distribution and diversity in different groups of species are strongly correlated with each other. This approach is being adopted by the International Council for Bird Preservation (ICBP), who are mapping the distributions of all bird species in Africa whose overall range size is estimated at 50,000 km^2 or less. Areas with concentrations of such species are considered priorities for conservation action. Figure 4.1 illustrates the major centres of endemism for birds in continental Africa identified in this way, and Table 4.1 gives the number of endemic birds found in each centre. Figures 4.2-4.4 give more detail on three of the most important centres, and show how this approach can be used to identify and illustrate the key sites for the conservation of endemics.

Historically, conservation efforts in Africa have tended to concentrate on areas with spectacular populations of 'big game', particularly in eastern and southern Africa. With some notable exceptions, the species found in such areas tend to be widespread and, as yet, not threatened with extinction. Areas, such as montane forest, with large numbers of endemics but fewer large, well-known species, have tended

to be under-represented in protected area networks. It is precisely in these areas that species extinctions may be most imminent.

In the long-term, however, concentration on areas with a large number of local endemics would lead to an imbalance: such areas may have lower overall species diversity than other habitats which may, as development proceeds, eventually become threatened themselves. The most extreme example of this is probably lowland tropical rainforest, undoubtedly the most diverse habitat in the Afrotropical Realm and yet one in which most species appear to be widespread (albeit at low density). On present knowledge, no single site can be identified as being of prime importance, and yet preservation of suitable samples of this habitat could be considered the single most important long-term priority for conservation of biological diversity in Africa.

As development proceeds, and natural habitats become ever more fragmented, areas may become de facto centres of endemism' through becoming the last refuges of previously much more widespread habitats and/or species. This may be illustrated by the West African rainforests and the areas in Chad and Niger which appear to hold the last populations of several previously widespread members of the sahelo-saharan fauna.

4.2.1 The Guineo-Congolean Tropical Moist Forests.

The most species-rich habitat in Africa is lowland tropical moist forest which is found in two main areas: the vast Guineo-Congolean forest blocks of west and central Africa, and the eastern and north-western parts of Madagascar. The latter is dealt with separately.

The Guineo-Congolean region can be divided into two very unequal sub-units. The smaller of these is the Guinean region which lies along coastal west Africa from western Ghana through Ivory Coast, Liberia and Sierra Leone into Guinea; its overall area is around 420,000 km^2, although the extent of surviving rainforest is very much smaller. The Congolian unit is nearly six times as large as the Guinean region, and embraces the southern parts of Nigeria, Cameroon and the Central African Republic, the whole of Gabon, Congo and Equatorial Guinea and the central part of Zaïre. The two areas are separated from each other by the so-called Dahomey Gap in Togo, Benin and eastern Ghana where savanna and woodland extends to the coast. This gap serves as a barrier to dispersal for many groups of species and has led to differences in faunistic and floristic composition in the two forest blocks, with the Guinean region being generally somewhat less rich than the Congolian region but having a notable number of endemic species.

Taken as a whole, the region is very rich in species, with an estimated 8,000 plants, of which around 80% are believed to be endemic. It also has by far the highest diversity of butterflies in Africa, with around 1,200 species confined to the region out of a total of 2,700 in the Afrotropical region as a whole. In all it is estimated to hold over half of all the species of the Afrotropical Realm.

4.2.1.1 The Guinean (West African) Rainforests

Lowland rainforest in West Africa has been severely reduced and only remnants of primary forest remain. Notable mammals confined to the region include three species of duiker *(Cephalophus zebra, C. niger and C. jentinki),* the royal antelope *Neotragus pygmaeus,* the slender-tailed giant squirrel *Allosciurus aubini,* Pel's flying squirrel *Anomalurus peli,* Nimba otter-shrew *Micropotamogale lamottei,* Johnston's genet *Genetta johnstoni,* Libcrian mongoose *Liberiictis kuhni,* olive colobus *Colobus verus,* and diana monkey *Cercopithecus diana.*

Twenty-eight bird species are endemic to the Guinean rainforests. Eight of these are considered threatened with extinction: the rufous fishing owl *Scotopelia ussheri,* the white-breasted guineafowl *Agelastes meleagrides,* the western wattled cuckoo shrike *Campephaga lobata,* the yellow-throated olive greenbul *Criniger olivaceus,* the spot-winged

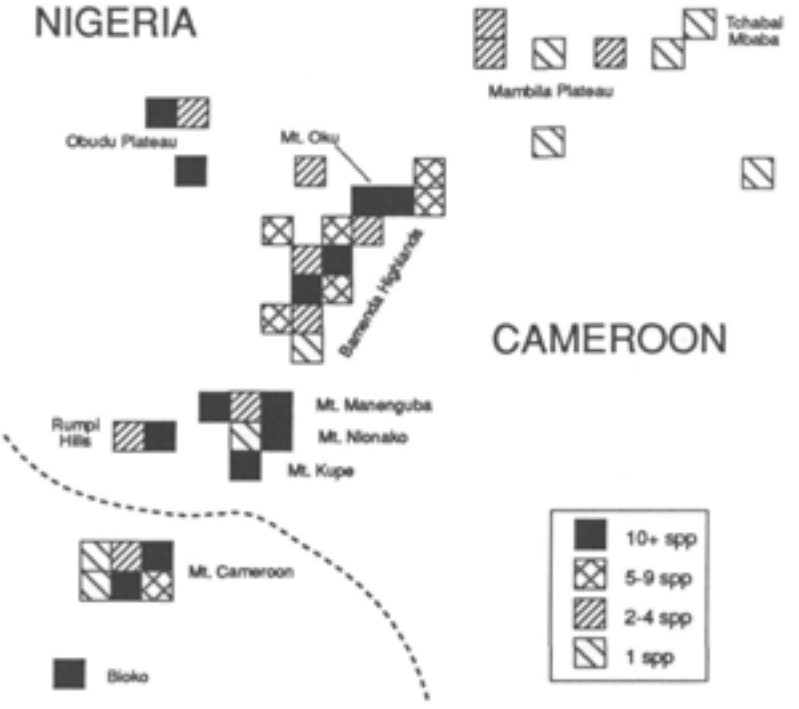


Fig 4.2 The distribution of endemic birds in the Cameroon Highlands. Data provided by ICBP.

Centre of Endemism	Number of restricted-range endemic bird species	Altitudinal Preference Lowland / Montane	Habitat Preference Forest / Non-forest
Upper Guinea Forests	7	L	F
Cameroon Highlands	23	M	F
Angola Scarp	12	L/M	F/N
Cape Region	4	M	N
South-East African high-altitude grasslands	4	M	N
East Zaïre Mountains	25	M	F
East African Mountains	26	M	F/N
Coastal forests of Kenya and Tanzania	6	L	F
Ethiopian Highlands	8	M	N

Table 4.1: Centres of restricted endemism among birds in continental Africa. This table gives the number of restricted-range endemic bird species in each centre of endemism, the altitudinal zone in which these endemic species occur, and the general habitat preference of the majority of the endemic species.

Greenbul *Phyllastrephus leucolepis*, the white-necked picathartes *Picathartes gymnocephalus,* the Nimba Flycatcher *Melaenornis annamarulae,* and the Gola malimbe *Malimbus ballmanni.*

By far the most important protected area for this habitat and the species which occur in it is the Tai National Park/N'Zo Faunal Reserve complex in Ivory Coast. This has a total area of 445,000 ha of which the national park constitutes 350,000 ha. Although part of it has been disturbed by logging and mining activities, it still contains one of the largest areas, if not the largest area, of primary rainforest in the Guinean region. Forty-seven of the 54 large mammal species known to occur in the Guinean forests have been recorded in the park, as have over 230 bird species, including 143 characteristic of lowland rainforest and at least seven of the eight threatened species endemic to the Guinean forests. Some 1,300 higher plant species have been recorded of which around 700 are believed endemic to the Guinea-Congolean forest blocks, and 200 confined to the Tai region. Other important areas are the 130,700 ha Sapo National Park in Liberia and the 116,000 ha Massif du Ziama Biosphere Reserve in Guinea. Because rainforest in West Africa outside protected areas is generally considered extremely threatened, these protected areas are of great continental, and indeed global, importance. Outside these protected areas, the region which appears to have the least impacted forests in West Africa is southern Guinea. This area should be considered a high priority for future conservation action.

4.2.1.2 The Congolean (Central African) Rainforests

The central African rainforests cover a much larger area than those of West Africa and support a greater diversity of species. However, this diversity is not evenly distributed as the central part of the rainforest, essentially that lying in the sweep of the Zaïre River (the so-called Cuvette Centrale), is relatively impoverished compared with the areas to the west and east of this. Typical vertebrates endemic to the western lowland forests include the angwantibo *Arctocebus calabarensis,* Allen's galago *Galago alleni,* black colobus *Colobus satanas,* drill *Mandrillus leucophaeus,* and mandrill *Mandrillus sphinx;* typical vertebrates of the eastern forests include the okapi *Okapia johnstoni,* the owl-faced guenon *Cercopithecus hamlyni,* the aquatic genet *Osbornictis piscivora* and the giant genet *Genetta victoriae,* although some of these have distributions which extend some way to the west. Several species, such as the congo peacock *Afropavo congensis,* Ansorge's cusimanse *Crossarchus ansorgei,* pygmy chimpanzee *Pan paniscus* and the black mangabey *Cercocebus aterrimus* appear largely or wholly confined to the central rainforests; however, the last two are very similar to taxa found outside the Cuvette Centrale (the common

chimpanzee *Pan troglodytes* and the grey-cheeked mangabey *Cercocebus albigena* respectively) and are considered by some taxonomists to be only distinguishable at subspecific level.

Most lowland rainforest species for which information on distribution is available are relatively widespread within the forest block. It is thus difficult to identify specific sites of particular floristic or faunistic significance. Important areas are therefore those with large, intact expanses of rain forest, particularly those in the more diverse western and eastern forests. In the west these include Korup National Park (126,000 ha), the Campo Faunal Reserve (271,160 ha) and the Dja Faunal Reserve (526,000 ha) in Cameroon, and Wonga-Wongue National Park (500,000 ha), Lope Faunal Reserve (500,000 ha) and the Sette Cama reserve complex (700,000 ha) in Gabon. The extremely remote forests in south-eastern Cameroon, northern Congo and south-western Central African Republic are probably very important and deserve protection.

In the east there are two important areas, both in Zaïre: Kahuzi-Biega National Park (600,000 ha, of which around 500,000 ha is lowland rainforest) and Maiko National Park (1,083,000 ha). The Ituri Forest, the southern part of which is protected in Maiko National Park, is considered a major conservation priority in this region, being the most important site for the okapi and having 13 species of primate, the highest number recorded for any forest in Africa.

In the Cuvette Centrale, by far the most important area is the 3,600,000 ha Salonga National Park.

Between them these areas cover just over 7.8 million hectares, the great proportion of which is rainforest, and with good representation of the three major areas. However, the rather unusual forests of southern Nigeria which are now highly fragmented require increased protection. Some areas, particularly those in the eastern and central parts of the Congolian region, are still poorly known in terms of their fauna and flora, but between them, the areas listed above are likely to contain populations of most of the species found in these forests. Many of these areas are inadequately protected at present, and subject to a variety of pressures and threats, including vegetation clearance through logging and mining and for agriculture, and poaching. These sites and those in the Guinean subregion between them probably account for over half the terrestrial species in the whole of continental Africa and are thus of major importance in conserving the biological diversity of the realm.

4.2.2. The Cape Fynbos Region

The Cape Region, entirely within Cape Province in South Africa, is remarkable chiefly for its flora. With an estimated 8,500 species of vascular plants, of which around 70% are endemic, in a total area of 71,000 sq. km, it has a richer flora than any other area of comparable size in Africa, and possibly in the world. Most of the native vegetation is fynbos, which is sclerophyllous scrubland 1-3 m tall with some scattered taller trees and *Protea* bushes. Fynbos is differentiated into mountain and lowland forms, the latter being more diverse than the former.

The area is faunistically less rich, although it is still important, with notable levels of endemism amongst the lower vertebrates, having 23 endemic amphibian species, 43 endemic reptiles, and numerous endemic, and often threatened, freshwater fishes.

The Cape region has been heavily settled for several centuries, and large areas of natural vegetation, particularly in the lowlands, have been cleared for agriculture and urban development. While lowland fynbos is thus considered a severely threatened habitat with only 20% of the original area of natural vegetation remaining, mountain fynbos has fared much better with most of the original vegetation intact, and nearly one-fifth included in protected areas, of which the two largest and most important are Hawequas and Sederberg Mountain Catchment Areas (115,910 ha and 126,375 ha respectively). Only 31,800 ha of lowland fynbos, or 0.4% of the original area of this habitat, is protected, mostly in small though well managed and secure reserves. It is not clear what percentage of the endemic fauna and flora of the region is protected in these reserves, but it is evident that lowland fynbos is underprotected.

4.2.3 Afromontane Regions

Africa has extensive, though widely scattered, montane areas with a particularly distinctive and rich flora and, to a lesser extent, fauna. The separate areas have definite floristic affinities with each other and taken as a whole the region has a flora of around 4,000 species of which 80% are endemic. Because of their often wide geographical separation, the different areas have also evolved their own distinctive floras and faunas and are best considered separately. The main regions are: West African, Ethiopian, Kivu-Ruwenzori, Imatongs-Usambara, Uluguru-Mulanje, and Drakensburg Mountains. Each of these areas also has affinities with the areas immediately surrounding it Two other highland areas (those west of the Dahomey Gap in West Africa and the Angolan highlands) are sometimes not considered true Afromontane regions because they have a high proportion of species in common with the surrounding lowlands; they are included here for convenience. Taken as a whole, these montane areas include some of the most important sites for conservation action in the Afrotropical Realm.

4.2.3.1 West African Montane Areas

These consist of two main areas: the Cameroon Highlands in the north-western part of the Congolean Forest Block and the uplands in the western part of the Guinean Forest Block,

from Mount Nimba on the Guinea/Liberia/Ivory Coast border west into Guinea.

The mountains in the Guinean Forest Block are relatively low (maximum height is 1752 m on Mount Nimba) and the fauna and flora are generally similar to that in the surrounding lowlands, with fairly low levels of endemism. However, these areas are often rich biologically because the altitudinal variation allows the development of a wide variety of habitats within a comparatively small area. There are few protected areas in the region; the most important are the 116,170 ha Massif du Ziama Biosphere reserve in Guinea, part of which is montane, and the transnational Mount Nimba Reserve, with 13,000 ha in Guinea and 5,000 ha in Ivory Coast, adjacent to a proposed nature reserve in Liberia. The Mount Nimba area is under pressure from mining activities, and is need of increased protection.

The Cameroon Highlands (which in fact extend into north-east Nigeria and onto the offshore island of Bioko) are in contrast, an extensive area of largely volcanic uplands with significant areas of montane vegetation and a notable number of endemic species. The area has 53 montane forest bird species, of which 22 are endemic, as well as around 55 endemic amphibian species, and ten reptiles. The most important areas are the Bamenda Highlands (in particular Mount Oku), Mount Cameroon itself and Mount Kupe, all in Cameroon; Mount Malabo on Bioko; and the Obudu Plateau in Nigeria. These areas are all in urgent need of increased protection.

4.2.3.2 Ethiopian Highlands

Ethiopia has by far the largest area of land over 2,000 m in Africa and has a rich Afromontane flora and fauna. There are 30 bird species, 20 mammals and at least 13 amphibians endemic to the region. The highest areas have an impoverished Afroalpine vegetation with affinities to other alpine areas; the mid-montane forests are much richer in species, although severely reduced in extent. However, many of the endemic species in these highlands are open-habitat rather than forest species.

Mount Baker, Upper Bujuku Valley, Ruwenzori Range, Uganda (Photo: WWF/J.H. Blowcr/J. Allan Cash).

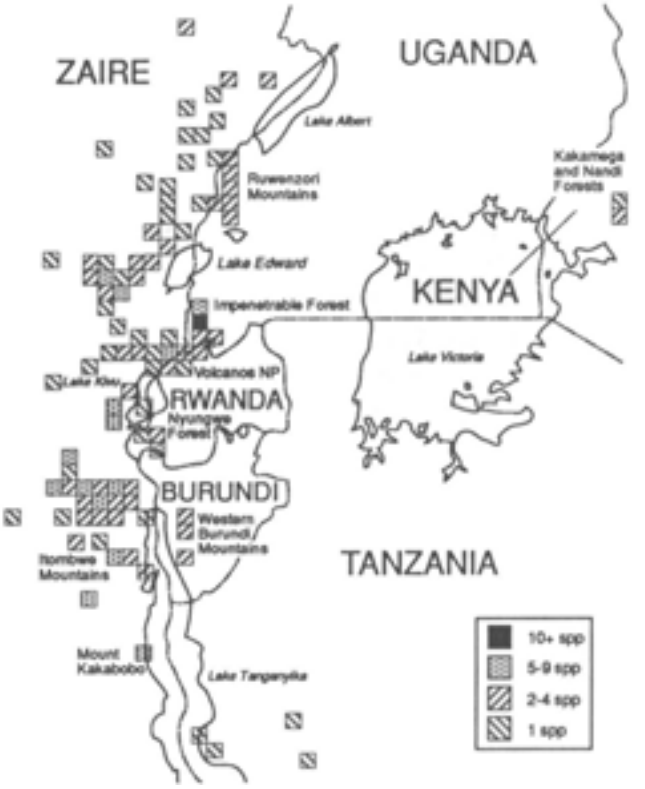


Figure 4.3 The distribution of endemic birds in the Albertine Rift Highlands. Data provided by ICBP.

By far the most important protected areas in the region are the Bale (247,100 ha) and Simen (17,900 ha) National Parks, lying respectively north-west and south-east of the Rift Valley. The latter is in an area of political unrest and its current status is unknown although it appears to be non-functional at present; the former, although not officially gazetted, is actively managed. The park holds populations of 14 of the birds and 11 of the mammals endemic to the Ethiopian mountains, the latter including the mountain nyala *Tragelaphus buxtoni* and the Simen jackal *Cards simensis.* The mid-montane forests in south-western Ethiopia, between 1,200 and 1,800 m altitude, are relatively little known but appear to be rich in species and are not included in any protected areas. They may be under threat from immigration of settlers from the more arid, famine-prone regions of Ethiopia.

4.2.3.3 Kivu-Ruwenzori Highlands or Albertine Rift Highlands

These form a chain running along either side of the Rift Valley in eastern Zaïre and western Uganda, Rwanda and Burundi into western Tanzania. The montane forests on the western side of the highlands fringe the lowland Congolean

rainforests resulting in a rich transitional fauna and flora. This area is very rich in species in comparison with the other montane regions of Africa. There are at least 14 endemic species of butterfly and 37 endemic species of birds; the latter figure is probably the highest in Africa for any equivalent sized area. For birds, and probably for other groups, the Itombwe Mountains are by far the most important part of the region: 32 of the birds endemic to the highlands occur there. The area is currently unprotected; the setting up of a protected area here should be considered a high priority.

The most important existing protected areas in this region are the 780,000 ha Virunga National Park in Zaïre, which is contiguous with the Parc National des Volcans in Rwanda (12,500-13,000 ha) and the 8800 ha Gorilla Reserve in Uganda; and the eastern part of the Kahuzi-Biega National Park, covering ca 75,000 ha, also in eastern Zaïre. Other very important areas are the Nyungwe Forest in Rwanda and the Impenetrable forest in Uganda, both receiving protection as forest reserves.

4.2.3.4 Imatongs-Usambara

This area includes the scattered uplands of Kenya and northern Tanzania as well as the Imatong Hills of southern Sudan and Mount Elgon on the Kenya-Uganda border. These areas

Figure 4.4 The distribution of endemic birds in the East African Highlands. Data provided by ICBP.

are particularly important for endemic plants and also have a significant number of the montane bird species of Africa; most of these are relatively widespread species not considered threatened at present although there are four local endemics. The area has a relatively rich butterfly fauna, although low in endemics. Two areas identified as particularly significant are the Imatong Mountains in southern Sudan and the Usambara Mountains in north-east Tanzania. In the latter some 50 tree species are endemic or nearly so. Levels of endemism amongst some groups of invertebrates appear to be very high, those amongst vertebrates less so, although two birds, the Usambara ground-robin *Sheppardia montana* and the Usambara eagle owl *Bubo vosseleri*, and at least two amphibians are apparently endemic. The forests in many of these areas are under threat from a variety of factors, including logging and charcoal manufacture, and clearance for crop cultivation, tea plantations and commercial plantation forestry. Protected area coverage here is very poor; its improvement should be considered a high priority.

4.2.3.5 Uluguru-Mulanje

This area includes most of the eastern Tanzanian uplands extending south to Mount Mulanje in northern Malawi. The most important areas are the Ulugurus, the Uzungwas and Mount Mulanje itself. The Ulugurus have a rich endemic flora as well as two endemic birds, five endemic reptiles and six endemic amphibians. Mount Mulanje is principally important for its flora, with around 20 endemic plant species. As with the other eastern African montane regions, protected areas coverage is poor and should be improved.

4.2.3.6 Angolan Highlands

The escarpment region of western Angola is a distinctive and apparently important area with cloud forests which appear to be in part a southern extension of the central African rainforests as well as having distinct Afro-montane affinities. The area is little known scientifically, although at least eight bird species are endemic or largely endemic to the region, which is also believed to have a significant endemic flora. There appear to be no protected areas in the region at present Further study of the region and the designation of protected areas to conserve the most important sites, should be considered a high priority on a continental scale.

4.2.3.7 Drakensberg Mountains

This southernmost extensive montane region in Africa supports a wide range of vegetation types, including forests, savannas, shrublands and grasslands. It is considered a very important area for plants, with an estimated 300 endemics out of a total of around 1,800 species. Four bird species are also endemic to the open montane grasslands. Overall

around 200,000 ha are protected in state forests and national parks, representing a significant proportion of the total area.

4.2.4 The Somali-Masai Region

This region encompasses a large part of eastern Africa as well as the south-western part of Arabia. It includes the whole of Djibouti and almost all Somalia, most of lowland Ethiopia, south-eastern Sudan, a large part of Kenya excluding the highlands and the coastal belt, the north-eastern corner of Uganda and the dry lowlands of central and northern Tanzania.

The natural vegetation of much of the area is deciduous *Acacia-Commiphora* bushland and thicket; much of the northern part is very arid with semi-desert grassland and scrub while the moister south-western part supports a mosaic of climax evergreen woodland and secondary Acacia savanna and open woodland.

Floristically the area is fairly rich with around 2,500 species of flowering plants of which around 50% appear endemic to the region. The northern, arid part of the region is particularly important for endemic plants and also has diverse reptile and ungulate fauna with a high proportion of endemic species. There are at least 86 reptile species endemic to the region, most of these occurring in Somalia. Notable amongst endemic ungulates are the beira *Dorcatragus megalotis,* four species of dikdik *(Madoqua saltiana, M. piacentinii, M. phillipsi* and *M. guentheri),* the dibatag *Ammodorcas clarkei,* the gerenuk *Litocranius walleri,* Speke's gazelle *Gazella spekei,* Grant's gazelle *Gazella granti,* Hunter's antelope *Damaliscus hunteri* and Grevy's zebra *Equus grevyi.* There are several large protected areas within this region in Ethiopia, notably the contiguous Mille-Sardo Wild Ass Game Reserve, Gewane Game Reserve and Yangudi Rassa National Park in north-central Ethiopia, which together cover just under 1.6 million hectares and part of the 345,000 ha Omo National Park in the south-west (part of this is in the Sudanian region). Most, if not all, of these areas appear to be non-functional at present. The situation in Somalia at present is unclear, but it seems that even those protected areas which have been officially declared do not function in any effective way owing to widespread security problems, especially in the northern part of the country. The lack of effective protected areas in Somalia and the adjacent Danakil region of Ethiopia is undoubtedly a major gap in the protected areas network in the Afrotropical Realm.

The southern part of the region shares much of its fauna with the adjacent Zambesian region and has relatively few endemic species. However the high quality rangeland here supports spectacular concentrations of large mammals. The most important areas here are Tsavo National Park in southern Kenya (2,082,114 ha) and the Serengeti reserve complex, mostly in Tanzania, including the Serengeti National Park (1.48 million hectares), Ngorogoro Conservation Area (828,200 ha), Maswa Game Reserve (220,000 ha), Ikongoro and Loliondo Game Controlled Areas as well as the Maasai Mara National Reserve in Kenya. This region probably holds the greatest concentration of large mammals anywhere in the world. Theoretically protected area coverage in this region is good; however there are increasing problems with poaching and land-use conflicts with pastoralists.

4.2.5 The Zambezian Region

This area occupies a large part of southern Africa, and includes the whole of Zambia and Zimbabwe, most of Malawi (excepting the highlands), a large proportion of Angola, Mozambique and southern Tanzania and parts of Zaïre , Namibia, Botswana and South Africa. It has very varied vegetation and a diverse flora and fauna. The flora is estimated to number around 8,500 species, making it the richest on the African continent, but with a lower proportion and absolute number of endemics than the Guineo-Congolean forests (54% as opposed to 80%, and around 4,600 as opposed to 6,400 respectively). Similarly, the fauna is generally rich but low in endemics. There are a large number of important protected areas in this region and it is difficult to pick out particular areas which are more important than any others. Management of protected areas in several of the countries in the region is good, resulting in the area being one of the best protected overall in Africa.

4.2.6 The Karoo-Namib Region

This region runs from south-west Angola through Namibia into South Africa north of the Cape fynbos region (although it also has some significant enclaves within the fynbos). The northern part of the region is desert, the southern part is semi-desert karoo. The region has a relatively rich flora, with around 3,500 species of which over half are endemic. The fauna, on the other hand, with the exception of reptiles, is comparatively impoverished, with low diversity and relatively low rates of endemism, although there are some significant desert forms.

The northern, desert part of the region is well covered by two protected areas, the 1,515,000 ha Iona National Park in Angola and the 4,976,800 ha Namib-Naukluft Park in Namibia, although at present there is no effective enforcement or management in the former. Most protected areas in South Africa are small, but well-managed and together they protect a significant amount of the semi-desert Karoo, although two distinctive and floristically rich types of Karoo - dwarf Karoo and succulent Karoo - are very under-protected.

4.2.7 The Sudanian Region

This region runs along the whole of northern Africa from the Atlantic coast eastwards to the Ethiopian highlands. To the

north it is bounded by the Sahelian transition zone which merges with the Sahara Desert and to the south by the Guineo-Congolian forest blocks.

It is thought that dry forest was probably the original climax vegetation over much of the area, but little of this remains. Much of the region is heavily settled and a large proportion of the natural vegetation has been severely degraded or destroyed, leaving large areas of open woodland. The area also has extensive wetlands, in the form of the Sudd swamps in southern Sudan, and part of the internal delta of the Niger River in Mali.

Floristically the area is relatively impoverished, with a maximum of around 2,750 species of plants, of which around one-third are believed endemic to the region. The area is reasonably rich in animal species, although with respect to mammals and birds at least, most of these species are also found outside the region. The eastern part of the region, however, in southern Sudan and the Central African Republic, has very important concentrations of large mammals. The Boma region in south-east Sudan has herds of antelopes (chiefly migratory white-eared kob *Kobus kob leucotis,* but also tiang *Damaliscus lunatus tiang,* lelwel hartebeest *Alcelaphus buselaphus lelwel,* and Mongalla gazelle *Gazella thompsonii albonotata)* which rival in numbers the antelope of the Serengeti ecosystem in Tanzania and southern Kenya. These antelope are an important resource for local people. Theoretically, protected area coverage in this area is good, with the Boma and Southern National Parks in Sudan covering 4.6 million hectares between them. However civil disturbance in the region has apparently led to the cessation of active conservation activities in many areas and the current state of most of the protected areas here is not known.

4.2.8 Other Important Areas

4.2.8.1 The Sahel and Sahelo-Saharan Region

This region forms the transition zone between the Sudanian region and the Sahara desert to the north. The fauna and flora of the area are relatively impoverished, with few endemics: of the 1,200 or so plant species in the region, fewer than 3% are believed to be strictly endemic, although there are several bird species largely or entirely confined to the region. However, the area has a notable ungulate fauna, including the addax *Addax nasomaculatus,* the scimitar-horned oryx *Oryx dammah,* the dama gazelle *Gazella dama,* dorcas gazelle *Gazella dorcas,* and slender-horned gazelle *Gazella leptoceros.* The addax and oryx in particular have been severely reduced and are now on the verge of extinction in their original ranges in the wild. The vast Air and Ténéré region in Niger is believed to hold the last viable population of addax although it may conceivably also survive in the Ouadi Achim - Ouadi Rimé Faunal Reserve in Chad. Just under 1.3 million hectares of the Air and Ténéré is a strict nature reserve, with a further 6.5 million hectares partially protected as a national nature reserve. The last wild scimitar-horned oryx possibly survive in the Ouadi Achim - Ouadi Rimé Faunal Reserve in Chad; however the latter is in an area of civil disturbance and the oryx may have been extirpated in recent years.

4.2.8.2 Coastal East Africa

A belt of moist habitats somewhat different from the regions further inland runs along the coast of eastern Africa from southern Somalia to the Limpopo River in southern Mozambique. Most of this area was originally covered in moist forest but this has largely been cleared as much of the area has been heavily settled for many years. Botanically the area is rich, with an estimated 3,000 species of flowering plants, of which nearly 40% are believed endemic to the region. It also has a reasonably rich fauna, with several endemic bird species. Important sites in the area include the Shimba Hills and Arabuko-Sokoke Forest in Kenya. The latter has two endemic bird species (Clarke's weaver *Ploceus golandi* and Sokoke scops owl *Otus ireneae)* as well as four other localised and threatened species. Areas in other countries (Somalia, Tanzania, Mozambique) are likely to be similarly important but are less known at present

In general protected area coverage in this region is inadequate; several of the remaining forest areas in Kenya and Tanzania are gazetted as forest reserves, although this will probably not afford enough protection in the long-term.

4.2.9 Freshwaters

Africa has extensive inland waters; significant amongst these are the major river systems (the Nile, Zaïre, Niger and Zambezi); the rift valley lakes (notably Victoria, Tanganyika, Nyasa, Turkana, Mweru and Albert); Lake Chad, and the vast inland wetland of the Inner Niger Delta in Mali; the Sudd in southern Sudan and adjacent Ethiopia; and the Okavango Delta in Botswana.

With respect to their fish faunas, African inland waters can be divided into several provinces of which the three most important are the Soudanian or Nilotic, the Zaïrean and the Great Lakes. Other significant areas include the Cape Region of South Africa, which has an impoverished but highly endemic fish fauna, the Zambezi River, which has a relatively rich fauna, much of which it shares with the Zaïre River system, and the Somali-Masai region, which again has an impoverished fauna, but with a significant number of endemic species.

4.2.9.1 The Soudanian or Nilotic Region

The rivers and lakes of most of Africa north of 5°N share a

Lake	Cichlids Species Total	Endemics	Genera Total	Endemics	Non-Cichlids Species Total	Endemics	Genera Total	Endemics	Total Species Total	Endemics	Genera Total	Endemics
Victoria	150 - 170	all but 3	8	4	38	16	20	1	178 - 208	163 - 183	28	5
Edward - George	35 - 40	all but 5	4	0	17	2	10	0	52 - 57	45 - 50	14	0
Malawi	c. 200	all but 4	23	20	42	26	19	0	c. 240	c. 220	41	20
Tanganyika	126	126	37	33	67	47	29	7	193	173	66	40

Table 4.2 Fish faunas of the major Rift Valley lakes.

similar and relatively impoverished fish fauna. This area includes the Nile south to Lake Mobutu, the Niger, Gambia, Senegal and Volta Rivers in West Africa, Lakes Chad and Turkana. Thus 100-120 species are found in the inner Niger Delta of which 24 are apparently confined to the Niger Basin; similarly some 115 species have been recorded in the Nile of which 26 are confined to the Nile Basin. Other river systems in the area appear to have similar levels of endemism.

4.2.9.2 The Zaïre River Basin

This area has a rich fish fauna, both in terms of numbers of species and in the number of endemics. Around 700 species have been recorded and it is thought very likely that the final total will exceed 1,000. Some 560 of the species so far described are endemic to the basin. The upper Lualaba River in south-east Zaïre has a very distinctive fish fauna, being largely isolated from the rest of the Zaïre River system by rapids. It has a significant number of endemics but also shares species with the Zambezi River and with the Soudanian Region.

4.2.9.3 The Great Lakes

Four of the Great Lakes of the Rift Valley have a remarkable, diverse fish fauna with large numbers of endemic species. Much of this diversity is results from a radiation of haplochromine cychlids, but non-cichlid species are also diverse (Table 4.2).

Collectively these form the most diverse of any lake fish fauna in the world. The lakes also have a diverse aquatic invertebrate fauna, with large numbers of endemic crustaceans and molluscs.

The fisheries in these lakes are productive and of considerable socio-economic importance. However the fish faunas themselves are subject to a variety of actual and potential threats, including the introduction of exotic species, notably tilapias and, most significantly, the predatory Nile perch Lates into Lake Victoria, over-fishing and various forms of pollution. The conservation of the endemic species may be considered one of the highest priorities for the maintenance of biological diversity in the Afrotropical Realm; however it is also problematic at present as some of the threats (most notably that of introduced species) appear intractable. There is also a need to reconcile the conservation of these species with the legitimate development of the lake for the well-being of the people who live there; such development should include well managed fisheries.

4.2.10 Madagascar

The island of Madagascar, which covers some 590,000 sq. km in the Indian Ocean off the coast of south-east Africa, is generally included in the Afrotropical region. Its fauna and flora are so different from those of the African mainland, however, that it can be treated virtually as a separate entity, of great global importance for biological diversity. The country shows marked biological affinities with the nearby Comoro Islands, with the Mascarenes to the east and with the Seychelles to the north.

Estimates of the number of plant species vary from around 8,000 to 12,000 with rates of endemism of from 55% to 80%. Rates of endemism are comparable, or higher, in many faunal groups. Thus of 197 resident bird species, 106 are strict endemics, with a further 25 occurring also on the Comoro Islands. There are at least 144 amphibian species (with new taxa continuing to be discovered), of which all but two are endemic, and around 260 reptiles, over 90% of which are endemic. The country also possesses a very important terrestrial mollusc fauna, with around 380 described species of which around 360 are endemic.

Botanically the island is generally divided into two centres of endemism - the east and the west. The dominant natural vegetation of the eastern region, which also includes the Sambirano region in the north-western part of the island, is tropical rainforest, zoned altitudinally into lowland, mid-altitude and montane forests. The west can be divided into two sub-regions: in the southern part is found a highly distinctive thorny scrub dominated by members of an endemic family, the Didiereaceae; further north is deciduous tropical forest which occurs in two markedly different types, one on sandstones and one on calcareous soils.

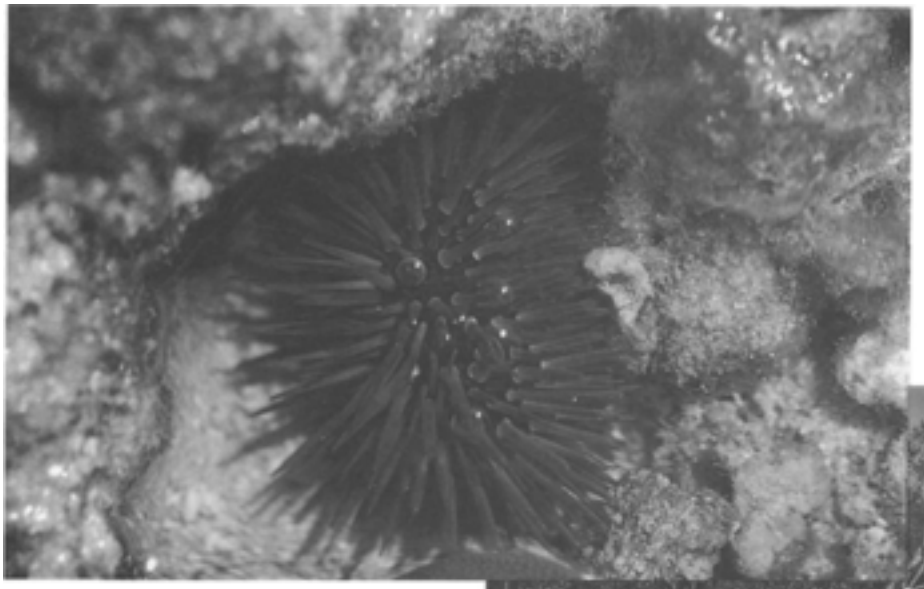
Despite the fact that the vast majority of native Madagascan species are found in forest or wooded habitats, such habitats now cover less than 30% of the land area. Most of the remainder, and particularly the central plateau region, consists of species-poor grassland. There is considerable debate as to the extent to which this grassland is the result of man's activities, or whether a significant proportion of it is natural climax vegetation. Whatever the outcome of this debate, there is no doubt that destruction of species-rich habitats on the island is proceeding at an accelerating rate and poses a very serious threat to the maintenance of biological diversity in the medium or long-term.

Madagascar possesses a relatively extensive network of protected areas, in the form of two national parks covering ca 100,000 ha, 11 strict nature reserves with a combined area of 570,000 ha and 23 special reserves covering 365,500 ha. Enforcement in many of these, particularly the special reserves, is minimal. Coverage of different habitats and vegetation types is variable. Montane areas in both centres of endemism are well covered, as are the limestone karst areas in the north and west; the latter includes the largest reserve in Madagascar, covering 152,000 ha of the Tsingy de Bemaraha. In general, lowland areas of rainforest, western deciduous forest on sandstone and southern thorny scrub are under-represented.

4.2.11 Marine and Coastal Ecosystems

4.2.11.1 Coral Reefs

Coral reefs are ecosystems of very high biological diversity found in warm, shallow marine waters. They do not occur along the western coast of Africa although there are assemblages of coral at several sites on islands in the Gulf of Guinea. These are poorly known and merit further investigation.



Sea urchin, Mallndi Reef, Kenya (Photo: WWF/Mauri Rautkari).

In contrast there are extensive areas of coral reef along the eastern coastline of Africa and around the islands of the western Indian Ocean. These reefs run discontinuously from the Red Sea coast of Sudan south to Inhaca Island in extreme southern Mozambique. Reefs are also well developed along the western coast of Madagascar and around some islands of the Comoros, Seychelles and Mascarenes groups.

Most reef organisms are widespread, and many of the species found in East Africa range throughout the tropical Indian Ocean into the western Pacific, although there are several species and genera which are confined to the western Indian Ocean. There are few localised endemic species, and it is thus difficult to identify particular sites of major importance.

4.2.11.2 Mangroves

Mangroves are widely distributed in sheltered coastal waters and in river estuaries in much of the Afrotropical Realm. Those on the west coast have fewer species than those on the east coast (six as opposed to nine); no species are common to both areas, and the west coast mangroves are more similar to those of the Atlantic coast of the Americas than to the east African mangroves. Although relatively poor in species, mangroves play important roles as nursery areas for fishes and in shoreline stabilisation.

Along the west coast, mangroves are found discontinuously from Senegal to northern Angola. Important areas in West Africa include the coasts of Guinea and Guinea-Bissau, both of which were formerly almost entirely fringed by mangroves. Large expanses in both have been cleared in recent years, nevertheless substantial areas still reportedly remain (around 285,000 ha in Guinea and 100,000 ha in Guinea-Bissau); further west Nigeria still has large stands of mangroves, again despite extensive clearance, with an estimated 500,000 ha in the Niger delta alone. Further south, there are ca 300,000 ha of mangroves in Cameroon, mostly in the north, and probably a similar area in Gabon. Most of these areas are unprotected at present.

Mangroves at Cinq Cases, Aldabra, Seychelles (Photo: WWF/Jeanne Mortimer).

Mangroves are generally sporadic along the northern part of the east coast of Africa, but become more extensive along the Kenyan and Tanzanian coasts, reaching their maximum development around the Rufiji delta in Tanzania. There are estimated to be around 200,000 ha of mangroves in Tanzania, and probably around half this in Mozambique, although the latter country has not been fully surveyed, and this may be an underestimate. Some mangrove areas in

Kenya and Mozambique are included in protected areas, although these almost certainly do not function in Mozambique at present.

There are estimated to be around 300,000 ha of mangroves in Madagascar, over 90% of this on the west coast. None is protected at present.

4.3 Conclusion

The effectiveness of Africa's conservation effort is patchy. Some of the biogeographical regions, such as the Cape Fynbos, Karoo-Namib and Zambezian regions, are receiving reasonably good conservation attention. This is a reflection of the greater financial support received by conservation agencies in several countries in southern Africa compared with most of the rest of the continent, as well as higher levels of training and expertise in environmental management.

Of greatest concern is the fact that the biogeographic regions with the highest biodiversity are often the least effectively protected, notably the Guineo-Congolian, Afromontane and Madagascan regions. There is also considerable concern for the Somali-Masai region which is hardly protected at all in any effective sense in Ethiopia and Somalia where most of its endemic species occur. In this case, the principal problem is one of armed conflict and poor security. However, in much of tropical Africa and the surrounding islands there is enormous potential to enhance existing conservation efforts. In this respect, it is heartening to have seen a number of African governments allocating increased financial resources to environmental conservation over the last few years.

Section 2: Country Profiles for Biodiversity Conservation

Chapter 5: Introduction

In this chapter, the conservation status of species and ecosystems is briefly outlined for each country in Africa. Each country section is divided into six parts:

Introduction. This includes a summary of the land area, human population data, economic data, biogeographical affinities, and vegetation of each country.

Critical Sites. These are sites of particular importance for the conservation of biodiversity, either because they contain a great diversity of species, or are centres of species endemism, or because they contain populations of rare or unusual species or ecosystems.

Critical Species. These are species for which the country has an international responsibility, either because they are endemic (or nearly so) to the country, or because the species is in danger of extinction, or because the populations of the species in question are of cultural, scientific, or economic importance.

Threats. The principal threats to biodiversity in each country are oudined.

Current Conservation Measures. A brief resume is made of the current conservation programmes in each country, including contributions made by both governments, non-governmental organisations, and development assistance agencies. It should be noted that in most countries, the contributions of development assistance agencies and non-governmental organisations are considered to be contributions to government programmes, and so these sections should be read in this light

Suggested Conservation Activities. Based on the data presented in previous sections, a series of possible new conservation initiatives is listed. While these lists are certainly not exhaustive (for instance the more general recommendations made in Chapter 3 are not repeated), they may form a starting point for developing coherent national conservation programmes for the maintenance of biodiversity.

The information in the following chapters is far from complete. We have included all that was made available to us. For certain countries in particular, the data are sparse, and it is hoped that gaps can be filled in subsequent editions. In particular, information is poor on plants, reptiles, amphibians, fishes, invertebrates, and the activities being carried out by African governments and development assistance agencies on biodiversity conservation. Any apparent biases in these country chapters are not intended. However, it was felt important that all the information gathered so far be made generally available, with allowance for the publication of a more comprehensive document at a later stage.

Chapter 6: Angola

Introduction

Area: 1,246,700 km^2. Cultivated: 3%. Pasture: 23%. Forest/woodland: 43%.

Population: (1989 data): 8,534,000. Urban: 25%. Labour force in agriculture (1980): 74%. Density: 7/km^2. Annual growth rate: 2.6%, increasing. Doubling time: 27 years.

Economy (1987 data): World Bank Index: no data. GNP/capita: no data. GNP annual growth rate: no data.

Biogeographic affinities: Predominately Zambesian, with Kalahari-Highveld and Karoo-Namib in the southwest, Guinea-Congolian/Zambezian Regional Transition Zone in the northern third, and Guinea-Congolian in Cabinda

Vegetation: Predominately miombo woodland and other forms of woodland and grassland savannas, with patches of lowland rainforest in the north, intermediate elevation forest on the western escarpment, montane forest in the highlands, and arid desert and subdesert formations in the southwest.

Critical Sites

1. The highlands in the Huambo, Huila, Benguela, Cuanza Sul and Bie Provinces, especially west of Bailundo (including Mount Moco) and Mount Bandeira in the southwest, are important for birds and plants, with many endemic species.

2. The small forest patches on the western escarpment of the country, especially in the Amboim and Gabela areas, are important as a centre of endemism for plants and birds.

3. In the centre of the country is the important Kangangadala National park and nearby Luando Natural Integrated Reserve. These areas are the main sites for the endemic giant sable antelope. There is a need to resolve human-wildlife conflicts in the area of Kangandala National Park, and to promote sustainable use of wildlife as part of the local development process.

4. The Kisama National Park on the coast as important for a wide array of species (including manatees and marine turtles), though there has been a lack of sufficient protection for large mammals in recent years.

5. The conservation of the rich diversity of species, particularly chimpanzees and gorillas, in the lowland forests of

Approximate major natural vegetation zones of Angola. Miombo *(Brachystegia/Julbernardia)* plateaux woodlands contain an extensive network of grassy dambos along drainage lines, with dense gallery forests along major watercourses and occasional patches of moist evergreen forest, especially towards the north. Forest-savanna mosaic comprises dense humid rainforest (especially well developed in Cabinda) and semi-deciduous forest in a mosaic with woodland and shrub savanna. Mopane *(Colophospermum mopane)*/thorn scrub savanna includes stretches of dense dry *Baikiaea plurijuga* forest, mopane and *Pterocarpus* woodland savanna, thorn scrub *(Acacia/Sclerocarya)* savanna and semi-arid grassland. Coastal savanna and thicket includes grassy plains, woodland savanna with baobabs, euphorbias and *Strychnos/Dickrostachys* thickets, and dense humid gallery forests, backed in the foothills of the escarpment by dry *Acacia* bushland. The arid coastal strip comprises sparse *Acacia* scrub and open sand dunes. 1: Zaire River. 2: Cuanza River. 3: Longa River. 4: Cuango River. 5: Luando River. 6: Zambezi River. 7: Cunene River. 8: Cubango River. 9: Cuito River. 10: Cuando River. 11: Cabinda enclave. 12: Luanda. 13: Mocamedes.

the Cabinda Enclave is an important priority.

6. There are patches of lowland forest in the north of country along the border with Zaïre, which are known to be important for a wide variety of species, but detailed information is lacking at present. None of these areas in protected.

7. Concern exists over the level of management in the protected areas in the south and west of the country, which should be given high priority as the political situation improves. Areas of importance include: the Iona National Park and the Mocamedes Partial Reserve (in the arid semi-desert zone in the southwest); the Kameia, Bikuar and Mupa National Parks, and the Mavinga Partial Reserve (in the miombo woodland zone); and Luiana Partial Reserve (in mopane savanna in the extreme southeast).

Critical Species

1. Plants. 5,000 species occur, of which 1,260 are believed to be endemic. Most of these are concentrated in the highland and escarpment zones (see nos. 1 and 2 under *Critical Sites* above). Habitat protection is an urgent priority.

2. Primates. About 18 species occur, including the chimpanzee and gorilla. The endemic black-nosed monkey *Cercopithecus ascanius atrinasus,* is particularly uncommon, and occurs in the north, near Zaïre. A very rare and distinctive subspecies of the black mangabey *Cercocebus aterrimus opdenboschi* is known only from the gallery forests of northern Angola and an adjacent part of Zaïre.

3. Antelopes. 26 species occur, of which 15 are threatened owing to the minimal protection currently being afforded the country's protected areas. Angola is the only country in which the giant sable antelope *Hippotragus niger variani* occurs, in and around the Kangandala National park and Luando Natural Integrated Reserve. Angola also has important populations of tsessebe, red lechwe, and black-faced impala (the latter only in the southwest and in adjacent Namibia).

4. Elephants and Rhinos. Elephant and black rhino numbers have been severely reduced by poaching, though there is little recent information on either species. The black rhino is thought to be nearing extinction.

5. Fruit Bats. 15 species occur, of which four are of conservation concern: *Epomophorus angolensis* (only known from Angola and extreme northern Namibia); *Epomophorus grandis* (only known from northeast Angola and southwest Congo); *Micropteropus intermedius* (one locality in northeast Angola and three localities in southwest Zaïre); and *Plerotes anchietae* (known only from west-central Angola, southeast Zaïre and north Zambia).

6. Other Mammals. Ansorge's cusimanse *Crossarchus ansorgei* is only known from northern Angola and adjacent Zaïre and the Angolan population is an endemic subspecies; similarly, the mouse *Mus callewaerti* is known from central Angola and southeast Zaïre. The conservation requirements of these two species are currently unknown. In addition, there is concern over the protection of the West African manatee. The numbers of small cetaceans killed in the fishing industry is currently unknown.

7. Birds. Populations of the wattled crane in the protected areas of southern Angola could be of international significance. Swierstra's francolin is endemic to the highland region (see no. 1 under *Critical Sites* above) and is a high priority for specialist conservation measures. Several other rare bird species occur in the highlands. In the escarpment forest (see no. 2 under *Critical Sites* above), four threatened species occur, together with two other endemic bird species. The threatened species are: Gabela helmet-shrike; Monteiro's bush-shrike; Gabela akalat; and Pulitzer's longbill. In addition, the rare white-headed robin-chat occurs in the north of the country, near the Zaïre border, and the Loango slender-billed weaver occurs on the Cabinda coast; the conservation requirements of these two species are currently not known.

8. Crocodiles. The Nile, slender-snouted and dwarf crocodiles have all been severely over-harvested for their hides, and conservation in a sustainable use context is a high priority.

9. Marine Turtles. Four species nest along the coast, the loggerhead, green, olive ridley and leatherback turtles. Important sites exist in the Iona and Kisama National Parks, but others probably exist and require identification. It is known that species are extensively harvested, especially in the nesting season.

10. Snakes. The status and conservation needs of the Angolan python *Python anchietae* are not known.

11. Amphibians. About 20 species of amphibians are reported to be endemic to Angola, and most of these have only been recorded on one occasion. Most of them are recorded from the north of the country but their conservation requirements are not fully known.

12. Freshwater Fishes. Two threatened species are known: the ocellated spiny-eel *Afromasculatus vanderwaali* (occurring at Caiundo on the Okavango River); and the broad-headed catfish *Clariallabes platyprosopos* (occurring at Namatuntu on the Okavango River).

13. Invertebrates. Two rare dragonfly species, *Aciogrion*

rarum and *Monardithemis flava*, are known only from Angola and neighbouring northern Zambia. The rare African giant swallowtail butterfly occurs in the forests of northern Angola, where its habitat is currently unprotected.

Threats

The minimal protection currently being afforded Angola's protected areas, due to the lack of security in parts of the country, means that many of the country's most critical sites are in serious danger of being compromised. Large mammal population are particularly at risk through poaching.

Several important habitats are receiving no protection at all (even if the existing parks and reserves are re-established). In particular, forest habitats in the mountains, along the western escarpment, and in the north, are at serious risk. The same is probably true for certain marine habitats.

Because Angola is so poorly known biologically, there must be many critical sites that could easily be lost before their true value can become known.

Current Conservation Measures

1. Government Administration of Conservation

(a) Responsibility for the environment resides with the Ministry of Agriculture, and in particular the National Directorate for Conservation of Nature (DNACO) and the National Directorate for Fisheries and Agriculture (DINOPA).

(b) Other institutions with some environmental responsibility are the Institute for Agronomic Research (IIA) and the Institute for Veterinary Research (IIV), both under the Ministry of Agriculture, and the National Department of Water in the Ministry of Industry.

2. Multi-agency Projects

(a) Anti-desertification in Tombwa (FAO/UNDP). This project in the arid southwest aims to reverse the desertification process through sand dune stabilisation, and re-forestation along the Curoca River, and use of improved charcoal stoves.

Suggested Conservation Activities

1. Improved management and security in existing protected areas of all types, with particular emphasis on large mammal habitats, is important. International assistance in the form of staff training and finance should be sought to this end.

2. There is a need to integrate protection and management activities into rural development programmes wherever possible, e.g. profits from controlled trophy hunting being ploughed back into local community development, and involvement and employment of local people in crocodile management, etc.

3. Visitor facilities need to be established in protected areas to generate revenue which can be used to finance further training, anti-poaching measures and rural development programmes. Subsidies for local visitors will be necessary to prevent facilities being used only by foreign visitors.

4. New reserves need to be established in forest and grassland areas in the north, highland and western escarpment regions. These should focus on conserving the diversity of species of endemic plants and birds and also address the needs of a number of rare and threatened species: black-nosed monkey, Ansorge's cusimanse, 15 species of antelope, the mouse *Mus callewaerti,* wattled crane, Swierstra's francolin and a range of other bird species.

Conservation areas of Angola. 1: Kisama National Park (9960 sq km). 2: Kangandala National Park (630 sq km). 3: Proposed extension to Kangandala National Park. 4: Luando Natural Integral Reserve (8280 sq km). 5: Bufalo Partial Reserve (400 sq km). 6: Chimalavera Natural Regional Park (100 sq km). 7: Kameia National park (14 450 sq km). 8: Mocamedes Partial Reserve (4450 sq km). 9: Iona National Park (15 150 sq km). 10: Bikuar National Park (7900 sq km). 11: Mupa National Park (6600 sq km). 12: Mavinga Partial Reserve (5950 sq km). 13: Luiana Partial Reserve (8400 sq km).

5. Anti-poaching measures should be strictly enforced, especially in relation to the elephant, black rhino, crocodiles and marine mammals.

6. The Kangandala National Park should be linked with Luanda Integral Nature Reserve to form a "Giant Sable National Park" with appropriate integrated development programmes in the buffer zone. A giant sable antelope conservation initiative should be launched, including controlled tro-

phy hunting and a captive breeding programme.

7. The boundaries of Kisama National Park need to be redefined to include both banks of the Cuanza and Longa Rivers.

8. A new lowland forest reserve should be created in the Cabinda Enclave.

9. The lowland forest in the north of the country should be surveyed to assess conservation needs and establish priorities, especially with regard to amphibians, birds, antelopes and the giant swallowtail butterfly.

10. It is important to assess conservation needs and establish appropriate conservation measures for marine habitats, with particular emphasis on the manatee, cetaceans in coastal fishing waters and marine turtles.

11. The conservation needs of selected rare bird species should be assessed (see *Critical Species* 6 above) and appropriate programmes established, including captive breeding of Swiersta's francolin.

12. The status and conservation needs of the Angolan python should be assessed.

13. Surveys are needed to assess the conservation needs for threatened freshwater fish species.

Chapter 7: Benin

Introduction

Area: 112,622 km^2. Cultivated: 16%. Pasture: 4%. Forest/Woodland: 33%.

Population (1989 data): 4,664,000. Urban: 39%. Labour force in agriculture (1980): 70%. Density: 41/km^2. Annual growth rate: 3.0%, increasing. Doubling time: 23 years.

Economy (1987 data): World Bank Index: low-income economy. GNP/capita: US$ 300. GNP annual growth rate: 3.7%.

Biogeographic affinities: Predominately Sudanian, with Guinea-Congolian/Sudanian Regional Transition Zone in the southern third.

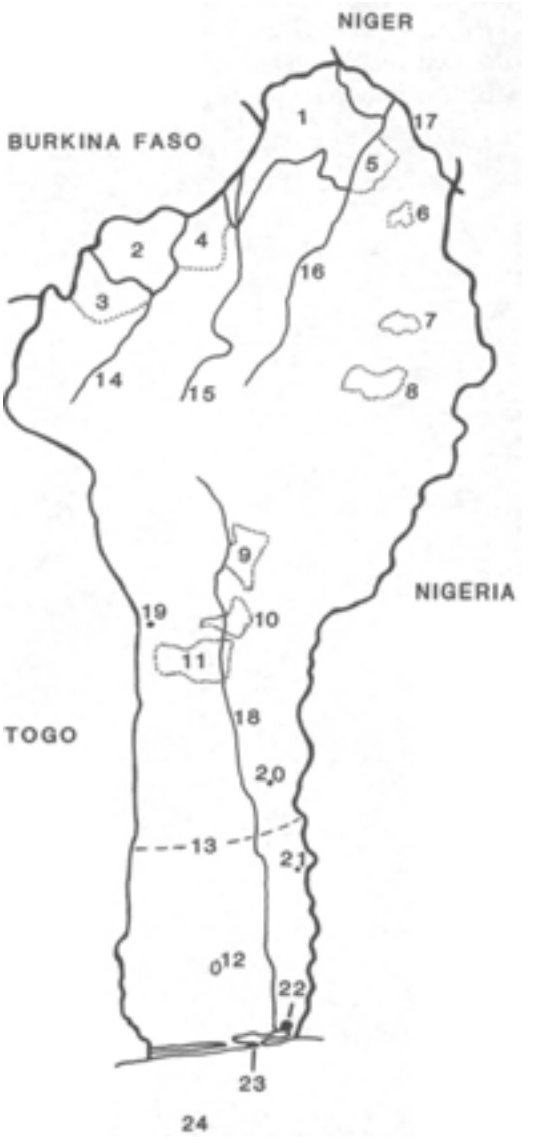
Vegetation: Mostly Sudanian woodland, with patches of lowland rainforest interspersed with secondary grassland in the south.

Critical Sites

1. The "W" and Pendjari National Parks and the Djona, Atakora and Pendjari Hunting Zones form a chain of protected areas that overlap into neighbouring Burkina Faso and Niger. Together, these areas constitute one of the most important sites for ecosystem and species conservation in West Africa, but some important species remain unprotected in nearby habitats and illegal hunting remains a problem. Tourist development is an important support to conservation here.

2. Protection of the central forest reserves, especially Ouéme, Ouari Maro and Monts Kouffé, is an important priority, and might involve integrated rural development programmes. There are also problems with the regulation of hunting.

3. The remaining forest patches in the densely populated southern part of the country are very seriously threatened, and Benin is liable to lose a number of species that occur nowhere else within its territory. Areas of particular importance include the Lama and Pob6 Forests (the latter has already been seriously damaged by clearance and timber planting), and also swamp forests along the coast.



Major conservation areas and geographical features of Benin. 1: W National Park (5680 sq km). 2: Boucle de la Pendjari National Park (2755 sq km). 3: Pendjari Hunting Zone (2000 sq km). 4: Atakora Hunting Zone (1750 sq km). 5: Djona Hunting Zone (2250 sq km). 6: Gougoun Classified Forest (730 sq km). 7: Sota Classified Forest (530 sq km). 8: Trois Rivieres Classified Forest (2595 sq km). 9: Oueme Classified Forest (1800 sq km). 10: Ouari Maro Classified Forest (1076 sq km). 11: Monte Kouffe Classified Forest (1080 sq km). 12: Lama Classified Forest (162 sq km). *Other features* —13: Approximate southern limit of continuous natural savanna. 14: Pendjari River. 15: Mekrou River. 16: Alibori River. 17: Niger River. 18: Oueme River. 19: Bassiia. 20: Save. 21: Ketou. 22: Porto Novo. 23: Cotonou. 24: Atlantic Ocean.

Critical Species

1. Plants. Some 2,000 species occur, some of which are believed to be endemic.

2. Primates. About 10 species of primate occur, including tnona monkeys in the southern forest areas. It is likely that the extremely rare white-throated guenon occurs in forest patches in the south of the country.

3. Antelopes. 14 species are known to occur, with another 3 possibly occurring but unconfirmed (bay and black duikers and red-fronted gazelle). Nine of this total of 17 are considered threatened, at least to some degree. The population of the korrigum in the northern protected areas, especially in Pendjari National Park, is of international importance since the species has become extinct through almost all of West Africa. The bongo is extinct in Benin and the Sitatunga nearly so: populations of the former might survive in Monts Kouffé, and of the latter in unprotected coastal swamp forests. Duikers include the grey and red-flanked in "W" National Park and Maxwell's in Mont Kouffé and several other classified forests.

4. Other Mammals. The elephant population in "W" National Park (which overlaps into Niger and Burkina Faso) is one of the 30 top priority "baseline" populations for the species in Africa. Important populations also exist in Pendjari National Park and Hunting Zone. A major buffalo population (>5,000) occurs in Pendjari National Park. The impact of incidental catches on dolphins and porpoises is currently unknown. The red river hog is restricted to the south-central region, where it occurs at low densities in Wari Maro and Mont Kouffé Forest Reserves, and may be endangered.

5. Birds. About 200 Damara terns spend the non-breeding season on the west Benin coast. It is not known where they suffer from persecution, as is the case with terns elsewhere along the West African coast

6. Crocodiles. The Nile, slender-snouted and dwarf crocodiles all occur and were formerly common. There is, however, little recent information on their status.

Threats

1. Forest habitats are poorly represented in Benin's protected area system, and those patches that survive are severely at risk from clearance for agriculture and settlements. Similarly, marine habitats are also receiving minimal protection in Benin.

2. Illegal hunting is posing a serious threat to mammal species within the reserves: this is exacerbated by cross-border hunters in many areas.

Current Conservation Measures

1. Government Administration of Conservation

(a) All environmental matters come under the Department of Water, Forests, and Hunting, under which there are four Inspectorates. The Inspectorate of Nature Protection and Hunting is responsible for the management of protected areas and wildlife. There are three Forestry Inspectorates covering the southern, central and northern parts of the country, and the Classified Forests come under their jurisdiction.

2. GTZ Projects

(a) Improvement of forestry management with a view to ensuring that an adequate timber supply is available on a sustainable basis.

(b) Promotion of ecologically balanced management of fisheries in coastal lagoons and flood plains, including ecological restoration through re-planting of mangroves.

3. Netherlands Government Projects

(a) Reforestation programme, with the objective of restoring natural vegetation and soil fertility.

4. WHF Projects

(a) Training course on natural resources conservation, regional planning, development and reserve management.

Suggested Conservation Activities

1. Existing protected areas need improved management, through increased material resources, personnel and training. International aid should be sought to these ends.

2. Surveys of the use of bushmeat as a protein source should be undertaken and programmes established to develop sustainable-yield hunting by local residents.

3. Anti-hunting laws need improved enforcement, especially in relation to large mammals and in the chain of protected areas in the north. Cross border poaching control, particularly with regard to elephants, needs more resources and co-operation with neighbouring countries.

4. The Pendjari National Park should be expanded southwards to include the Pendjari River Gorge, Atacora Escarpment and the uplands of the Atacora Range with *Isoberlinia doka* savanna woodland (a further 20,000 hectares) extending protection to a number of additional important bird and primate species. Current assistance programmes for tourist development should continue as a means of income generation for conservation, and a management

plan should be developed and implemented.

5. Protection of central forest reserves, especially Oueme, Ouari Maro and Mont Kouffé is needed; this should involve rural development programmes based on sustainable timber use and controlled hunting.

6. A survey of marine habitats, especially in relation to cetaceans, is needed to establish protection priorities.

7. A survey and subsequent conservation measures are needed in relation to the very rare white-throated guenon.

8. Protection measures for antelopes (nine threatened species, see *Critical Species* 3 above) need strengthening. The korrigum needs increased protection and a captive breeding programme.

9. A crocodile survey is needed with appropriate subsequent conservation action.

Chapter 8: Botswana

Introduction

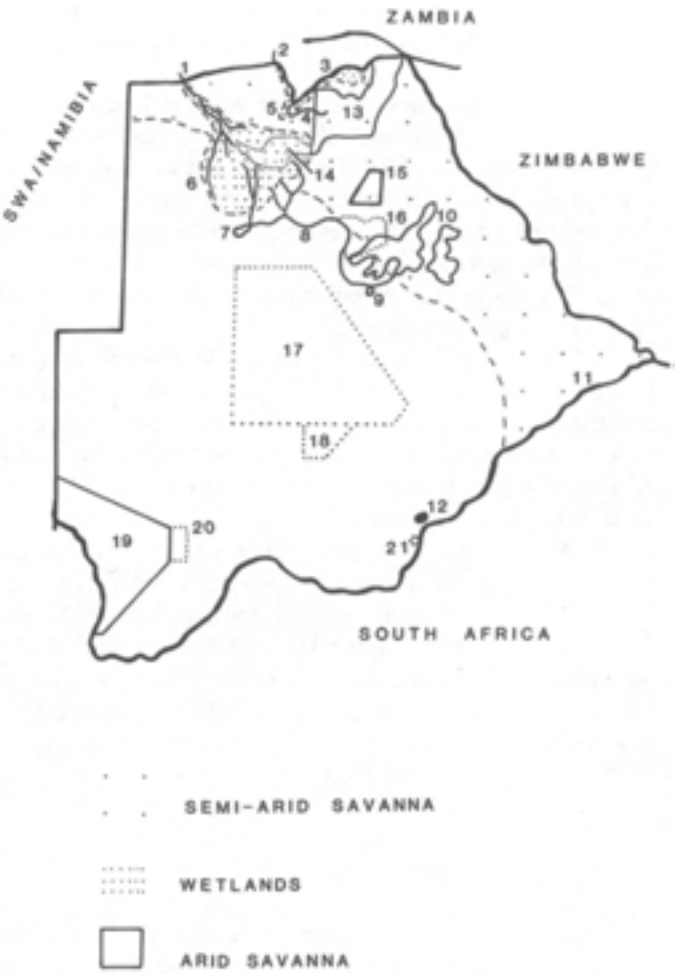
Area: 575,622 km^2. Cultivated: 2%. Pasture: 73%. Forest/woodland: 2%.

Population (1989 data): 1,241,000. Urban: 16%. Labour force in agriculture (1980): 70%. Density: 2/km^2. Annual growth rate: 3.4%, increasing. Doubling time: 20 years.

Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: US$ 1030. GNP annual growth rate: 10.8%.

Biogeographic affinities: Zambezian in the north and east and Kalahari-Highveld in the remainder of the country.

Vegetation: Kalahari *Acacia* wooded grassland and deciduous bushland in the southwest, and Zambezian woodland in the northeast, with extensive wetlands in the Okavango Delta and halophytic vegetation in the Makgadikgadi Pan.



Major natural vegetation zones and conservation areas of Botswana. 1: Okavango River. 2: Kwando River. 3: Linyanti/Chobe River. 4: Savuti River. 5: Linyanti Swamp. 6: Okavango Delta. 7: Lake Ngami. 8: Boteti River. 9: Lake Xau. 10: Makgadikgadi Pans. 11: Limpopo River. 12: Gaborone. *Conservation areas* — 13: Chobe National Park (11 000 sq km). 14: Moremi Game Reserve (3880 sq km). 15: Nxai Pan National Park (2100 sq km). 16: Makgadikgadi Pans Game Reserve (3900 sq km). 17: Central Kgaligadi Game Reserve (52 800 sq km). 18: Khutse Game Reserve (25 000 sq km). 19: Gemsbok National Park (24 800 sq km). 20: Mabuasehube Game Reserve (1790 sq km). 21: Mannyelanong Hill Game Reserve (1.5 sq km).

Critical Sites

1. Chobe National Park is of international importance, especially for large mammals. It needs to be expanded to include the swampland along the Linyati River, and possibly also the adjacent Chobe Forest Reserve.

2. The Okavango Delta is one of the most important wetland sites in Africa, and would be a suitable Ramsar site if Botswana joined the Ramsar Convention. The Moremi Game Reserve in the east of the delta is a good representation of all the Okavango habitats, except papyrus swamps. The potential threats to the Okavango are the possible expansion of cattle in the area following tsetse eradication; pollution from pesticide spraying; repeated uncontrolled burning of vegetation; siltation resulting from vegetation cutting, especially papyrus and reeds; and large-scale water removal for development programmes. All these pressures are worth continued resistance, and the government deserves credit for the well-balanced and integrated programme that it has carried out so far.

3. Lake Ngami, although dry for part of the year (or even several years at a time), is an important site and has considerable potential as a multi-use conservation area. When the lake is present, enormous numbers of waterfowl concentrate there. There are indications that flamingoes are returning to the area.

4. Central Kgalagadi (Kalahari) Game Reserve has important, though very low density, large mammal popula-

tions. Problems have arisen because of the construction of a veterinary cordon fence (the Kuke) along the northern border of the reserve, which has deprived certain species of water sources in drought years. Consequently, mortality was high. However, boreholes have been provided and their use by wildlife is now being monitored. The government has resisted pressure to expand cattle ranching in the area, and is instead working towards the successful integration of wildlife-based industries with other forms of land-use in the Kalahari.

5. The Makgadikgadi Pan Game Reserve (together with Soa Pan) and the Nxai Pan National Park are important sites for large mammals and for flamingoes, but much of the former system is outside protected area boundaries. The Nxai Pan National Park needs extending westwards and south to link with the Makgadikgadi Game Reserve.

6. The Cape vulture colony at Mannyelanong Game Reserve is of great importance.

7. The Gemsbok National Park and Mabuasehube Game Reserve constitute an important region for fauna and flora adapted to semi-arid conditions. Free movement of migratory animals across the international border with South Africa's Kalahari Gemsbok National Park is crucial to the survival of viable populations.

8. A number of new conservation areas in Botswana have been proposed: Tsodilo Hills, Aha Mountains, Kwebe Hills, Tamafupa/Jari Pan Complex, Pataletsabe Hill, Shashe Elephant Reserve, Lepakola Hills, Tswapong and Mabeleapodi Hills, Shoshong Hills, Mokwane Hills, and the Notwane-Limpopo Area. Many of these relatively inaccessible places exhibit important remains of bushman culture, depicted in the form of rock paintings.

Critical Species

1. Plants. The number of species in Botswana is over 2,000, and there are believed to be at least 17 endemics.

2. Antelopes. 22 species occur in Botswana, and many important populations exist, including blue wildebest, red lechwe, tsessebe, greater kudu and sable in the northern reserves. There are significant numbers of Sitatunga in the northern Okavango, outside protected areas. Large populations of gemsbok, springbok, red hartebeest and eland occur in the Central Kgalagadi Game Reserve and Gemsbok National Park, and the area between the two areas forms a critical corridor for migratory antelope species. Numbers of blue wildebeest in the central Kalahari have declined drastically because the veterinary cordon fences, overgrazing by cattle, and settlements have limited their access to water during droughts. Small populations of lechwe and puku occur along the Chobe but the bushbuck is now rare in this area owing to habitat destruction.

3. Elephants and Rhinos. Botswana now has an increasing population over 50,000 elephants in the north of the country, and Chobe is considered a priority baseline population for southern Africa. Many areas are now considered to be stocked beyond a desirable level. Both black and white rhinos occur in the Moremi and Chobe areas, where they have been subject to poaching pressure. Probably fewer than 10 black rhinos and only 100-150 white rhinos survive.

4. Other Mammals. In the Okavango region, there are major populations of giraffe, hippo (>1,000 each) and buffalo (>10,000). Giraffes also occur in significant numbers in the Central Kalahari. An important population of common zebra exists in the northern reserves. The bush pig has a restricted distribution (Chobe National Park and Haremi Game Reserve) at low densities but is believed to be naturally rare in the country. Botswana has one of Africa's most important populations of the wild dog.

5. Birds. A number of internationally important water-bird populations occur in Botswana, especially in the northern half of the country. Lake Ngami is an important pelican breeding area and flamingo feeding ground, and periodically holds vast aggregations of waterfowl. The Okavango Delta and Chobe National Park are the main sites in the world in which the rare slaty egret is known to breed. The Okavango and Linyanti are also important breeding grounds for the wattled crane, and the Makgadikgadi Pan is a major feeding ground for non-breeding birds. Two breeding colonies of the rare and threatened Cape vulture survive in Botswana, at Mannyelanong and in the Tswapong Hills.

6. Crocodiles. The Nile crocodile exists in the Okavango, Chobe-Linyanti and Limpopo Rivers, though there is a risk of excessive exploitation in the Okavango Delta. A crocodile management plan exists and there is ongoing research on wild crocodile populations including assessment of their reproduction. Monitoring of three captive breeding schemes (farms) continues and research on further farms is in process.

Threats

1. Further extension of cattle ranching is a serious potential threat to Botswana's wildlife resources. In some places, this might occur following tsetse fly eradication. The construction of cattle fences seriously impedes the migration of various species of large mammal over wide areas of the country.

2. There is the potential threat of large-scale removal of water, for mining purposes, from the Okavango Delta, which could have disastrous consequences on this valuable wetland site. Other potential threats to the Okavango are the possible expansion of cattle in the area following tsetse eradication,

pollution from pesticide spraying, repeated uncontrolled burning of vegetation, and siltation resulting from vegetation cutting, especially papyrus and reeds.

3. Soa Pan, part of the Makgadikgadi system, is extremely important for waterbirds but is threatened by large-scale soda ash extraction.

4. Certain species are threatened by hunting, notably both species of rhino and the wild dog.

Current Conservation Measures

1. Government Administration of Conservation

(a) Responsibility for the environment is divided between a number of ministries. The Ministry of Agriculture has a Division of Land Utilization which is responsible for forestry, fisheries, range ecology, communal areas management, and bee keeping. The Department of Veterinary Services in the same Ministry includes tsetse fly control among its responsibilities.

(b) The Ministry of Commerce and Industry includes the Department of Wildlife and National Parks which is responsible for the management of the national parks and game reserves, the regulation of hunting, the implementation of wildlife education programmes, and research and monitoring of animal populations and their habitats. The Tourism Development Unit in the same Ministry is responsible for all aspects of tourism.

(c) The Ministry of Local Government and Lands has a unit responsible for land-use planning. The Department of Water Affairs in the Ministry of Mineral Resources and Water Affairs is involved in environmental issues, in particular concerning the management of the Okavango Delta.

(d) Among the specific conservation activities being carried out by the Government are: completion of the National Conservation Strategy; drafting of elephant management plan, currently under discussion in the Ministry of Commerce and Industry; establishment of an anti-poaching unit; establishment of Wildlife Management Areas (WMAs); establishment of a Wildlife Utilisation Unit in the Department of Wildlife and National Parks, to co-ordinate such utilisation nationally; preparation of tourism policy by Ministry of Commerce and Industry; and research on the effects of land-use changes on bird populations around Lake Ngami.

2. Multi-agency Projects

(a) Development and implementation of the National Conservation Strategy (Government/IUCN/NORAD/EEC/DDA/SIDA/Netherlands Government): Provision of technical and financial assistance to the Botswana Government for the strategy.

(b) Wild dog research (EWT/University of California): country-wide studies to identify interaction between wild dogs and livestock.

(c) Southern African Wetlands Project (SADCC/IUCN/NORAD): aims to develop a regional wetlands strategy based on a review of the status of wetland resources, the identification of priority conservation actions, and the development of integrated land-use in wetlands management

3. F1NNIDA Projects

(a) Environmental training course for African communicators: course available to nationals of English-speaking SADCC countries.

4. KCS Projects

(a) Migrant mammal research and ecology in Chobe National Park.

(b) Anti-poaching fund: supplies equipment as required.

(c) Conservation education: various projects.

5. WWF Projects

(a) Monitoring effects of insecticide spraying in Okavango: study of insecticide levels on fish mortality and behaviour, and the implications for biodiversity of related downward trends in fish populations.

(b) Assistance to the Kalahari Conservation Society: aid to develop the environmental educational functions of the KCS.

Suggested Conservation Activities

1. Conservation of the Okavango Delta should be carried out by restrictions on cattle ranching, chemical spraying, tourism and further water removal. Within this broad requirement, specific programmes are needed in relation to the rare slaty egret, wattled crane and Nile crocodile. Botswana should join the Ramsar Convention as soon as possible and should gazette the Okavango wetlands as a Ramsar site. There are indications that Botswana is now moving towards implementation of these programmes.

2. The effects of drainage and clearance of vegetation in all wetlands and lakes should be constantly monitored.

3. Chobe National Park should be extended to include the swampland along the Linyati River, and possibly also the adjacent Chobe Forest Reserve, and effective management of the elephant population, including culling, should be introduced. Tourism needs to be investigated and appropriate controls introduced.

4. The free movement of migratory animals should be ensured throughout the country either by maintaining existing freedoms across international boundaries or by reducing as much as possible the use of veterinary fences to permit migration and water-seeking by large mammal populations (e.g. area linking Gemsbok National Park and Central Kgalagadi Game Reserve). The blue wildebeest needs specific action to protect it from the latter threat.

5. The management of Lake Ngami as a multi-use conservation area should be considered, particularly in relation to the protection of waterfowl, pelicans and flamingoes. Care should be taken to ensure that the lake receives adequate water from the new Maun reservoir at appropriate times of year.

6. The establishment of Wildlife Management Areas around protected areas should continue to be pursued as a matter of urgency, to support sustainable-yield hunting.

7. Poaching counter-measures need to be properly implemented and additional resources allocated to this activity. The situation is particularly urgent in relation to both black and white rhinos.

8. The Makgadikgadi Pan Game Reserve and Nxai Pan National Park need continued vigilant management with regard to large mammals and birds. The Nxai Pan National Park needs extending westwards and south to link with the Makgadikgadi Game Reserve. Problems from uncontrolled tourism in Makgadikgadi need to be investigated and appropriate action taken.

9. The two breeding colonies of Cape vultures (Mannyelanong and Tswapong Hills) need continued effective protection.

10. A number of new conservation areas should be identified and gazetted in appropriate categories *(Critical Sites* 8 above gives details).

11. Policies for rational use of wildlife in the country as a whole need continued development in order to coordinate human and conservation needs, along the lines of the "Wildlife Conservation Policy" promulgated in 1986.

12. The shortage of personnel, equipment and training throughout the National Park and protected area system (especially at Gemsbok and Moremi) needs remedy, with appropriate international assistance and finance.

13. Wildlife tourism needs careful planning and monitoring in order to realise its maximum revenue potential without deleterious effects on wildlife, along the lines suggested in the new draft tourism policy.

14. Hunting legislation needs to be strengthened to enable effective protection of many species: the Hunting Quota Committee, using aerial surveys and other data, is an important monitoring and regulatory tool.

15. The persecution of the wild dog should be stopped and a rational species protection policy developed: current research is addressing this problem.

Chapter 9: Burkina Faso

Introduction

Area: 274,122 km^2. Cultivated: 10%. Pasture: 36%. Forest/woodland: 25%.

Population (1989 data): 8,305,000. Urban: 8%. Labour force in agriculture (1980): 87%. Density: 30/km^2. Annual growth rate: 2.8%, increasing. Doubling time: 25 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 170. GNP annual growth rate: 3.5%.

Biogeographic affinities: Predominately Sudanian with Sahelian Regional Transition Zone in the extreme north.

Vegetation: Formerly dominated by Sudanian woodlands, though the densely populated centre of the country has been transformed into park-like woodland. There are dry *Acacia* woodlands in the north.

Critical Sites

1. The Arly Total and Partial Faunal Reserves and the Singou Total Faunal Reserve are of particular importance for large mammal conservation, particularly elephants. These reserves are adjacent to the equally important Pendjari complex in Benin.

2. The "W" National Park is also of high priority, and overlaps into Benin and Niger. There are a number of problems here, including human settlements within protected areas and resultant over-hunting.

3. The ecosystem in the southwest of the country, in the area of Comoe-Leraba and the Diefoula-Logoniegue Classified Forest, is important for large mammal conservation.

4. The Po National Park has problems related to human settlements within its boundaries and to its use as a military exercise area.

5. The Classified Forests at Deux Bales and Dibon are currently threatened by conflicting mining, agricultural and elephant conservation interests.

6. Most of the Sahel Partial Faunal Reserve, apart from the far northwest corner, is now severely degraded by livestock, with many people living in the reserve.

7. There are proposals for a new biosphere reserve in the west at Mare aux Hippopotames. This area includes relict populations of forest zone species.

8. The Nazinga Game Ranch is probably the best known attempt to incorporate wildlife utilisation as part of the rural economic development process in West Africa. It indicates a possible new way ahead in conservation, as well containing important populations of large mammals. Another important area is the Parc de Nauri adjacent to the Nazinga Ranch.

9. There are proposals for new ornithological reserves at Beli and Mare d'Oursi.

Critical Species

1. Plants. About 1,100 species are thought to occur, but the level of endemism is unknown.

2. Antelopes. 16 species occur, though the scimitar-horned oryx is almost, if not already, extinct. An internationally important korrigum population occurs in the east, especially in Arly and "W", and is contiguous with populations in adjacent Niger and Benin. It is currently threatened by illegal hunting and livestock grazing. Very small populations of the dorcas and dama gazelles occur in the far north, but these are certain to become extinct, unless the Seno-Mango Biosphere Reserve is established soon. The red-fronted gazelle occurs largely outside protected areas and is becoming rarer. Red-flanked and grey duikers occur in "W" and Nazinga, but the status of forest duikers is little known, being believed to occur in Mare aux Hippopotames and Comoe-Leraba. "W" National Park has one of West Africa's largest buffalo populations.

3. Elephants. One of the thirty top priority elephant populations in Africa occurs in the "W" National Park (about 1,700 animals, overlapping into Benin and Niger). Important populations (about 1,300 animals) also occur in the Arly-Singou area and some are supported in the Nazinga game ranch.

4. Reptiles. The Nile, slender-snouted and dwarf crocodile populations are all severely depleted. The status of the uncommon African spurred tortoise is unclear, but the attempt to breed these animals at Nazinga as part of a local utilisation scheme is most encouraging.

Threats

1. Protected area management, and anti-poaching efforts

Protected areas of Burkina Faso and zones censused for wildlife. ***National Parks*** **— 1: W (2350 sq km). 2: Kabore Tambi (Po) (1555 sq km).** ***Total Faunal Reserves*** **— 3: Arli (760 sq km). 4: Singou (1928 sq km). 5: Madjoari (170 sq km). 6: Bontioli (107 sq km).** ***Partial Faunal Reserves*** **— 7: Arli (1300 sq km). 8: Kourtiagou (510 sq km). 9: Pama (2230 sq km). 10: Bontioli (295 sq km). 11: Nabere (365 sq km). 12: Sahel (16 000 sq km).** ***Classified Forests*** **— 13: Diefoula (850 sq km). 14: Logoniegue (290 sq km). 15: Dida (750 sq km). 16: Deux Bale (570 sq km). 17: Koflande (300 sq km).** ***Game Ranch*** **— 18: Nazinga (940 sq km).** ***Biosphere Reserves and additional census zones*** **— 19: Mare aux Hippopotames Biosphere Reserve (192 sq km). 20: Ouest Forage Christine census zone (1020 sq km; part of proposed 1227 sq km Seno-Mango Biosphere Reserve within the Sahel Partial FAunal Reserve). 21: Southwest census zone (2890 sq km, including Diefoula, Logoniegue and Koflande Classified Forests and intervening area). 22: Sirba census zone (1200 sq km).**

are currently inadequate in most parts of Burkina Faso, leading to severe threats to many species, especially large mammals and other economically valuable species.

2. Several important habitats are not currently receiving any form of protection, especially woodland and patches of dry forest in the west and southwest.

3. Severe overgrazing by livestock is resulting in serious degradation of ecosystems in many parts of the country, but especially in the north.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Tourism and Environment, which has four Directorates covering wildlife, fisheries, water and forests, and national parks and protected areas.

(b) There is a separate Ministry of Agriculture which has some responsibilities for environmentally sound land management.

2. Multi-agency Projects

(a) Conservation and sustainable use of natural resources in southern Burkina Faso (IUCN/ISF).

(b) Schools education project centred on Po National Park (IUCN/ISF)

(c) Management of natural forests around Ouagadougou to provide firewood (FAO/UNDP): this project aims to ensure an adequate supply of firewood to local people at a sustainable level through improved forest management.

(d) Management of the Mare d'Oursi (FAO/UNDP): developing improved management of the area, including sand dune stabilisation.

3. DDA Projects

(a) Support of village-level forestry and reforestation.

Scimitar-horned Oryx (Photo: WWF/Thane Rhiney).

4. GTZ Projects

(a) Assistance in the sustainable management of forests in the Gonse district, according to sound economic and ecological principles.

(b) Sustainable resource management in the central plateau area, concentrating on forestry, agriculture, and livestock.

5. Netherlands Government Projects

(a) Village forestry development, including improved wood-stoves, village plantations, erosion control, management of Forest Reserves, and strengthening of the forest service.

Major natural vegetation zones of Burkina Faso. 1. Northern limit of Sudan-Guinea savanna element. 2: Mouhoun (Black Volta) River. 3: Nazinon (Red Volta) River. 4: Nakambe (White Volta) River. 5: Ouagadougou. *6:* Laga Koundiri area.

(b) Assistance in establishing cooperatives, and facilitating credits for erosion control measures.

(c) Promotion of the optimal use of the karité tree in Burkina Faso.

(d) The Manga Integrated Rural Development Programme, which includes a component on management of forests.

(e) Support to the Dinderesso Forestry School in training middle-level staff in the forest service.

Suggested Conservation Activities

1. Protected area management needs considerable attention, including basic matters such as precise boundary definition, allocation of resources for start-up equipment and staff, etc.

2. A national wildlife policy is needed as a framework for conservation activities in the country (as recommended at a recent national environment workshop).

3. Anti-poaching measures need to be strengthened and activated, especially in relation to large mammals.

4. Protected areas need to be inventoried before a firm status is accorded and appropriate protection methods implemented.

5. Arly, "W", Singou and Kourtiagou reserve system, plus a zone northeast of Arly, should be integrated into a single system with a new management plan, with Arly, Kourtiagou and part of Singou being fully protected and the remainder of the area, incorporating a number of villages, being a game utilisation area. Boundary lines for parks, particularly Arly, need to be clearly marked with a timber cut line, and the northern boundary of Arly should be moved north to the Doubodo River, to include dry season waterholes in the protected area.

6. A new National Park proposed for the Komoe-Leraba area should be established to protect the ecosystem in the southwest of the country. This would include large mammal populations plus the Diefoula-Logoniegue Classified Forest.

7. An national inventory of wildlife resource use should be carried out with a view to integrated development programmes based on sustainable use of wildlife. More schemes on the model of Nazinga Game Ranch are needed to reconcile human and conservation needs.

8. The management of fully protected areas (with human settlements excluded) needs to be combined with multiple-use buffer zones that permit sustainable hunting of animals. This model should be implemented as soon as possible around Po and "W" National Parks.

9. Integrated rural development programmes are needed to reconcile human-elephant problems, particularly at Deux Bales.

10. With the exception of its northwest corner, the Sahel Partial Faunal Reserve should be de-gazetted, as most of the area is too degraded to warrant protection.

11. The effects of irrigation projects on wildlife and habitats should be monitored, particularly in the north of the country where these give rise to permanent settlements.

12. The proposed Biosphere Reserve at Mare aux Hippopotames should be established.

13. Special emphasis needs to be given to antelope protection in the eastern Protected Areas and in the north, particularly for the dorcas and dama gazelles. Duiker surveys are needed in Mare aux Hippopotames and Komoe-Leraba.

14. Populations of all three species of crocodile need immediate protection.

15. The African spurred tortoise needs surveying: breeding of this species at Nazinga should be monitored to determine the applicability of that conservation model in the sub-Sahelian zone.

Chapter 10: Burundi

Introduction

Area: 27,834 km^2. Cultivated: 47%. Pasture: 33%. Forest/woodland: 2%

Population (1989 data): 5,456,000. Urban: 5%. Labour force in agriculture (1980): 93%. Density: 196/km^2. Annual growth rate: 3.3%, increasing. Doubling time: 21 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 240. GNP annual growth rate: 3.5%

Biogeographic affinities: Predominately Afromontane in the highlands and Lake Victoria Regional Mosaic in the lowlands, with a small Zambezian element along the border with Tanzania.
Vegetation: Montane vegetation in the west (including some patches of forest) and evergreen bushland and secondary *Acacia* wooded grassland in the east, with patches of miombo woodland in the southeast.

Major conservation areas and localities of Burundi. 1: Ruvubu National Park (436 sq km). 2: Kibira National Park (377 sq km). 3: Bururi Forest Natural Reserve (15 sq km). 4: Rusizi Natural Reserve (52 sq km). 5. Rusizi River. *6:* Ruvubu River. 7: Ankanyaru River. 8: Lake Tanganyika. 9: Bujumbura.

Critical Sites

1. The Ruvubu National Park is the most important site in Burundi for large mammals, but suffers from insufficient resources, and human settlements within the protected area.

2. The Kibira National Park represents the largest area of montane forest vegetation in Burundi, and is an essential water catchment for the country.

3. The Rusizi Managed Nature Reserve is an interesting area of floodplain habitats, although most of the large mammals have died out. It remains important for other species.

4. The Bururi Natural Forest Reserve consists of some of the finest emergent *Entandophragma excelsum* forest in Africa, but lacks sufficient protection and management

5. Some papyrus swamps, with an interesting community of species, survive in the centre of the country near Karuzi and the Ndurumu Valley, but are unprotected.

6. In southeast Burundi, at Murugaragara in the Mosso Plain, near the border with Tanzania, there is an important, unprotected site for amphibians.

7. Lake Tanganyika is particularly important for its large number of endemic fish species, especially cichlids.

Critical Species

1. Plants. About 2,600 species of plants occur in Burundi, but it is not known how many of these are endemic.

2. Primates. About 11 species of primates occur, including the chimpanzee. The Kibira National Park is an important site for primates.

3. Other Mammals. Important hippopotamus populations occur in Ruvubu National Park and the Rusizi Managed Nature Reserve. Ruvubu also has an important population of buffalo. Several species of antelope still occur: the current status of forest duikers is unknown in Kibira and Bururi. The Warthog survives but at low densities and only at Malagarazi, Ruvubu and Bujesera; it is believed to be endangered. The giant forest hog is believed extinct or close to extinction.

4. Birds. Three threatened species occur. A small population (less than 100 pairs) of Grauer's swamp warbler survives north of Teza in the Kabira National Park (only 50-100 ha of suitable habitat remains). The papyrus yellow warbler occurs in the papyrus swamps near Karuzi and the Ndurumu Valley.

The Kungwe apalis occurs in the Bururi Forest where 10 ha of montane dry forest is all the suitable habitat that survives. All three of these species will only survive if their habitat is conserved.

5. Crocodiles. The Nile crocodile is apparently still common at the mouth of the Rusizi River in Lake Tanganyika, and in the Rusizi Managed Nature Reserve.

6. Amphibians. An endemic toad *Schoutedenella massoensis* occurs only at Murugaragara in the Mosso Plain near the Tanzanian border. It is rare and presumably requires protection. An endemic frog *Phrynobatrachus sulfureogularis* occurs only on the Massif du Nanzergwa near Bururi. The montane forests are important for amphibians in general, with several species with limited distributions otherwise occurring only in Rwanda, Uganda and Zaïre.

7. Fishes. There is an important endemic fish fauna, especially of cichlids, in Lake Tanganyika which is potentially threatened by over-fishing, pollution, and introduction of alien fish species.

8. Invertebrates. The rare cream-banded swallowtail butterfly *Papilio leucoptera* occurs in the highland forests (it also occurs in Rwanda, Uganda and Zaïre).

9. Wildlife Trade. The Burundi Government is making efforts to ensure that no wildlife products that have been taken illegally from surrounding countries are allowed to move through its territory. This is particularly important in the case of ivory and rhino horn.

Threats

1. Owing to the high human population density in the country, most of the natural habitats in Burundi have already been destroyed, and those that survive are often small and fragmented. As such, there is a considerable risk of extinctions of certain species, because the remaining habitats are not large enough to support viable populations.

2. Wetlands are poorly protected and managed in Burundi, and the important biological resources in these ecosystems could easily be lost through clearance and over-use.

3. Some protected areas are in danger of being compromised because they contain human settlements.

4. There is a continuing threat to the fish fauna of Lake Tanganyika from pollution, over-fishing, and the potential introduction of alien fish *species.*

Current Conservation Measures

1. Government Administration of Conservation

(a) General environmental matters come under the Ministry of Equipment, Tourism and the Environment. This Ministry works closely with the National Institute for the Conservation of Nature, which handles wildlife management and protected areas, and reports direct to the President.

(b) The conservation and management of forests comes under the Department of Water and Forests in the Ministry of Agriculture and Livestock.

Suggested Conservation Activities

1. The Ruvubu National Park needs increased finance and expertise to improve its management. Human settlements in the park should be moved out in the context of appropriate development projects in buffer zones. Important hippo and buffalo populations need improved protection within the Park.

2. Montane forest areas are critical for many wildlife resources and the following action is required:

(i) In the Kibira National Park, an appropriate management plan and effective protection are needed, especially against illegal forest clearance. Again, this should be in the context of buffer-zone development projects. Specific protection is needed for a small population of Grauer's swamp warbler. Important primate populations also need protection, and a survey is needed of the red colobus. A duiker survey is also needed.

(ii) The Bururi Natural Forest Reserve needs its legal status upgrading since full protection and appropriate management are needed. Specific protection should be developed for the Kungwe apalis which is only known to exist in 10 hectares of dry montane forest in the reserve. A duiker survey is needed.

(iii) Specific protection is needed for endemic and rare species of amphibians and invertebrates, as specified in *Critical Species* 6 and 8 above.

3. The management and protection of wetlands need improving throughout the country, with particular emphasis on papyrus swamps near Karuzi and the Nduruma Valley. Protection of this habitat is crucial to a number of species, especially the papyrus yellow warbler. The populations of hippopotamus and Nile crocodile in the Rusizi Managed Nature Reserve need monitoring.

4. Protected status should be accorded to a site at Murugaragara in the Mosso plain, in order to conserve important amphibian populations including the endemic toad *Schoutedenella massoensis which only occurs at this site.*

5. The Burundi government should continue its efforts to prevent traffic in illegal wildlife products, especially ivory and rhino horn.

Chapter 11: Cameroon

Introduction

Area: 475,500 km^2. Cultivated: 15%. Pasture: 17%. Forest/woodland: 53%.

Population (1989 data): 10,817,000. Urban: 42%. Labour force in agriculture (1980) 70%. Density: 23/km^2. Annual growth rate: 2.6%, increasing. Doubling time: 26 years.

Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: US$ 960. GNP annual growth rate: 9.4%.

Biogeographic affinities: Predominately Guinea-Congolian in the south and Sudanian in the north with a broad transition zone across the centre of the country. There are important Afromontane elements in the west, and Sahel Regional Transition Zone in the extreme north.

Vegetation: Extensive lowland rainforests in the south and Sudanian woodland in the north, with a mosaic of forest patches and secondary grassland in the transition zone. In the mountains there are important areas of montane forest and grassland, and in the extreme north there is a small area of sub-sahelian wooded grassland.

Critical Sites

1. Cameroon possesses some of the most important protected areas in Africa. Among these are several in the lowland rainforests: Korup National Park, Takamanda Forest Reserve, Mbam et Djerem proposed national park, Pangar-Djerem Game Reserve, Dja Forest and Game Reserve, Douala-Edea Game Reserve and Campo Game Reserve.

2. There are some other biologically interesting forests in Cameroon that also need protection if the country's rich biological heritage is to survive. In the west of the country the following forests are worthy of note: Ejagham, Manne River, Nta Ali, Mokoko River, Barombi Mbo, and Bonepoupa. In the remote southeast, the following forests are of importance: Nki, Boumba Bek, and Lake Lobeke.

3. In the savanna zone the four national parks of Waza, Faro, Benoue and Bouba-Njida are of high priority, and include some internationally important large mammal populations. Wildlife has suffered in all the parks from illegal hunting, and in Waza there have been decreases owing to the reduced flooding of the plains since the creation of a dam on the Logone River. The management of all these protected areas is in need of improvement.

4. The conservation of the montane forests in western Cameroon is of great international concern for the many rare and endemic species that occur there. The following areas are of particular importance: Mount Cameroon (in particular the Bambuko Forest Reserve in the northwest and the continuous altitudinal spread of forest from sea-level to the high mountain slopes on the southern side); Mount Kupe (an important site for a new reserve); the Bamenda Highlands (in particular, the largest remaining forest patch in this area, on Mount Kilum (Oku), which is severely threatened and is the only home for a number of rare species; another important area in the Bamenda Highlands, further to the west with a slightly different fauna and flora, is Oshie); Mount Manenguba (there are serious problems here with the continued fragmentation of the forest); Mount Nlonako (probably a suitable site for a new reserve); the Bakossi Mountains (conservation requirements of this area are not well known at present); the Rumpi Hills (the utilisation of natural resources in this interesting area needs to be maintained at a sustainable level); and Tchabal Mbaba (an unusual forest further to the north, in need of careful protection). Apart from their unique biological values, all these forests also form essential water catchments for Cameroon and Nigeria.

5. Surviving areas of natural habitat in the Adamaoua Plateau are of interest for plants, amphibians, birds and mammals. Such habitat is now severely fragmented and further degradation needs to be prevented.

6. Similarly, few areas of natural habitat survive in the Bamileke Plateau, around places such as Foto, Bangwa and Petit Diboum. These are important sites for amphibian conservation.

7. The Mandara Mountains in the extreme north are of interest for rare plants and for the dry forest of Mozago Gokoro National Park and Mayo Lonti Forest Reserve where important populations of antelope and other large mammals occur. The Alantica and Poli mountains are likewise important from a floral point of view. However, the conservation requirements of these areas are not fully known at present.

8. The swamp forests along the Nyong River near Abong Mbang are unusual and constitute an important example of this type of habitat. There are also important mangrove areas along the northern sections of the coast and

Medicinal plants research at Korup National Park helps to identify useful plants and to encourage the development of important compounds (Photo: WWF/Mauri Rautkari).

around the mount of the Sanaga river.

9. There are numerous crater lakes in the west of the country, many of which are poorly explored biologically. Among those that are known to be important are Lake Barombi Mbo (for endemic fish) and Lake Oku (for amphibians). There are also some important deep forest pools in the Korup National Park.

10. In general marine habitats currently lack protection and conservation needs are poorly known. There are some important mangroves along the Rio Del Rey, with interesting fish faunas in the brackish and freshwater swamps.

Critical Species

1. Plants. About 9,000 species have been recorded, one of the highest levels in Africa, with at least 156 endemic species, of which 45 are on Mount Cameroon. Other important sites for endemic plants are Dja, Campo, the Adamaoua Plateau, the Mandara Mountains, and Mount Kupe.

2. Primates. A total of 29 species occurs, the second highest in Africa. Of particular importance are the gorilla (isolated northern population, perhaps subspecifically distinct, in Takamanda, with larger populations in the south of the country); the drill (Korup and Mount Kupe, probably most of the population of this threatened species occurs in Cameroon); the mandrill (Campo); Preuss's guenon (only occurs in eastern Nigeria, Bioko, and in Cameroon on Mount Cameroon, the Rumpi Hills, Mount Kilum (Oku) and Takamanda); the red-eared guenon (likewise restricted to eastern Nigeria, Bioko, and in Cameroon on Mount Cameroon, Mount Kupe, the Rumpi Hills, Korup, Ejagham and Takamanda); Pennant's red colobus *Procolobus pennanti preussi* (this subspecies almost entirely restricted to Korup); and black colobus (Douala-Edea and Campo).

3. Antelopes. A total of 23 species occurs. Important populations of the scarce giant eland occur in Faro, Benoué and Bouba-Njida, though these were reduced in the 1983 rinderpest outbreak and there is a fairly serious ongoing problem with illegal hunting. An isolated population of the mountain reedbuck occurs in the Adamaoua Plateau and possibly also the Mandara Mountains; its conservation requirements are not known. Major populations of korrigum and Buffon's kob occur in Waza and Benoué, though declines are attributable to reduced flooding, rinderpest and illegal hunting. The topi occurs in Waza. The Lake Lobeke area in southeastern Cameroon, has some species - duiker, bongo, Bates' pygmy antelope - in very high densities. This area needs to be considered for a linked protected area with the Central African Republic and Congo. Conservation requirements of duikers and other forest antelopes need clarification, especially in Korup, Takamanda and Dja.

4. Rodents. Eleven species of conservation concern occur, of which some of the more interesting are: the African pygmy squirrel, the flightless scaly-tailed squirrel and Dollman's tree mouse, all of which are rare species occurring in the forests of southern Cameroon, and in adjacent countries; there are also three endemic mice, *Praomys morio* only known from Mount Cameroon, *P. hartwigi* only known from Mounts Kilum (Oku) and Manengouba, and L*emniscomys mittendorfi* only known from Mount Kilum (Oku).

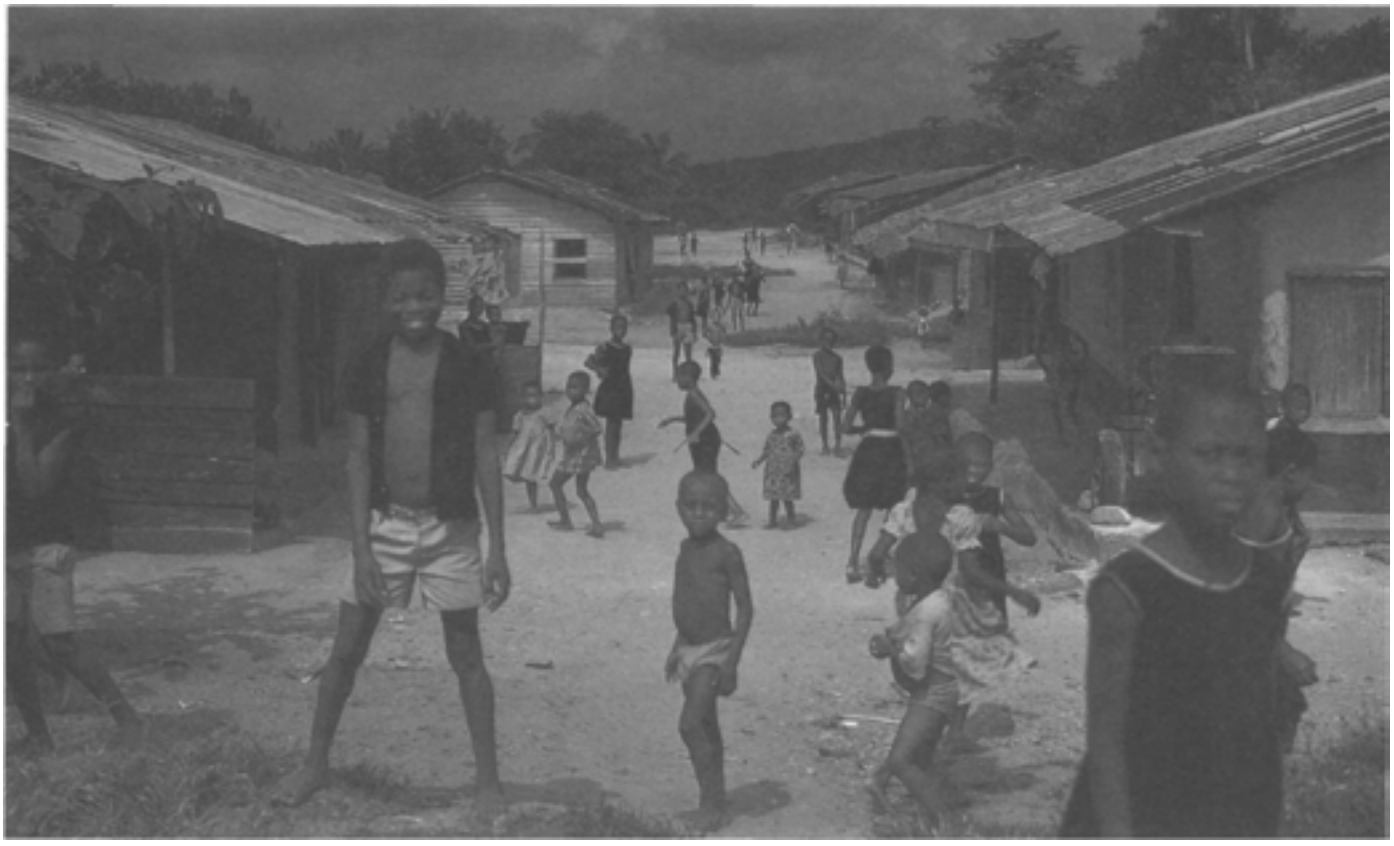
5. Fruit Bats. 14 species occur, including two of conservation concern: *Casinycteris argynnis* (known only from the lowland forests of Cameroon and Zaïre); and *Scotonycteris ophiodon* (known only from forest sites in Cameroon, Congo, Ghana and Liberia).

6. Other Mammals. One of the largest protected giraffe populations (>1,000) in West and Central Africa occurs in Waza National Park, where it is stable or increasing. Bouba-Ndjida National Park has an important buffalo population. The bat *Pipistrellus eisentrauti* is known only from Mount Cameroon, Mount Kupe and the Rumpi Hills. Important elephant populations occur in both the savanna and forest zones of Cameroon, and Korup is one of the top priority "baseline" populations for the African continent. There are around 800 in Waza, >600 in Bouba-Njida and significant populations in Benoué, Faro and Dja A population of black rhino, in the form of a distinct subspecies *Diceros bicornis longipes*, survives in Cameroon, the westernmost group in Africa. Most of these are in Bouba-Njida National Park, with **a** few in Benoué, and they are in **a** precarious position. The country probably also has a significant manatee population. The effect of coastal fisheries on dolphins and porpoises, through incidental killings, is currently not known.

7. Birds. 14 threatened species occur, of which the most important are: the Mount Cameroon francolin (endemic to Mount Cameroon); Bannerman's turaco and banded wattle-eye (endemic to the Bamenda Highlands, but the only significant populations occur on Mount Kilum (Oku)); the Mount Kupe bush-shrike (endemic to Mount Kupe, not seen for 35 years until 1989); the grey-necked picathartes (breeding sites restricted to caves in the lowland rainforest in the south and west of the country; also occurs in adjacent Nigeria, Gabon and Bioko); the Bamenda apalis (endemic to the Adamaoua Plateau and Bamenda Highlands; absent from Mount Kilum (Oku), its main population is probably on the Adamaoua); Bannerman's weaver (Mount Manenguba and the Bamenda Highlands, especially Mount Kilum (Oku), also adjacent Nigeria); and Bates's weaver (endemic to lowland forests of Cameroon, Douala-Edea and Dja probably being important sites). The mountain forests in the west of the country are important because some 22 bird species are endemic to the area (some of these occur marginally in adjacent Nigeria and on Bioko, in Equatorial Guinea).

8. Reptiles. A chameleon *Chameleo eisentrauti* is endemic to the Rumpi Hills, and three other species of chameleon are largely endemic to the forests of the mountains in the west of the country. Five species of *Panaspis* skink are largely endemic to the mountains, of which two are only found in the Bamenda Highlands. The current status of all three species of crocodile is not fully known: the Nile crocodile is known to be reduced in numbers, and the slender-snouted crocodile populations are depleted, except in the most remote areas. Likewise the status of marine turtles and their breeding sites is unknown at present.

9. Amphibians. There are 63 amphibians endemic to Cameroon, and 28 near-endemics (18 of which occur marginally in the highlands of eastern Nigeria). Most of these high priority species occur in one of the following general areas: the lowland forests in the south of the country; the Bamilckc Plateau; the Adamaoua Plateau; and especially the highlands in the west Mount Manenguba is of particularly high priority in the highlands, with four endemic species. Other important sites in the highlands are: Mount Kupe, Mount Nlonako, the Rumpi Hills, the Bamenda Highlands (especially Mount Kilum (Oku)), Oshie and the Bamboutos Mountains), and Mount Cameroon. Interestingly, four species of caecilian are endemic to Cameroon and are known from only one site each: two of these are from the foot of Mount Cameroon at Limbe; one is from Mamfe (perhaps occurring in Takamanda); and one is from Mount Kilum (Oku). The status and conservation needs of the goliath frog *Conraua goliath* and the hairy frog *Trichobatrachus robustus* are unknown.



Local residents at Ndian Village, Korup National Park (Photo: WWF/Mauri Rautkari).

Major natural vegetation zones (approximate) of Cameroon. 1: Lake Chad. 2: Mandara Highlands. 3: Alantika Highlands. 4: Adamaoua High Plateau. 5: Western High Plateaux. 6: Southern Plateau. 7: Coastal Lowlands. 8: Mount Cameroon. 9: Douala. 10: Sanaga River. 11: Yaoundé. 12: Yokadouma. 13: Moloundou.

10. Freshwater Fishes. The crater lakes in the western part of the country (including Lake Barombi Mbo) contain a number of vulnerable endemic cichlid species. The fish fauna of the brackish/fresh mangrove swamps of Rio del Rey in west Cameroon and the deep forest pools in Korup are important and poorly known, with the latter possibly containing fish species not yet described.

11. Invertebrates. The dragonfly *Argiocnemis umbargae* is only known from Cameroon, but there are no recent records. The rare giant swallowtail butterfly is known from the lowland forests.

Threats

1. The most important threat to biodiversity in Cameroon is clearance of both lowland and montane forests, and the current lack of effective policies to enable the sustainable utilisation of products from those forests that are outside protected areas. Habitats are being lost through agricultural expansion, bush-fires, and commercial logging. With current trends, Cameroon is likely to loose many valuable species from this threat.

2. Illegal hunting of wildlife is a serious problem in both savanna and forest zones, with large mammals and crocodiles being particularly seriously affected. The economic problems of the country have contributed to the increase in poaching and a reduction in resources to combat poaching and support conservation.

3. There is a considerable export trade in parrots from Cameroon, though it is not clear whether this is posing a threat to any species. Likewise, the level of export trade in the goliath frog has given cause for concern, though again the significance of this for the conservation of the species is not yet clear.

4. Burning of savanna and cutting of fuelwood is increasing desertification in many areas.

5. Water management schemes in the north have disrupted natural flooding regimes, with a resultant serious deleterious effect on species and habitats.

6. Almost no protection is currently given to marine species and ecosystems.

Current Conservation Measures

1. Government Administration of Conservation

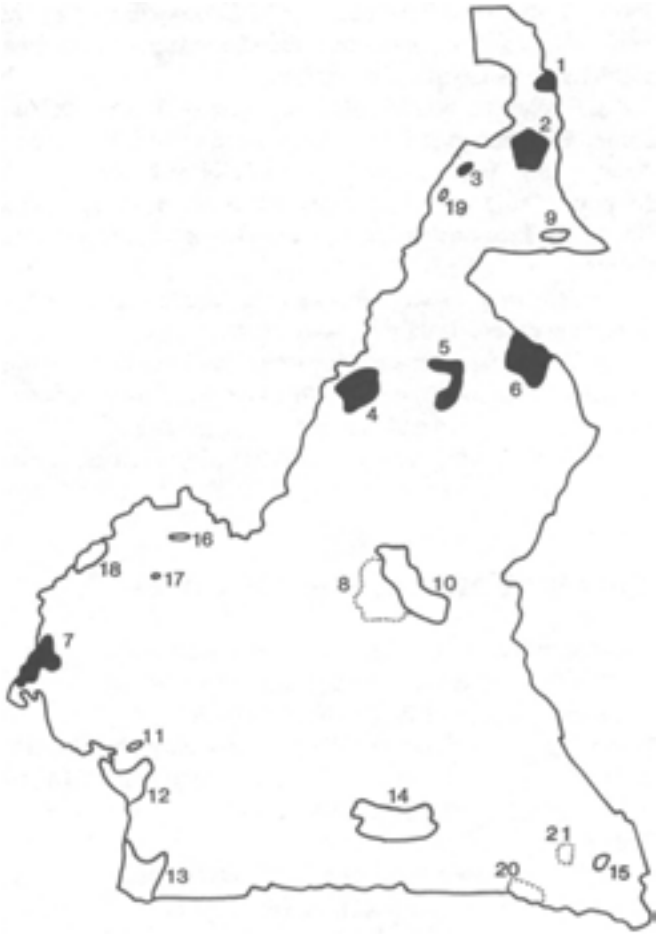
(a) The conservation and management of forests comes under the Ministry of Agriculture, through its Department of Forestry and the National Office for Forestry Development (ODANEF). These two agencies are responsible for the implementation of government policy with regard to the State Forests.

(b) The conservation of wildlife comes under the Ministry of Tourism, in particular its Department of Wildlife and Protected Areas. This department is responsible for: the development and implementation of government policy with regard to wildlife; research activities on wildlife; public education programmes on wildlife conservation; the management of all protected areas and zoological gardens; the development and enforcement of hunting regulations; the development of further protected areas; and the collaboration with external agencies working in the wildlife sector. The department has recently been reorganised to give more importance to tourism, and to improve its technical capabilities.

2. Multi-agency Projects

(a) Promotion of forest conservation (Government/ IUCN/EEC): development of an action plan for forest conservation by: planning a protected areas system to include rainforest habitats; development of sustainable use programmes in the forest zone; assessing conservation needs of forest wildlife; and dissemination of results of research.

(b) Support to the Ecole de Faune, Garoua (WWF/University Centre of Dschang): extension of the college's capabilities to include rainforest habitats, plus studies basic to establishing and maintaining Dja National Park, and development of MSc course in wildlife management and wetlands training course.



Major conservation areas in Cameroon. *National Parks* — 1: Kalamaloue (45 sq km). 2: Waza (1700 sq km). 3: Mozogo-Gokoro (14 sq km). 4: Faro (3300 sq km). 5: Benoue (1800 sq km). 6: Bouba-Ndjidah (2200 sq km). 7: Korup (1260 sq km). 8: Mbam et Djerem (proposed) (4210 sq km). *Forest and faunal reserves, game reserves, and forest reserves* — 9: Kalfou (40 sq km). 10: Pangar-Djerem (3000 sq km). 11: Lake Ossa (40 sq km). 12: Douala-Edea (1600 sq km). 13: Campo (3000 sq km). 14: Dja (5200 sq km). 15: Lake Lobeke (430 sq km). 16: Kimbi River (56 sq km). 17: Mbi Crater (4 sq km). 18: Takamanda (676 sq km). 19: Mayo Louti (15 sq km). 20: Nki (proposed) (1950 sq km). 21: Boumba-Bek (proposed) (2330 sq km).

(c) Dja Forest and Game Reserve (IUCN/EEC): re-gazetting of Dja Forest as a National Park.

(d) Waza-Logone Development Project (IUCN/Ecole de Faune/Leyden University): improvement of management and local integration of Waza National Park.

(e) Surveys of elephants in the forest zone to establish baseline population data (WCI/WWF/EEC).

(f) Assessment of elephant status in Santchou proposed reserve and Lake Lobeke proposed reserve in the southeast (WCI/EEC).

(g) Development of village-level forestry (Netherlands Government/CARE/ODANEF).

(h) Conservation of Mount Kilum (Oku) Forests (ICBP/WWF/USAID): protection of remaining forests, rehabilitation of degraded areas, soil conservation, livestock control, and education.

(i) Establish of Centre for Environmental Studies (University of Dschang/Netherlands Government): promotion of research on nature management, sustainable utilisation, and environment.

(j) Korup National Park management plan and buffer zone development (WWF/GTZ/ODA).

3. FFPS Projects

(a) Study of ecological requirements of Bannerman's turaco and banded wattle-eye, Mount Kilum (Oku).

(b) Survey of the drill and assessment of conservation needs.

4. ICBP Projects

(a) Development of integrated conservation programme for Mount Kupe, to include habitat management, research, and education.

5. Netherlands Government Projects

(a) Ecology project at Mayo Louti.

(b) Research activities aimed at developing sustainable management programmes in tropical forests, implemented through TROPENBOS.

6. ODA Projects

(a) Limbe Forest social survey: attitudes to and uses of the forest.

(b) Limbe Gardens genetics conservation project: conservation of endangered or economically useful trees and plants.

(c) Forest inventory training project: student training in Forestry School.

(d) Teacher training: teacher training for Forestry School.

(e) Comparative ecology project: research into regeneration conditions.

(f) Hardwood research: development of informed species of hardwoods.

7. WCI Projects

(a) Biological inventory and training in Korup National Park to support the management plan development by WWF.

(b) Rhino status survey in the northern reserves.

8. WWF Projects

(a) Dja Education Centre: establishment of an education centre for local people in the Dja Game Reserve.

Suggested Conservation Activities

1. The major single emphasis needs to be on conservation of rainforest, woodland and montane forest. Improved management in all protected areas is needed to (1) enforce bans on unauthorised forest clearance, (2) develop programmes which move towards sustainable use of protected resources (e.g. controlled utilisation of non-threatened bushmeat species, buffer-zone hunting, prevention of low-yield timber harvesting), (3) reforest with indigenous species, (4) increase anti-poaching measures (especially in relation to elephants and rhinos) and (5) continue to train more staff at the Wildlife College at Garoua. Additionally, further protected forest areas should be designated (see below).

2. Consolidation of management plans for Korup National Park should be urgently pursued. In addition to general habitat protection, special protection should be considered for the following threatened species: drill, red-eared guenon, Pennant's red colobus and the elephant. A duiker survey is also needed.

3. A National Park should be created at Mbam et Djerem, to protect the internationally significant forest/savanna transition zone there. Plans to upgrade the Pangar-Djerem Game Reserve into a National Park should be abandoned since the area has been extensively degraded.

4. Dja Forest and Game Reserve needs improved management and protection based on multiple use compatible with the needs of the local human population and involving them actively in the development of programmes. Implementation of the plans for re-gazetting this as a National Park will aid this process considerably. The boundaries need to be clarified and an education centre established. Specific attention is needed for endemic plants and Bates's weaver, and gorilla, elephant and duiker surveys are needed.

5. The Takamanda Forest Reserve urgently need more conservation activity and the development of appropriately-managed buffer zones. A duiker survey is needed and specific protection considered for the gorilla, Preuss's guenon and the red-eared guenon.

6. The Douala-Edea Forest Reserve is in urgent need of increased protection and buffer-zone development. Species needing special protection are the black colobus and Bates's weaver.

7. The Campo Game Reserve needs urgent conservation measures and buffer-zone development The Rocher du Loup area off the coast should be considered as a possible marine reserve. Special protection may be necessary for a number of endemic plant species, the mandrill and the black colobus.

8. Management of the four National Parks in the savanna zone needs improvement (particularly Faro, where illegal hunting has caused wildlife population depletions and remains a threat to the current populations of large mammals). Annual fires need to be prevented in order to improve the vegetation and provide more fuelwood for the population. In terms of species, Waza National Park contains major populations of korrigum and Buffons's kob (and is almost free of poaching); Faro, Bouba-Njida and Benoue have significant numbers of the rare giant eland and other savanna antelope species; and Bouba-Njida has a small group of black rhinos. All of these species require specific protection. An inventory of wildlife populations in Faro National Park is needed

9. Areas of montane forest in western Cameroon need activity appropriate for the rarity and endemism of many of their species. The following specific measures are needed:

Sustainable use of natural resources is encouraged in the buffer zones of protected areas, as in this example of fuelwood being loaded outside Korup National Park (Photo: WWF/Mauri Rautkari).

(i) A new National Park (incorporating the Bambuko Forest Reserve) should be created for the whole of Mount Cameroon to preserve the continuous altitudinal spread of forests from sea-level to high mountain slopes. Specific activity is required for species noted in *Critical Species* 1, 2, 4, 6, 7, 8 and 9 above. A detailed proposal for such a new park urgently needs to be drawn up.

(ii) The largest remaining forest patch in the Bamenda Highlands, on Mount Kilum (Oku), is the only home of a number of rare species and needs urgent protection and an education programme in the surrounding towns and villages. Species needing special measures include Bannerman's turaco and others listed in *Critical Species* 2, 4, 7, 8 and 9 above.

(iii) Mount Manenguba needs urgent measures to arrest further fragmentation of the forest and also programmes to

protect Bannerman's weaver, the mouse *Praomys hartwigi* and various amphibians.

(iv) Mount Nlonako should be designated as a Forest Reserve.

(v) The Bakossi Mountains require a survey of conservation needs.

(vi) In the Rumpi Hills, a management plan is required to ensure that sustainable use of local wildlife is established and appropriate protection given to a number of individual species (see *Critical Species* 2, 6, 8 and 9 above).

(vii) Mount Kupe should provide a site for a new reserve offering protection to a number of important species: see *Critical Species* 1, 2, 6 and 7.

(viii) A new reserve should be considered for Tchabal Mbaba forest.

10. A number of biologically interesting forest areas need to be accorded protected status: in the west, Ejagham (also containing the red-eared guenon), Manne River, Nta Ali, Mokoko River, Barombi Mbo and Bonepoupa; in the remote southeast, Nki, and Boumba Bek. The Lake Lobeke area is particularly important for antelopes and consideration should be given to the establishment of an international protected area, linking with the Dzanga-Sangha Reserve in Central African Republic and Nouabale Forest in Congo, thus making one of the largest rainforest reserves in Africa.

11. Forest Reserves at Dendeng, Fungom and Mbembe should be redesignated as Category 4 Nature Reserves (see Table 3.2) to improve protection and stop uncontrolled wildlife exploitation.

12. A survey of wetlands and mangrove swamps is needed to prepare for the establishment of protected areas: crocodiles, manatees and other freshwater fauna should be included in the survey. An initial reserve should be created on the Nyong River near Abong Mbang, with others established following the survey.

13. Reserves should be created on the Adamaoua Plateau to protect remaining areas of natural habitat for plants, amphibians, birds and mammals, especially the mountain reedbuck and Bamenda apalis.

14. A survey should be carried out to assess conservation needs in the Mandara Mountains, with particular reference to plants and the mountain reedbuck. The unique but fragile ecosystem of Mozogo-Gokoro National Park needs special attention to ensure its protection.

15. Areas of natural habitat surviving on the Bamileke Plateau near Foto, Bangwa and Petit Diboum should be accorded protected area status and their amphibian populations should be monitored and protected.

16. Surveys are needed to assess the status and conservation needs of the hairy frog and the goliath frog.

17. Marine surveys, particularly of dolphins, porpoises and marine turtles should be carried out to establish conservation needs and to choose a suitable site for a marine reserve. One possible such site would be Rocher du Loup off the coast of the Campo Game Reserve.

18. Surveys of the Alantica, Poli and Mandara mountains are needed to assess conservation needs.

19. The level of training at the Ecole de Faune, Garoua, needs to be continually developed. This is an international issue as well as one purely for Cameroon.

Chapter 12: Cape Verde

Introduction

Area: 4,033 km^2. Cultivated: 10%. Pasture: 6%. Forest/woodland: 0%.

Population (1989 data): 368,000. Urban: 27%. Labour force in agriculture (1980): 52%. Density: 91/km^2. Annual growth rate: 2.5%, decreasing. Doubling time: 28 years.

Economy: World Bank index: no data. GNP/capita: US$ 500. GNP annual growth rate: 6.5%.

Biogeographic affinities: Two groups of volcanic islands (Windward and Leeward), in which the lowland ecosystems have African affinities and montane ecosystems have Macaroncsian and Mediterranean affinities.

Vegetation: Original vegetation unknown, and in any case long since destroyed through over-grazing and erosion. Present vegetation consists of arid lowland pastures, farms and plantations on fertile slopes, and bare rock at high altitudes.

Critical Sites

1. Lack of up-to-date information on the biological resources of the Cape Verde Islands makes it difficult to provide an accurate assessment of critical sites and priorities. A few priorities are, however, quite clear: for example, the small, uninhabited island of Raso has an endemic lark and some very rare lizards.

2. A number of scabird colonies exist on the islands, including São Antão, Fogo, São Tiago, São Nicolau, Raso, Gima, Branco, Brava, Boa Vista, Rhombos, Lajes, Passaros, Baluarte and Curral Velho.

Critical Species

1. Plants. 659 species of vascular plant occur, including introductions, with 92 endemic species. The islands are severely degraded with most of the original vegetation destroyed.

2. Birds. Two severely threatened species occur. A species of gadfly-petrel, the gon-gon, breeds on São Nicolau, Fogo, Santo Antão and São Tiago (as well as Madeira) and its total population is only a few hundred pairs. It is exploited as a food resource and is thereby endangered. The Raso lark is endemic to the tiny island of Raso, and its population has decreased to a mere 20 pairs, partly as a result of museum specimen collection. Its conservation requirements are currently unknown. In addition, 21 endemic subspecies of birds occur on the Cape Verde Islands. For most of these, their conservation requirements are poorly known. For instance, the endemic race of the purple heron on São Tiago is believed to be severely threatened. Ten species of seabird breed on the islands, and all of these are declining due to over-exploitation of eggs, young and adults, and the presence of introduced dogs, cats, monkeys and rats.

Map of Cape Verde.

3. Reptiles. 15 species of lizard occur on the islands, of which 12 are endemic. These include a remarkable giant skink on Raso, *Macroscincus coctei* (unfortunately possibly extinct), and a giant gecko *Tarentola gigas* on Raso and Branco. The other endemics include two more *Tarentola* geckos, three *Hemidactylus* lizards, and five *Mabuya* lizards. Conservation requirements for marine turtles, of which at least three species, the nawksbill, loggerhead and green, are believed to nest in the islands, are not known at present. It is clear that there is a considerable annual harvest of marine turtles.

Threats

1. Much of the biodiversity of Cape Verde has probably been lost through the near total destruction of the natural habitat

2. Introduced rats, cats, dogs and monkeys present a serious threat to much of the remaining wildlife.

3. There is severe exploitation of seabirds, which is likely to result in the local extinction of several species, and the global extinction of at least one.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Rural Development and Fisheries, which is responsible for all conservation measures in both terrestrial and marine ecosystems.

2. GTZ Projects

(a) Promotion of sustainable management of natural resources, including agriculture, forestry, and fisheries.

3. Netherlands Government Projects

(a) Ecological restoration of Planalto Este on Santo Antão, including an erosion control component

Suggested Conservation Activities

1. Biological Surveys need carrying out, particularly in the following areas:

(i) Plants: severe over-grazing effects need assessing and conservation measures need to be planned and implemented.

(ii) Birds: conservation requirements of endemic species need assessment and a survey of seabird colonies is needed.

(iii) Reptiles: marine turtles and endemic lizards need conservation assessment and planning.

2. A reserve should be established on the uninhabited island of Raso, in order to give absolute protection to the Raso lark and lizards *Macroscincus coctei* and *Tarentola gigas.*

3. The gon-gon, a species of gadfly-petrel, needs urgent protective action.

4. The impact of exploitation on all species of seabirds needs urgent assessment, followed by appropriate protective measures based, if possible, on sustainable use.

5. The impact of introduced species (particularly predators) needs urgent assessment with a view to enforcing controls and achieving eradication.

Chapter 13: Central African Republic

Introduction

Area: 624,977 km^2. Cultivated: 3%. Pasture: 5%. Forest/woodland: 58%.

Population (1989 data): 2,806,000. Urban: 35%. Labour force in agriculture (1980): 72%. Density: 4/km^2. Annual growth rate: 2.5%, increasing. Doubling time: 28 years.

Economy: World Bank index: low-income economy. GNP/capita: US$ 330. GNP annual growth rate: 0.1%.

Biogeographic affinities: Sudanian in the northern half of the country, and Guinea-Congolian in the southwest, with a broad transitional zone between these two.

Vegetation: Mostly Sudanian woodland, with a small area of *Acacia* dominated Sahelian woodland in the extreme north. Lowland forest, both moist and dry, dominates the southwest, and there are extensive area of forest interspersed with secondary grassland elsewhere in the south, especially in the Bangassou area. There are extensive floodplains in the north.

Pygmy family in the Central African Republic (Photo: WWF/Paul S. Wachtel).

Critical Sites

1. Important lowland forests exist in the extreme southwest of the country, particularly at Dzanga-Sangha and the Mbaere-Bodingue-Ngoto Forest, which is near the existing Basse-Lobaye Man-and-the-Biosphere Reserve. Other important lowland forests exist in the south of the country around Bangassou (especially the Massif de Bangassou). Further to the north, isolated forest patches exist, some of which are of high biological interest and are worthy of protection. These include forests at Kotto, Kaga-Bandoro, Nana and a large dry forest area south of Oudda.

2. The savanna reserves in the north of the country are of great importance for large mammals especially Bamingui-Bangoran National Park and surrounding reserves, and the Manovo-Gounda-St. Floris National Park (a World Heritage Site) and associated reserves. The ongoing programme to rehabilitate these protected areas, and to improve their management, is crucial to conservation here. The proposed establishment of the Bamingui-Bangoran complex as a Man-and-the-Biosphere Reserve is also important for this type of habitat. Good wildlife populations now exist outside the parks in the hunting concessions. The Zemongo Faunal Reserve warrants improved management but the Nana-Barya Faunal Reserve, the Yata-Ngaya Faunal Reserve and the André Felix National Park are now believed to be effectively devoid of significant wildlife.

3. The hills of the northeast are important for plant conservation, including the Massif des Bongos and the Massif du Dar Chala. Some of this area is in the Yata-Ngaya Faunal Reserve.

Critical Species

1. Plants. The flora of the Central African Republic is very poorly known; at least 3,600 species are known, but this is probably too low a total and a more realistic estimate would be around 5,000. There is a concentration of endemic species on the hills of the northeast.

2. Primates. Between 19 and 20 species occur, including the gorilla. The highest priority for primate conservation (including the gorilla) is the establishment of the Dzanga-Sangha reserve, with effective controls to prevent excessive hunting. Zemongo Faunal Reserve in the southeast supports eastern chimpanzees and other primate species. Chimpanzees are also present in low densities south of Bambio, east of Bayanga and possibly in Bangassou.

3. Antelopes. 23 species occur, many of them in good numbers. One of Africa's largest populations of the giant eland occurs in the north and east of the country (although these were severely reduced by the rinderpest outbreak of 1983-4 and are still at risk from the disease), and good populations of the bongo occur in the southeast, centre (between Bria and Bamingui) and southwest Major populations of duiker (six forest species), Sitatunga and bongo occur in the southwest, at Bangassou and elsewhere.

4. Rodents. At least five rodent species of conservation concern have been recorded from the Central African Republic: in the forests of the southwest, the flightless scaly-tailed squirrel *Zenkerella insignis*, Dollman's tree mouse *Prionomys batesi* and a species of African climbing wood mouse *Hylomyscus fumosus* all occur (these species also range into some neighbouring countries); and two species of mouse are endemic, *Mus goundae* from the north and *Mus oubanguii* from the south.

Major vegetation zones (approximate) and geographical features of the Central African Republic, and some of the localities mentioned in the text. 1: Dar Challa Massif. 2: Adamoua Massif. 3: Oubangui River. 4: Bangui. 5: Berberati. 6: Nola. 7: Sangha River. 8: Mboki. 9: Kaga Bandoro. 10: Ouanda Djalle. 11: Birao. 12: Bongo Massif and associated uplands. 13: Bouar.

5. Fruit Bats. Ten species occur, and there is one endemic subspecies, *Epomophorus gambianus poussarguesi*, known only from from two localities in the Central African Republic.

6. Other Mammals. Severe illegal hunting has greatly reduced elephant populations, has wiped out the northern white rhinoceros, and has brought the black rhinoceros (the subspecies *Diceros bicornis longipes)* to the verge of extinction. There are major giraffe (1,500) and buffalo (8,000) populations in the Manovo-Gounda-St. Floris complex, and a further major buffalo population in Bamingui-Bangoran (6,800). Elephants still survive with considerable conservation potential in the northern savannas and southern forests, and appropriate management schemes need to be introduced so that populations can recover and the species can be managed for the benefit of the country, and local human communities. Projects are particularly needed in the southeast, including in Zemongo Faunal Reserve. The rare Pousargue's mongoose occurs in the southeast of the country, possibly in Zemongo Faunal Reserve.

7. Birds. The shoebill is probably very rare in the northern wetlands, but its status and conservation requirements are not fully known at present

8. Reptiles. The Nile crocodile is still fairly common in some rivers but the dwarf and slender-snouted species are believed to be uncommon.

9. Invertebrates. The rare giant swallowtail butterfly has been recorded in the forests in the south of the country.

Threats

1. Lowland rainforest is insufficiently represented in the country's protected area system, and a long-term threat therefore rests over the survival of this biome in the Central African Republic. There have also been few attempts to manage the use of forest products outside protected areas in a sustainable way.

2. Illegal hunting of large mammals (for food, skins and live trade) and of crocodiles is essentially out of control, and has resulted in some very serious population declines, with at least one local extinction.

3. Rinderpest has severely depleted the populations of some susceptible species and the risk continues, with the disease being brought in by cattle from Chad and Sudan.

4. Large areas of forest are under threat from unregulated settlement and exploitation following the construction of the "Route du quatrieme parallel" connecting Bangui with southern Cameroon. Further areas of forest are likely to be submerged as a result of the dam being constructed on the Oubangui River at Mobaye.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the General Directorate of Water, Forests, Hunting and Fisheries in the Ministry of Water, Forests, Hunting, Fisheries and Tourism. Under this Directorate comes the National Office of Forests which is responsible for the implementation of the Forest Code, and the National Centre for Wildlife Protection and Management which is responsible for wildlife and protected areas.

2. Multi-agency projects

(a) Promotion of forest conservation (Government/ IUCN/EEC): development of an action plan for forest conservation by: planning a protected areas system to include rainforest habitats; development of sustainable use programmes in the forest zone; assessing conservation needs of forest wildlife; and dissemination of results of research.

(b) Surveys of elephants in the forest zone to establish baseline population data (WCI/WWF/EEC).

3. EEC Projects

(a) Development programme for wildlife and protected areas in the northern region.

(b) Elephant radio-tracking project.

4. IBRD Projects

(a) Study of ecological impact of the Route du quatrieme parallel, connecting Bangui with southern Cameroon.

5. MBG Projects

(a) Botanical survey and conservation of southwestern rainforests.

6. UNDP Projects

(a) Assistance to regulate the utilisation of the fauna.

7. WCI Projects

(a) Long-term research and monitoring of gorilla populations.

8. WWF Projects

(a) Development and management of Dzanga-Sangha Forest Sanctuary: a range of approaches to protect remaining lowland forest and its species.

Suggested Conservation Activities

1. Lowland rainforest needs to be upheld as a protection priority, especially in the southwest of the country. Planning for sustainable use of forest products is an urgent need. Suitable reserve sites exist at Dzanga-Sangha, where reserve proposals need implementing (which will aid protection of primates, especially the gorilla) and at Mbaere-Bodingue-Ngoto, near the Basse-Lobaye Reserve. The Dzanga-Sangha Reserve should be considered for linking with Congo and Cameroon to form an international reserve for this important area of pristine forest. Suitable protection for southern lowland forest needs to be developed in the Massif de Bangassou (where a duiker survey is needed) and, further north, at Kotto, Kaga-Bandoro and Nana.

2. Savanna reserves in the north need continued rehabilitation and long-term effective management in order to protect important large mammal populations, especially elephant, black rhino and giant eland. The two key areas are the Bamingui-Bangoran complex (which needs to be formally established as a Man-and-the-Biosphere Reserve) and the Manova-Gounda-St. Floris complex.

3. Development projects should be preceded by environmental impact assessments so that the potentially disastrous effects of construction projects can be foreseen and avoided: the "Route du quatrieme parallel" was assessed after construction began and there are numerous problems beginning to accrue which could probably have been avoided if prior assessment had occurred. The impact of the Oubangi dam near Mobaye needs to be urgently assessed and remedial action taken where possible.

4. International co-operation is needed in the southwest of the country (with Cameroon and Congo) to plan development in such a way that logging and diamond collection in particular do not proceed in an unregulated way and cause serious environmental degradation. Private companies, government planners and conservation organisations should work together on the problems in this area. Cooperation should include the continued development of the Dzanga-Sangha Reserve, in concert with contiguous proposed reserves at Lake Lobeke in southeastern Cameroon and Nouabale Forest in northern Congo.

5. Strict anti-poaching measures need to be developed and maintained in the National Parks and other protected areas, particularly in relation to elephant, rhino, giraffe and giant eland.

6. Methods of managing bushmeat use in a sustainable way should be explored, given the extremely high proportion (50%) of the population's protein that comes from this source.

7. A strictly guarded sanctuary for the black rhino is urgently needed in the northern savanna area. The siting of this should be consistent with the current territory of the remaining animals and reintroductions used if necessary to strengthen the population, provided protection is sufficient to warrant this.

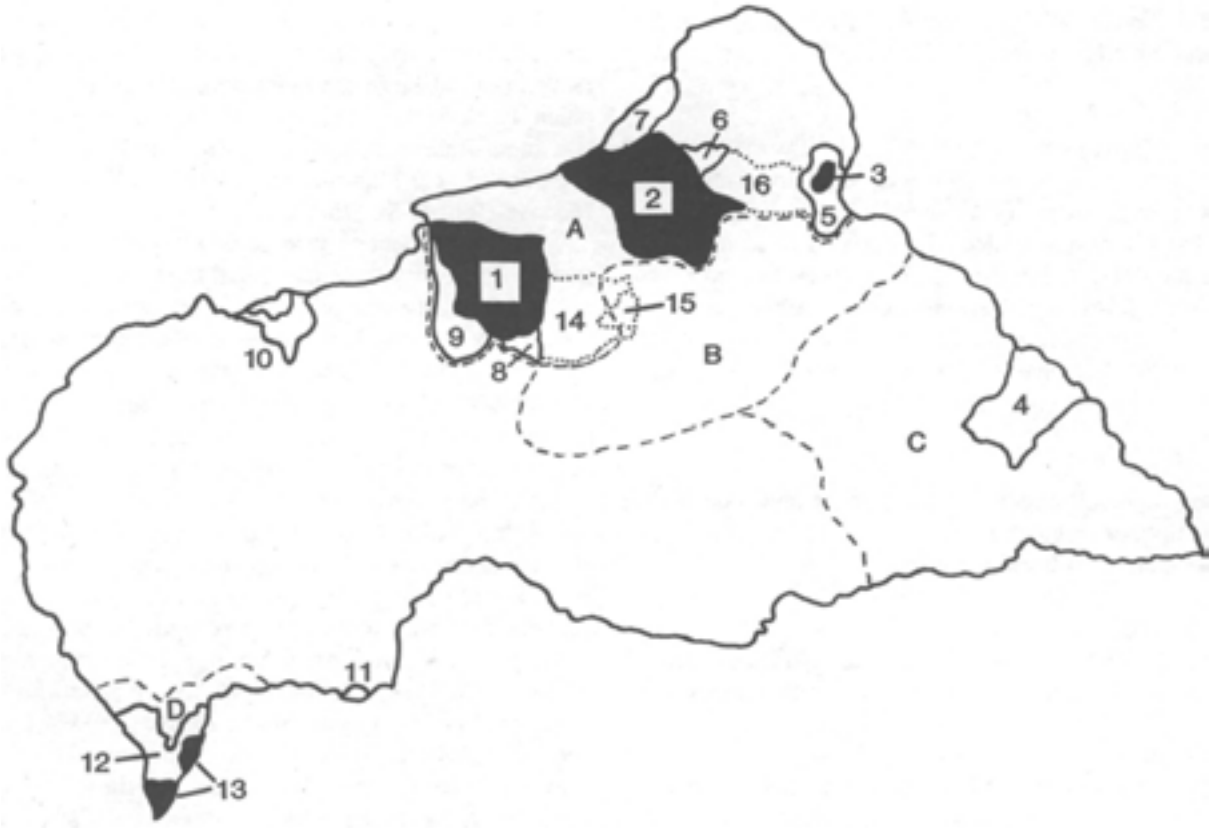
8. The antelope populations in the southeast and southwest need effective conservation and sustainable-use measures.

9. Floodplain conservation needs in the north should be assessed and appropriate conservation measures implement-

ing, including anti-poaching measures in the wet season and assessment of the status and requirements of the shocbill.

10. A full survey of all three species of crocodile is needed, with subsequent appropriate conservation action, preferably based on sustainable management by local communities. Taxation regulations that make such development difficult should be modified if at all possible.

11. Improved planning and management throughout the protected areas system is needed, as is the development of visitor facilities as an aid to protection and as a means of income generation to support conservation activity.



Conservation areas and major wildlife regions of the Central African Republic. *Conservation areas* — 1: Bamingui-Bangoran National Park (11 560 sq km, including the 860 sq km Vassako-Bolo Strict Nature Reserve). 2: Manovo-Gounda-St. Floris National Park (17 400 sq km). 3: Andre Felix National Park (1700 sq km). 4: Zemongo Faunal Reserve (10 100 sq km). 5: Yata Ngaya Faunal Reserve (4200 sq km). 6: Ouandjia-Vakaga Faunal Reserve (4800 sq km). 7: Aouk-Aoukale Faunal Reserve (3300 sq km). 8: Koukourou-Bamingui Faunal Reserve (1100 sq km). 9: Gribingui-Bamingui Faunal Reserve (4500 sq km). 10: Nana-Barya Faunal Reserve (2300 sq km). 11: Basse-Lobaye Reserve (146 sq km). 12: Dzanga-Sangha Dense Forest Reserve (proposed) (3359 sq km). 13: Dzanga-Ndoki National Park (proposed) (1220 sq km). *Major wildlife regions* — A: Northern region. B: South-central region. C: Southeastern region. D: Southwestern region. *Important wildlife areas included in 1985 aerial surveys* — 14: Hunting concessions adjacent to Bamingui-Bangoran National Park. 15: Sangba River area ("Secteur Rhinoceros") (2700 sq km). 16: Safeca hunting concession.

Chapter 14: Chad

Introduction

Area: 1,284,700 km^2. Cultivated: 2%. Pasture: 35%. Forest/woodland: 10%

Population (1989 data): 4,949,000. Urban: 27%. Labour force in agriculture (1980): 83%. Density: 4/km^2. Annual growth rate: 2.0%, increasing. Doubling time: 35 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 150. GNP annual growth rate: no data.

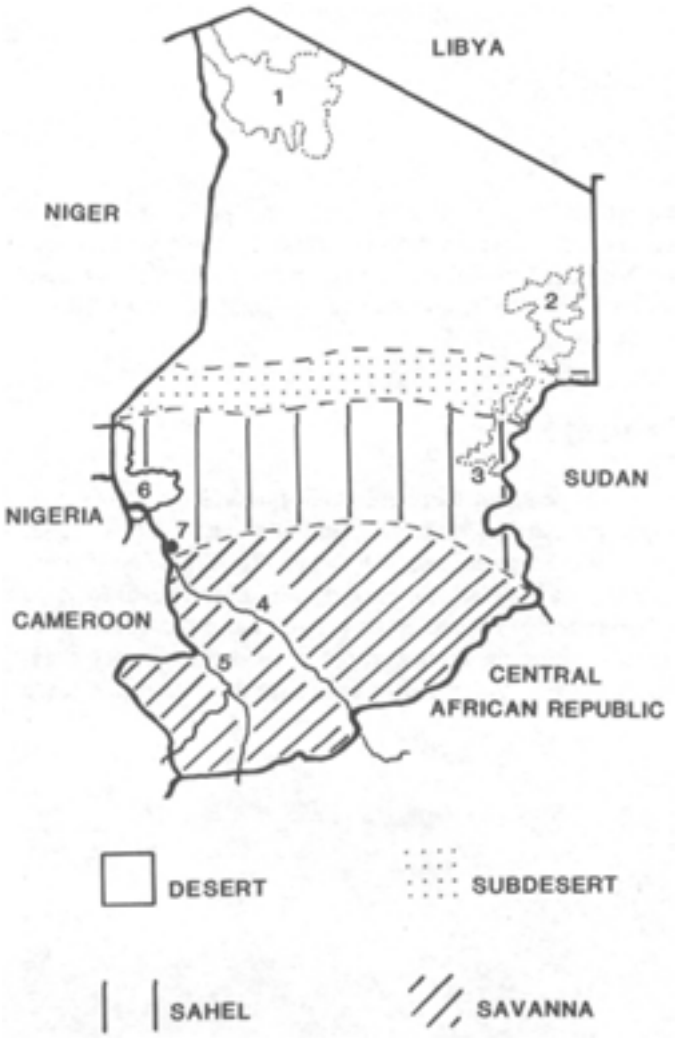
Biogeographic affinities: Saharan in the north and Sudanian in the south, with a large Sahel Regional Transition Zone in the centre.

Vegetation: Desert with little or no vegetation in the northern half of the country; dry wooded grassland in the Sahel; Sudanian woodland in the south, with extensive floodplains (also around Lake Chad); and montane vegetation in the Tibesti Mountains.

Critical Sites

1. In the south there are some important reserves with major populations of large mammals: Zakouma National Park, Bahr Salamat Faunal Reserve, Siniaka-Mima Faunal Reserve, Manda National Park, Binder Lere Faunal Reserve and Aboutelfan Faunal Reserve. All these protected areas suffered during the civil war, but now, as the security situation improves, the opportunity exists to rehabilitate these

Korrigum *Damalicsuc korrigum korrigum,* Zakouma National Park, Chad (Photo:WWF/F. Vollmar).



Major natural vegetation zones of Chad. 1: Tibesti Massif. 2: Ennedi Massif. 3: Ouaddai Massif. 4: Chart River. 5: Logone River. 6: Lake Chad. 7: N'Djamena.

reserves. This might involve collaboration with some neighbouring states in anti-poaching activities. The Bahr Salamat Faunal Reserve constitutes an important wetland site, and should present good opportunities for integrated rural development projects, linked with conservation activities. Pastoralists and cultivators present a problem in the Manda National Park. In the far south in the Aouk area, near the border with the Central African Republic, the seasonal elephant migration routes are threatened by poaching. The Aboutelfan Faunal Reserve also needs to be rehabilitated: illegal hunting presents a problem here also.

2. The Ouadi Rimé-Ouadi Achim Faunal Reserve is the most important protected area in the sahelian subdesert zone of Africa, and despite severe disruption during the civil war, it probably still contains the best surviving remnant of large mammals in this region of the continent. Up to date information on the status of its habitat and species is lacking.

3. Lake Chad and its surroundings form an important wetland area in the Sahelian zone. It is important for birds (including migratory species of palearctic waterfowl) and various species of antelope.

4. Another major wetland site is at Lake Fitri, which has been declared a Biosphere Reserve and Chad's first Ramsar Site.

5. The Fada Archei Faunal Reserve contains some interesting species. Like many of the other protected areas in Chad, it suffered from excessive hunting of wildlife during the civil war, and now requires rehabilitation, perhaps as part of the programme for Ouadi Rimé-Ouadi Achim Faunal Reserve.

6. Three new reserves have been proposed by local residents to protect rare species. These are a national park at Goz-Beida, and faunal reserves at Beinamar and Larmanaye.

Critical Species

1. Plants. 1,600 species occur, but the level of endemism is not known.

2. Antelopes. 20 species occur. Of particular importance is the last viable surviving population of scimitar-horned oryx in the world in the Ouadi Rimé-Ouadi Achim Faunal Reserve. Two other rare species of antelope occur in this reserve, the addax and the dama gazelle, plus major populations of dorcas and red-fronted gazelles, thus underlining the urgent priority to rehabilitate this reserve. The greater kudu reaches its northwestern distributional limit in Chad, and it occurs in a number of the reserves, including Aboutelfan which was established especially for it. It is particularly susceptible to rinderpest, which remains endemic and is spread by cattle movements. Sizeable populations of korrigum survive in parts of the south, especially in the Bahr Salamat Faunal Reserve, and annual migrations still take place. It is not known whether the slender-horned gazelle still survives in Chad; it has been recorded in the extreme north and a survey is needed to confirm its presence.

3. Other Mammals. Severe illegal hunting has drastically reduced elephant and black rhinoceros populations. Some 3,000 elephants are thought to survive, and their migratory routes around Aouk need to be protected. Increased vigilance is also needed to reduce the amount of illegal hunting. The black rhinoceros only survives in tiny numbers, and a strictly protected sanctuary is probably needed if this species is to survive in Chad. There is an important giraffe population in Bahr Salamat/Zakouma. A population of barbary sheep is protected in the Fada Archei Faunal Reserve.

4. Birds. The little known river prinia has been recorded from near Ndjamena, and near Lake Chad. It presumably depends on wetland conservation in order to survive. Surveys should be carried out in the southern wetlands, especially in Bahr Salamat, to determine whether the shoebill occurs there. The ostrich, which is greatly reduced in the sahelian countries, survives in Ouadi Rimé-0uadi Achim Faunal Reserve.

5. Reptiles. Both the slender-snouted and the Nile crocodiles occur, though they are severely reduced in numbers. Concentrations of the Nile crocodile exist in the Bahr Salamat Faunal Reserve. The scarce African spurred tortoise has been recorded from Chad. A survey is needed to assess its current status, and whether a reintroduction programme is advisable.

Threats

1. Chad's critical sites have become seriously compromised as a result of the disturbances to the protected area network during the civil war. Most of the reserves are insufficiently managed, and illegal hunting is a serious problem. In some reserves there are now human settlements.

2. Many of the habitats within the country are becoming seriously degraded as a result of over-grazing by livestock.

3. Several wetland areas in the country are at risk from pressure to pursue intensive irrigated agriculture, and increasing use of pasture and fishery resources.

4. Disease presents a threat to some wildlife: rinderpest is endemic and threatens all susceptible ungulates, and there is a possible threat of screw worm infection spreading southwards from Libya.

Current Conservation Measures

1. Government Administration of Conservation

(a) The authority responsible for conservation policy and the exploitation and protection of natural resources is the Ministry of Tourism and the Environment The ministry has Divisions of Water and Forests, National Parks, and Wildlife Conservation and Management. The ministry is also responsible for measures against desertification.

2. Multi-agency Projects

(a) Development of National Conservation Strategy (Government/IUCN/NORAD): provision of technical and financial assistance to the government for the strategy.

(b) Pilot project for the management of forests (Government/ Netherlands Government/FAO): development of village-level forestry and management of forest reserves to ensure a sustainable supply of firewood.

(c) Development of integrated wetlands management project at Lac Fitri (IUCN/ISF).

(d) Development of forestry activities in Chad (Government/FAO/UNDP/UNSO): aims to promote ecologically wise forestry practices as part of the government anti-desertification drive.

(e) Natural Resources Conservation Project (Government/ EEC): development of institutions and infrastructure for nature conservation.

(0 Zakouma National Park (Government/EEC): feasibility study for a rehabilitation programme.

3. EEC Projects

(a) Elephant radio-tracking project.

Protected areas and prefectures of Chad. ***Protected areas*** **— 1: Zakouma National Park (3000** ***sq km). 2:*** **Manda** ***National Park (1140 sq km). 3: Ouadi Rime-Ouadi Achim Faunal Reserve (80 000 sq km). 4:*** **Fada Archei Faunal Reserve (2110 sq km). 5: Mandelia Faunal Reserve (1380 sq km). 6: Aboutelfan Faunal Reserve (1100 sq km). 7: Bahr Salamat Faunal Reserve (20 600 sq km). 8: Siniaka-Minia Faunal Reserve (4260 sq km). 9: Binder Lere Faunal Reserve (1350 sq km).** ***Prefectures*** **— A: Tibesti. B: Borkou. C: Ennedi.. D: Kanem. E: Batha. F: Biltine. G: Lac. H: Chari Baguirmi. I: Guera. J: Ouaddai. K: Salamat L: Mayo Kebbi. M: Logone Occidental. N: Tandjile. O: Logone Oriental. P: Moyen Chari.**

Suggested Conservation Activities

1. Rehabilitation of protected areas in the south is urgently needed, in particular the following.

(i) Zakouma National Park, important for large mammals.

(ii) Bahr Salamat Faunal Reserve, which is a key area for wetland conservation. A shoebill survey is required here.

(iii) Siniaka-Mima Faunal Reserve, important for large mammals.

(iv) Manda National Park, important for large mammals. Pastoralists and cultivators should be removed from the Park in conjunction with the establishment of appropriate rural development programmes in the buffer zone.

(v) Binder-Lere Faunal Reserve, important for large mammals: measures to control illegal hunting are needed.

(vi) Aboutfelan Faunal Reserve.

(vii) Fada Archai Faunal Reserve.

2. A survey of wetland sites is required, and both rehabilitation of existing reserves and establishment of new ones should be take place. Sites involved are the Bahr-Salamat Faunal Reserve, Lake Chad and Lake Fitri.

3. The Ouadi Rimé-Ouadi Achim Faunal Reserve urgently needs surveying and a new management plan implementing, with particular reference to the conservation needs of antelopes, most notably the scimitar-horned oryx.

4. Proposals for new reserves at Goz-Beida, Beinamar and Larmanaye should be implemented.

5. Elephant migration routes around Aouk need protected area status with associated anti-poaching measures.

6. A strictly-guarded sanctuary is needed for the black rhino population.

7. Surveys of crocodiles are needed, and also of the African spurred tortoise.

8. Development plans to enable the removal of human settlements from protected areas need to be implemented.

Chapter 15: Comoros

Note: this section includes recommendations for the Republic of the Comoros and for the French dependent territory of Mayotte.

Introduction

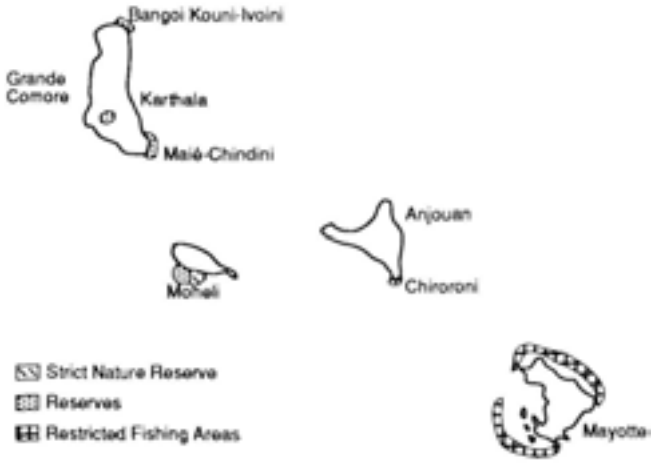
Area: 2,238 km^2 (Grand Comoro 1,024, Anjouan 424, Moheli 211, Mayotte 374). Cultivated: 43%. Pasture: 7%. Forest/woodland: 16%.

Population (1989 data): 444,000. Urban: 23%. Labour force in agriculture (1980): 83%. Density: 198/km^2. Annual growth rate: 3.3%, increasing. Doubling time: 21 years.

Economy (1987 data): World Bank index: no data. GNP/capita: US$ 380. GNP annual growth rate: no data.

Biogeographic affinities: Strong affinities to Madagascar, minor affinities to mainland Africa.

Vegetation: Originally forest on most parts of the islands: montane forest and montane heath survive on Grand Comoro, with mangroves and baobabs in the lowlands; montane forest on Moheli but very little on Anjouan and Mayotte; extensive mangroves on Mayotte; lowland forest largely destroyed throughout the islands. On lava flows and cinder fields there is a sparse, herbaceous vegetation. Some parts of the lowlands have a characteristic Indo-Pacific scrub.



Map of the Comoros.

Critical Sites

1. As much as possible of the original forested vegetation on all four islands needs to be conserved. The forests on Mount Karthala on Grand Comoro are of particular importance for endemic species. Forest conservation measures are particularly urgent on Anjouan and Mayotte, where very little natural vegetation remains.

2. The coastal and marine habitats around all four islands are vulnerable. The Comoros possess some valuable coral reefs (particularly around Anjouan and Mayotte), and a number of interesting marine species, most notably the coelacanth.

Critical Species

1. Plants. 935 species occur, of which 416 are indigenous and 136 are endemic. Lowland forest has been almost completely destroyed on all four islands, making it likely that many plant species are already extinct. Very little intact highland forest survives on Anjouan and Mayotte, thus making it likely that several more plant species are at risk on these islands. There are some unusual stands of palms on Mayotte that are in need of protection.

2. Mammals. Three species of fruit bat occur. The distinctive endemic Comoro fruit bat *Pteropus livingstonii* is critically endangered and has diminished to a population of around 60 on Anjouan. It also occurs on Moheli. Its principal threats are vulnerability to cyclones, habitat destruction and competition from the naturally-occurring *P. seychellensis comorensis*, which occurs on all four islands, as well as Mafia Island in Tanzania. This latter species adapts more easily to degraded forest, but is still considered at risk from deforestation. The status of the endemic fruit bat *Rousettus obliviosus* of Grand Comoro and Anjouan is unknown but it was not seen between the 1940's and the 1980's. The Comoros populations of the mongoose lemur on Anjouan and Moheli, having once been more numerous than those on Madagascar, are now critically endangered. The incidental catch of dugongs (around Moheli), dolphins and porpoises in

coastal and marine fisheries may constitute a conservation problem.

3. Birds. Four threatened species are endemic to Mount Karthala on Grand Comoro. Of these the Grand Comoro scops owl is particularly threatened because of its dependence on large tracts of virtually intact forest. The Mount Karthala white-eye has a tiny range at the top of the mountain, though its population is probably reasonably safe, providing that volcanic activity does not resume. The Grand Comoro flycatcher and Grand Comoro drongo can tolerate some habitat disturbance, but still depend ultimately on the conservation of the forest on the mountain. On Mayotte, the endemic Mayotte drongo is restricted to the few remaining patches of forest, and is at serious risk. The six other bird species endemic to single islands in the Comoros are not at risk at present. There are several endemic subspecies on the various islands, of which the blue vanga on Grand Comoro seems to be very rare (if not extinct) and green pigeon on Moheli is threatened by hunting. Ground nesting birds on Grand Comoro are threatened by introduced mongooses.

4. Reptiles. Two species of marine turtle breed in the islands. About 1,850 green turtles are estimated to breed annually on Moheli, 500 on Mayotte (including offshore islets), and small numbers on Grand Comoro and Anjouan. Hawksbill turtles breed in small numbers, about 50 annually on Moheli and 25 on Mayotte. It should be noted that population estimates for marine turtles in the Comoros are only rough approximations dating from 1972 and 1972. The Comoros are exporting considerable quantities of bekko (from hawksbills) to Japan, and this probably constitutes a serious conservation problem. Some exploitation of nesting turtles takes place, and this might be having a negative impact on numbers. Loggerhead turtles occur in waters around the Comoros, but there is no evidence that they breed on these islands. Twenty-five species of snakes and lizards are native to the islands, of which at least 11 (five geckoes, two chameleons, a skink and three snakes) are endemic. Some have very small ranges and all are poorly known. Two species of gecko have been described from the Comoros since 1980. *Phelsuma* day geckoes have been widely collected for the pet trade but the effect on natural populations is unknown.

5. Fishes. Sixteen species of freshwater fish occur, but little is known of their conservation requirements. There is a rich and important coral reef fish fauna. The coelacanth occurs only in Comoran coastal waters, and its conservation is a very high international priority given that the impact of the current trade in the species to museums in the West is probably very serious.

6. Invertebrates. Two threatened species of swallowtail butterfly occur: *Graphium levassori* (endemic to Grand Comoro, dependent upon forest conservation on Mount Karthala for its survival) and *Papilio aristophontes* (which depends on forest conservation on Grand Comoro, Anjouan and Moheli).

Threats

1. Forest conservation measures are inadequate, and there is a high risk of large-scale extinctions without the appropriate protective measures. Forest conservation is also essential for watershed management and for ensuring a reliable water supply in the islands, as well as controlling soil erosion.

2. Similarly, there are almost no protective measures in place for marine species and ecosystems, and exploitation is consequently proceeding in an unregulated manner, especially of marine turtles. Siltation from increased erosion is becoming a serious problem, as is direct excavation of reefs for building materials.

3. It is also likely that the live export trade in geckoes is threatening the species concerned.

Current Conservation Measures

1. Government Administration of Conservation

(a) The "Direction Environnement" in the Ministry of Planning is responsible for the conservation of wildlife, and the environment more generally.

(b) The Ministry of Production is responsible for both fisheries and agriculture, and also oversees the government rural development agency CEFADER, which has a Forest Service responsible for forest protection, management and utilisation.

(c) There is also a separate Ministry of Tourism.

2. Multi-agency Projects

(a) Conservation programme for the coelacanth (Centre National de Documentation et de Recherche Scientifique/Coelacanth Conservation Council/J.L.B. Smith Institute of Ichthyology/Max Plank Institut fur Verhaltensphysiologie).

3. JWPT Projects

(a) Recovery and captive breeding programme for the Comoro fruit bat.

4. FFPS Projects

(a) Assessment of status of Comoro fruit bat, mongoose lemur, and Grand Comoro scops owl.

Suggested Conservation Activities

1. Forest reserves need establishing on all four islands, with a National Park on Mount Karthala (Grand Comoro) affording full protection to all species. Action is needed particularly urgently on Anjouan and Mayotte.

2. The recommendations of the 1985 survey of coastal and marine fisheries should be implemented, with particular reference to dolphins and porpoises. Appropriate marine ecosystem protection should also be introduced.

3. Conservation action, including a captive breeding programme, are urgently needed for the Comoro fruit bat.

4. The coelacanth trade should be suspended immediately until the impact of such utilisation has been fully assessed; thereafter, exports should be set through a careful monitoring programme and licensing system.

5. Assessment of the conservation needs of marine turtles is needed and an appropriate conservation programme, with an emphasis on breeding sites, should be implemented. The export of bekko to Japan should be halted.

6. Marine National Parks, particularly for the protection of coral reefs and mangroves, should be established around Moheli and Mayotte.

7.The impact of trade in lizards, especially *Phelsuma* day geckoes, should be assessed, and the necessary conservation measures implemented.

Chapter 16: Congo

Introduction

Area: 342,000 km^2. Cultivated: 2%. Pasture: 29%. Forest/woodland: 62%.

Population (1989 data): 2,228,000. Urban: 48%. Labour force in agriculture (1980): 62%. Density: 7/km^2. Annual growth rate: 3.4%, increasing. Doubling time: 21 years.

Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: US$ 880. GNP annual growth rate: 7.1%.

Biogeographic affinities: Guinea-Congolian.

Vegetation: Mainly lowland rainforest, with swamp forest along the border with Zaïre, and areas of secondary grassland and cultivation, mainly in the south.

Critical Sites

1. Congo is still poorly known biologically, but it is clear that the existing protected area system is totally inadequate if the nation's biological diversity is to be safeguarded. In order to ensure that the full range of the country's ecosystems is protected, the following new reserves are necessary: Mont Nabemba-Garabinzam, Nouabal6 (which links with Central African Republic and Cameroon), Likouala-aux-herbes-Lack Télé, Bowé de Kouyi, Ogoué-Zanaga, Ibenga-Motaba, Forêt de Bangou, Aubeville-Boko Songo, Londela-Kayes, Kelle-Oboko II, and two sites near Brazzaville, Patte d'Oie and Tsiémé. The first five of these are of particular importance. The addition of these reserves would greatly increase the various forms of humid, semi-humid and dry forests in the protected areas system, and would therefore be much more effective in conserving the great majority of the species in the country.

Firewood gathering near Impfondo, Congo (Photo: WWF/J. Powell).

2. The existing reserves are seriously short of resources for equipment and personnel. The following are of highest priority: Odzala National Park (with Lekoli-Pandaka Faunal Reserve and Mboko Reserve); Lefini Faunal Reserve; Conkouati Faunal Reserve; Mont Fouari Faunal Reserve (with Nyanga North Faunal Reserve, Nyanga South Hunting Reserve, and Mount Mavoumbou Hunting Reserve); Tsoulou Faunal Reserve; and Dimonika Biosphere Reserve. The Conkouati Faunal Reserve should be extended to include the coastal and marine zone. Of the sites listed here, Odzala, Conkouati and Dimonika are of particular importance.

Critical Species

1. Plants. About 4,000 species are recorded, but the flora has been very poorly studied, and the level of endemism is not known (though it could possibly be as high as 20%).

2. Primates. 22 species occur, most notably the endemic Bouvier's red colobus *Procolobus pennanti bouvieri,* only known from the Lefini Faunal Reserve. Other interesting species include the red-capped mangabey, mandrill, Allen's swamp monkey, black colobus, gorilla and chimpanzee. In order to conserve Congo's primate fauna adequately, the protected area system needs to be expanded, as indicated under Critical Sites (1) above.

3. Rodents. Four species of conservation concern occur, including a mouse *Dendroprionomys rousseloti* (which is known only from around Brazzaville), and a pygmy species of African climbing wood mouse *Hylomyscus parvus* (which presumably occurs in the forests, and is also known from Gabon and Cameroon).

4. Fruit Bats. 13 species occur, of which three are of conservation concern: *Epomophorus grandis* (known

Major natural vegetation zones of the Congo Republic. 1: Congo River. 2: Oubangui River. 3: Brazzaville. 4: Atlantic Ocean. 5: Sangha River. 6: Enyele. 7: Ewo. 8: Etoumbi. 9: Loubomo (Dolisie). 10: Mouyondzi. 11: Likouala River.

only from one site in Congo and one in Angola); *Epomophorus labiatus* (known only from one specimen from Congo); and *Scotonycteris ophiodon* (known only from forest sites in Congo, Cameroon, Ghana and Liberia).

5. Other Mammals. 13 or 14 species of antelopes occur, and there are good populations of the forest species in the north. The status of duikers and other forest antelopes is not well known. The elephant population, at about 60,000, is one of the largest in Africa, but poaching presents a serious threat. A national elephant conservation and management programme is a high priority. The extent to which incidental catches of dolphins and porpoises in marine and coastal fisheries presents a conservation problem is not known.

6. Birds. Only one threatened species is known to occur, the black-chinned weaver, from the Bateke Plateau (presumably within the Lefini Faunal Reserve); the species also occur in the Angolan highlands. Three other threatened species might occur in Congo, the grey-necked picathartes (in the forests of the north), the Dja River warbler (in the savannas), and the Loango slender-billed weaver (along the coastal strip).

7. Reptiles. All three species of crocodile occur, and although populations are depleted, good numbers of all of them probably remain in the forested north. Three species of marine turtle, the loggerhead, olive ridlcy and green, occur in Congolese waters, but neither the extent of nesting, nor their conservation requirements, are known.

8. Amphibians. The status and conservation needs of the hairy frog *Trichobatrachus robustus are* not known.

9. Invertebrates. The dragonfly *Aethiothemis watuliki* is known only from Mambili Forest. The rare African giant swallowtail butterfly occurs in the forests.

Threats

1. Although the pressures on Congo's natural resources are currently less severe than those in many other countries, the protected area system is so inadequate that the nation is ill-prepared to enforce conservation measures once exploitative forces become stronger. Almost every habitat is underrepresented in the existing network of reserves.

2. The management of the existing reserves is not receiving priority attention by the government; in particular, illegal hunting is likely to continue to be a serious problem for the next few years and will need addressing actively.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Water and Forests, which has a Wildlife Management Service responsible for wildlife and protected areas. Other branches of the ministry are responsible for forestry, fisheries, and aquaculture. Environmental management generally takes place though regional offices, with the central office in Brazzaville being responsible for policy and policy development.

2. Multi-agency Projects

(a) Promotion of forest conservation (Government/ IUCN/EEC): development of an action plan for forest conservation by: planning a protected areas system to include rainforest habitats; development of sustainable use programmes in the forest zone; assessing conservation needs of forest wildlife; and dissemination of results of research.

(b) Surveys of elephants in the forest zone to establish baseline population data (WCI/WWF/EEC).

(c) Development of a management plan, and execution of socio-economic studies and a biological survey in Odzala National Park (IUCN/EEC).

(d) Survey of Conkouati Faunal Reserve (IUCN/BP): survey of fauna and flora, socio-economic study, and environmental impact assessment of preliminary oil exploration activities.

(e) Research and development planning in the Mayombe region (Government/UNESCO/UNDP): aims to achieve sustainable development in the context of the Dimonika Biosphere Reserve.

(0 Pilot study on the management of the forest ecosystem in Dimonika Biosphere Reserve (Government/ UNESCO/UNDP).

(g) Development of rural fisheries in Congo (Government/FAO/UNDP).

3. WCI Projects

(a) Reconnaissance of proposed Nouabale reserve in north.

Suggested Conservation Activities

1. Twelve new reserves should be gazetted as soon as possible, as specified under *Critical Sites* 1 above. Of particular importance is the establishment of a reserve in the Nouabalé forest in the north, to be contiguous with the Dzanga-Sangha reserve in Central African Republic and the proposed Lake Lobeke Reserve in Cameroon.

2. Increased investment in personnel and equipment is needed in existing reserves, especially with a view to eradicating illegal hunting. Priority should be given as indicated in *Critical Sites 2* above.

3. The Conkouati Faunal Reserve should be extended to include the coastal and marine zones.

4. More detailed studies of flora are needed to identify centres of endemism, and sites for threatened species.

5. Forest antelope surveys should be carried out.

6. A national elephant conservation programme is needed with strong anti-poaching measures as a central feature.

7. Surveys of all three crocodile species are needed and appropriate conservation measures should be subsequently applied.

8. A survey of the status and conservation needs of the hairy frog should be carried out.

9. A survey of marine and coastal fisheries should be carried out to assess conservation needs of dolphins and porpoises, with subsequent conservation measures if required.

Administrative regions and protected areas of the People's Republic of the Congo, and areas surveyed in 1989 and 1990. *Administrative regions* — A: Sangha. B: Likouala. C: Cuvette. D: Plateaux. E: Niari. F: Lekoumou. G: Pool. H: Kouilou. J: Bouenza. *Protected areas* — 1: Odzala National Park (1266 sq km, including 1100 sq km Biosphere Reserve). 2: Lekoli-Pandaka Faunal Reserve (682 sq km). 3: M'boko Hunting Reserve (900 sq km). 4: Mount Fouari Faunal Reserve (156 sq km). 5: Mount Mavoumbou Hunting Reserve (420 sq km). 6: Nyanga North Hunting Reserve (77 sq km). 7: Nyanga South Faunal Reserve (230 sq km). 8: Tsoulou Faunal Reserve (300 sq km). 9: Loudima Reserve (60 sq km). 10: Lefini Faunal Reserve (6500 sq km). 11: Conkouati Faunal Reserve (3000 sq km). 16: Dimonika Biosphere Reserve. *Survey areas* — 12: Site 1 (Mboukou-Djeke). 13: Site 2 (Upper Motaba-Ibenga). 14: Site 3 (Mbomo-Sembe). 15: Nouabale site (4580 sq km) (potential protected area).

Chapter 17: Djibouti

Introduction

Area: 23,000 km^2. Cultivated: 0%. Pasture: 9%. Forest/woodland: 0%.

Population (1989 data): 394,000. Urban: 74%. Labour force in agriculture: no data. Density: 17 km^2. Annual growth rate: 3.0%, decreasing. Doubling time: 23 years.

Economy: World Bank index: no data. GNP/capita: no data. GNP annual growth rate: no data.

Biogeographic affinities: Somali-Masai.

Vegetation: Semi-desert grassland, shrubland and succulent scrub, with coastal desert and mangroves; dry evergreen forest in the mountains.

Critical Sites

1. The small area of remaining forest in Day National Park and the Mabla Mountains is of importance for birds and plants. There is also an important area of unprotected relict juniper forest in the Goda Mountains adjacent to the Day National Park. In both the Goda and Mabla Mountains, the forest is being damaged severely through fires, cattle grazing, tree felling and military exercises.

2. The conservation needs of the coastal mangroves and the Sept Frères Islands are largely unknown.

3. There are a number of important reefs in the Golfe de Tadjoura, and their resources are being researched by local scientists.

Critical Species

1. Plants. Only 534 species of plant are recorded. However, there are likely to be good numbers of endemic species in the Goda and Mabla Mountains. Two species of interest are the Nubian dragon tree *Dracaena ombet* which also occurs in Sudan, Ethiopia and Somalia, and the Bankouale palm *Wissmania carinensis*, which occurs in Somalia and Yemen. The palm, at least, occurs in the Day National Park.

2. Mammals. Several species of antelope occur, including Soemmerring's gazelle, and good numbers of Pelzeln's gazelle. Antelope populations are recovering slowly, following the hunting ban imposed since the early 1970s. However, their recovery is greatly hampered by the abundance of sheep and goats in the country, with the resulting competition for grazing land. Such overgrazing by livestock threatens serious environmental degradation to the whole country. The Warthog occurs only in Day National Park and is vulnerable and declining due to hunting pressure. Dugongs survive in Djibouti's coastal waters, but their conservation requirements are uncertain. It is conceivable that the rare Abyssinian genet occurs, and biological surveys should take account of this possibility.

3. Birds. The endemic Djibouti francolin is known only from Day National Park and the Mabla Mountains. Although it is tolerant of considerable forest disturbance, the current rate and degree of destruction poses a serious threat which improved management of the forests will only partly allay: a captive breeding programme is also necessary. The importance and conservation needs of the seabird colonies on the Sept Frères Islands are not known at present.

Djibouti, showing 1/4° squares visited during the surveys by G. and H. Welch. 1: Foret du Day. 2: Mabla Massif. 3: Grand Bara. 4: Gulf of Tadjoura. 5: Lake Abbe. *6:* Lake Assal. 7: Lake Allol. 8: Djibouti.

4. Marine Turtles. Green and hawksbill turtles occur in the coastal waters, and it is known that at least some turtle nesting takes place.

Threats

1. Djibouti's biological resources are under severe threat because of excessive overgrazing by sheep and goats throughout the country, and also fire and hunting in certain areas. This is leading to the severe degradation of the country's ecosystems.

2. The country's protected area system does not include an adequate representation on the various habitats (including marine areas), and so the risk of biodiversity loss is very high.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Ministry of Agriculture and Rural Development takes the lead on environmental matters through its Service on Agriculture, Livestock, Water and Forests. Wildlife and terrestrial protected areas come under this ministry.

(b) The Ministry of Commerce, Transport and Tourism is responsible for the management of coastal and marine conservation, including marine protected areas.

Suggested Conservation Activities

1. Day National Park should be enlarged to cover as much of the relict juniper forest in the Goda Mountains as possible. Its management should be improved (if necessary with external assistance) with a particular emphasis on arresting overgrazing and tree-felling, by removing all livestock and commencing re-forestation schemes around the Park.

2. Measures to control overgrazing in the country as a whole need to be developed and implemented.

3. Surveys of coastal mangroves, coral reefs and Sept Frères Islands should be undertaken to determine conservation needs and stimulate appropriate action, possibly including the establishment of reserves. Seabird colonies on the islands should receive particular emphasis.

4. Management of protected areas on Musha and Maskali Islands, established for coral reef protection, needs to be improved.

5. A captive breeding programme for the Djibouti francolin should be implemented.

6. Marine turtle surveys are needed to assess conservation needs, with particular emphasis on nesting grounds.

7. Conservation requirements of dugongs need to be assessed, with appropriate conservation action following.

Chapter 18: Equatorial Guinea

Introduction

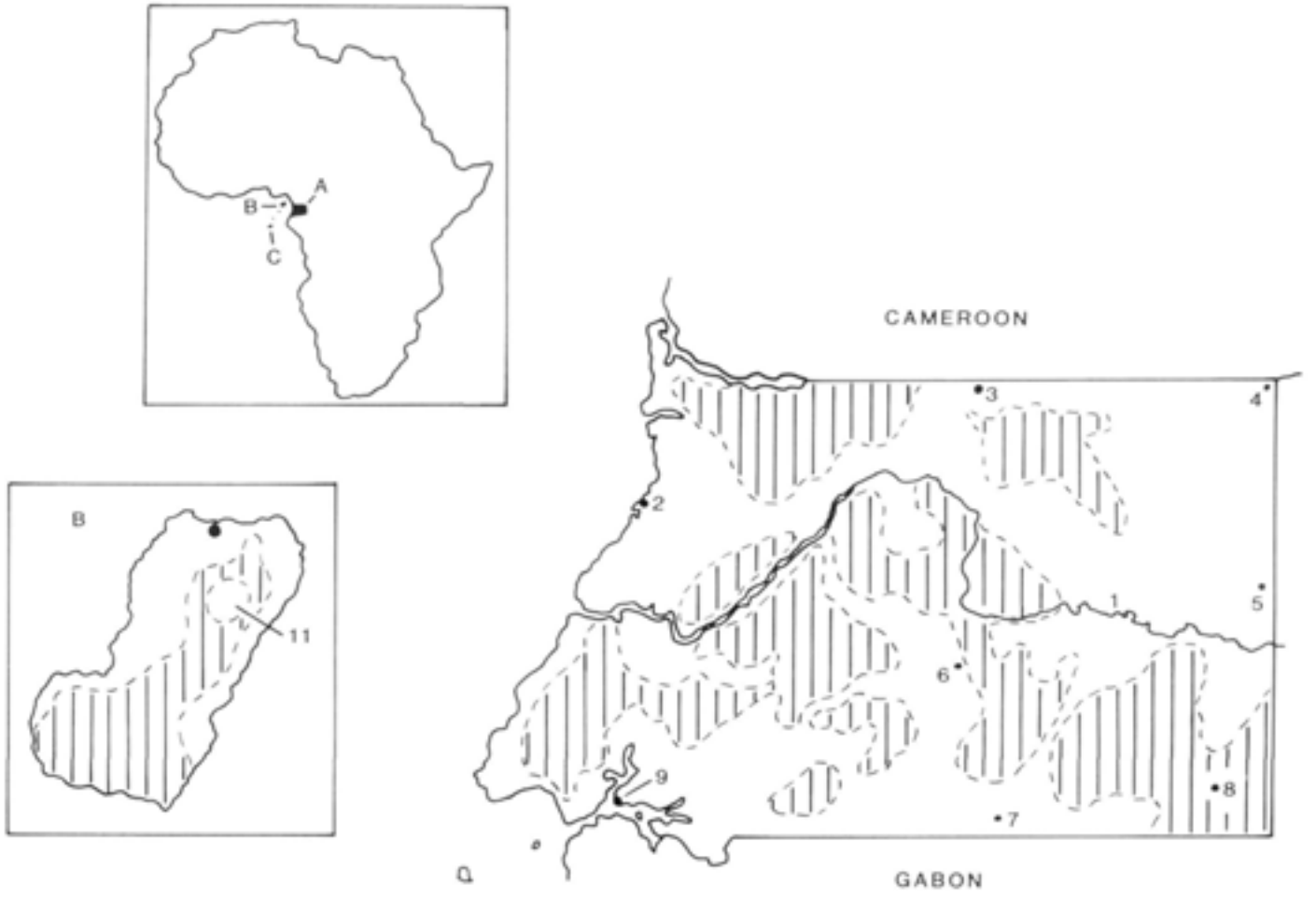
Area: 28,051 km^2. Cultivated: 8%. Pasture: 4%. Forest/woodland: 47%.

Population (1989 data): 353,000. Urban: 60%. Labour force in agriculture (1980): 66%. Density: 13/km^2. Annual growth rate: 1.9%, increasing. Doubling time: 37 years.

Economy (1987 data): World Bank index: no data. GNP/capita: no data. GNP annual growth rate: no data.

Biogeographic affinities: On Mbini (the mainland) and the island of Bioko affinities are Guinea-Congolian (with Afromontane elements at high altitudes on Bioko); affinities on the island of Pagalu are closer to the other islands in the Gulf of Guinea (São Tomé and Príncipe).

Vegetation: On Mbini, lowland rainforest with small areas of mangrove along the coast; on Bioko, mainly lowland rainforest (though this is largely replaced in the north), with montane forest and grasslands in the mountains; on Pagalu, originally dry forest, though this is largely destroyed except at higher altitudes.



Equatorial Guinea. Hatching represents the remaining areas of primary forest A mosaic of secondary forest and cultivation covers the rest of the Mbini (Rio Muni). B: Bioko Island. C: Pagalu Island. 1: Uolo River. 2: Bata. 3: Micomeseng. 4: Ebebiyin. 5: Mongomo. 6: Evinayong. 7: Acurenam. 8: Nsoc. 9: Cogo. 10: Malabo. 11: Pico Basile.

Critical Sites

1. Despite its small size, Equatorial Guinea is diverse in species, because the three main territories that make up the country are very distinct from one another. The mainland territory of Mbini is dominated by lowland rainforest, in contrast to the spectacular mountainous island of Bioko just off the African coast, and the small oceanic island of Pagalu. Equatorial Guinea's protected areas network broke down during the 1970s, but the possibility now exists to re-establish it. The opportunity of re-establishing the former Mont Raices National Park and Rio Ekuku Game Reserve exists. The former Mont Alen Partial Reserve, which includes an important area of lowland forest, is an area of high priority.

2. New protected areas are needed in Mbini, as follows: Mount Mitra (including the peaks of Atom, Mabumu-Wom, Bekuo, Mitong and Miton); in the Acurenam-Nsoc area (which includes pristine forest of importance for wildlife); the Rio Ntem-Rio Mbia area (including forest, mangroves and coastal areas); and the Rio Muni estuary (with mangroves and riparian forest).

3. Two important reserves are needed on Bioko. In the north, a reserve should be created on Mount Malabo (Pico Basile), to include montane forest and high altitude heathland. In the south there are some very important forests centred on the Gran Caldera de Luba, and the reserve should include the caldera, the adjacent forests and part of the southern coast of the island.

4. The island of Pagalu including its coastal waters, has considerable potential if established as a conservation area.

Critical Species

1. Plants. The total number of species is not known, and there is particularly little information on the flora of Mbini, though this territory is undoubtedly rich in species. 1,105 species are known from Bioko (with 49 endemics) and 208 species are known from Pagalu (with 17 endemics).

2. Primates. Despite the small size of the country, 21 species occur in Equatorial Guinea. Of particular conservation importance are the red-capped mangabey (Mbini), mandrill (Mbini), drill (endemic subspecies on Bioko), Preuss's guenon (endemic subspecies on Bioko), red-eared guenon (endemic subspecies on Bioko), Pennant's red colobus (endemic subspecies of Bioko), black colobus (Bioko and Mbini), chimpanzee (Mbini) and gorilla (Mbini). The recommended protected areas will be sufficient to conserve these species.

3. Other Mammals. There are probably significant populations of forest antelopes and rare rodents in Mbini. Endemic subspecies of blue and Ogilby's duikers occur on Bioko. The buffalo occurs in Mbini where it is considered threatened. There is a diverse fruit bat fauna of ten species, though none of these is of particular conservation concern at present. A sizeable manatee population exists in the Rio Muni estuary, and there is a population of hippopotamus in the Rio Ntem estuary. Elephants occur in Mbini, with the population tentatively estimated at 500 animals.

4. Birds. Important populations of lowland and montane forest species occur. Two species are endemic to the forests of Bioko, the Bioko batis, and the Bioko speirops (which only occurs on the highest parts of Mount Malabo). Other important species are the Bioko swift (which also occurs on the African mainland) and the grey-necked picathartes (which occurs in southern Bioko, and might also occur in Mbini). The Pagalu white-eye is endemic to Pagalu. There are 44 endemic subspecies of birds on Bioko.

5. Reptiles. Green and hawksbill turtles are known to breed on Pagalu and southern Bioko in substantial numbers, but are subject to intense persecution. There are no data on possible nesting on the Mbini coast. There is hole information on crocodiles in Mbini, though the slender-snouted crocodile is known to occur, and the other two species probably do as well.

6. Amphibians. Two species are endemic to Bioko, a tree frog *Leptopelis brevipes* and a caecilian *Schistometopum garzonheydti.* Three other rare species are restricted to Bioko and the nearby mainland on Cameroon. The very large goliath frog *Conraua goliath* occurs only in Mbini and Cameroon but its conservation needs are not presently known. Likewise the status and conservation requirements of the hairy frog *Trichobatrachus robustus* need to be assessed.

7. Invertebrates. The dragonfly *Trithemis hartwigi* is endemic to Bioko. The rare African giant swallowtail butterfly occurs in Mbini.

Threats

1. The main threat to Equatorial Guinea's biodiversity is the lack of any protective measures following the breakdown in the country's protected area system. As a result, should the pressures on its natural resources become more severe, the country is ill-prepared to act. It is already clear that some economically valuable species are subject to intense exploitation.

2. There is evidence that the live animal trade is threatening some species.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental management comes under the Ministry of Water and Forests, which has sections on water and fisheries, and on forests. Responsibility for wildlife comes under forests.

2. Multi-agency Projects

(a) Promotion of forest conservation (Government/ IUCN/ EEC): development of an action plan for forest conservation by; planning a protected areas system to include rainforest habitats; development of sustainable use programmes in the forest zone; assessing conservation needs of forest wildlife; and dissemination of results of research.

(b) Surveys of elephants in the forests to establish baseline population data (WCI/WWF/EEC).

Suggested Conservation Activities

1. The former Mont Alen Partial Reserve should be re-established as a matter of priority.

2. The feasibility of re-establishing the former Mont Raices National Park and the Rio Ekuku Game Reserve should be seriously investigated.

3. New protected areas should be established in Mbini as specified in *Critical Sites 2* above.

4. Two reserves should be established on Bioko, one on Mount Malabo (Pico Basile) and one including the Gran Caldera de Luba, adjacent forests and part of the southern coast

5. The island of Pagalu, including its coastal waters, should be declared a conservation area.

6. Surveys of the flora in Mbini are needed.

7. Strict conservation measures should be introduced for turtles on Pagalu and southern Bioko.

8. The status and conservation needs of the goliath frog and the hairy frog need to be assessed.

Proposed protected areas of Equatorial Guinea. Bioko Island — 1: Southern Bioko Island (Caldera de Luba) (600 sq km). 2: Pico Basile (Santa Isabel) (150 sq km). Mbini — 3: Rio Ntem (Rio Campo) Estuary (200 sq km). 4: Rio Muni Estuary (700 sq km). 5: Monte Mitra (300 sq km). 6: Monte Alen (800 sq km). 7: Nsoc Highlands (400 sq km).

Chapter 19: Ethiopia

Introduction

Area: 1,023,050 km^2. Cultivated: 11%. Pasture: 37%. Forest/woodland: 23%.

Population (1989 data): 49,763,000. Urban: 11%. Labour force in agriculture (1980): 80%. Density: 49/km^2. Annual growth rate: 2.1%, increasing. Doubling time: 33 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 120. GNP annual growth rate: 2.0%.

Biogeographic affinities: Predominately Afromontane in the centre of the country with Afroalpine elements at the highest altitudes; Somali-Masai in the south and east and in the Rift Valley; Sudanian in the west; Sahel Regional Transition Zone in the far north.

Ethiopia (shaded area represents approximate distribution of land above 2000m). 1: Simien Mountains. 2: Bale Mountains. 3: Arssi Mountains. 4: Chercher Mountains. 5: Rift Valley. 6: Omo River. 7: Mago River. 8: Lake Chamo. 9: Lake Ahaya. 10: Lake Shalla. 11: Lake Abiyatta. 12: Awash River. 13: Blue Nile. 14: Addis Ababa. 15: Camholla Salient.

Vegetation: In the highlands, montane forest (now much reduced, though most extensive in the southwest), bamboo, heath, moorland, grassland and cultivated areas; in the lowlands, mainly dry bushland and *Acacia* woodland, with semi-desert in parts of the east and north, and Sudanian woodland in the west.

Critical Sites

1. Ethiopia has many critical sites for biodiversity, and several protected areas are being managed. However, only two of these, the Simien Mountains National Park, and the Awash National Park, have been legally gazetted and other areas lack legal protection.

2. The Simien Mountains National Park represents an area of spectacular scenic beauty, as well as being of critical importance for a number of rare species. Management of the area has been hampered by the civil war.

3. The ungazetted Bale Mountains National Park contains the largest area of afro-alpine habitat in Africa. Effective conservation of the area would preserve the water catchments of three major rivers, as well as safeguarding several rare species. The Arsi Mountains to the north are also important.

4. Most other areas of montane forest in Ethiopia are currently receiving no form of protection. With the increasing immigration of people into the highland areas, better protection and management of these areas, in the context of meeting human needs, is essential if water catchments are to survive and if the extinction of many endemic species is to be prevented. Key forest protection areas are in the Sidamo, Gamo Gofa, Kefa, Ilubabor, Welega, Arsi, Shoa, Gojam, Amhara, Welo and Harerge Provinces.

5. There are important wildlife resources in the Yavello region of Sidamo Province, including five endemic bird species and a population of the endemic Swayne's hartebeest.

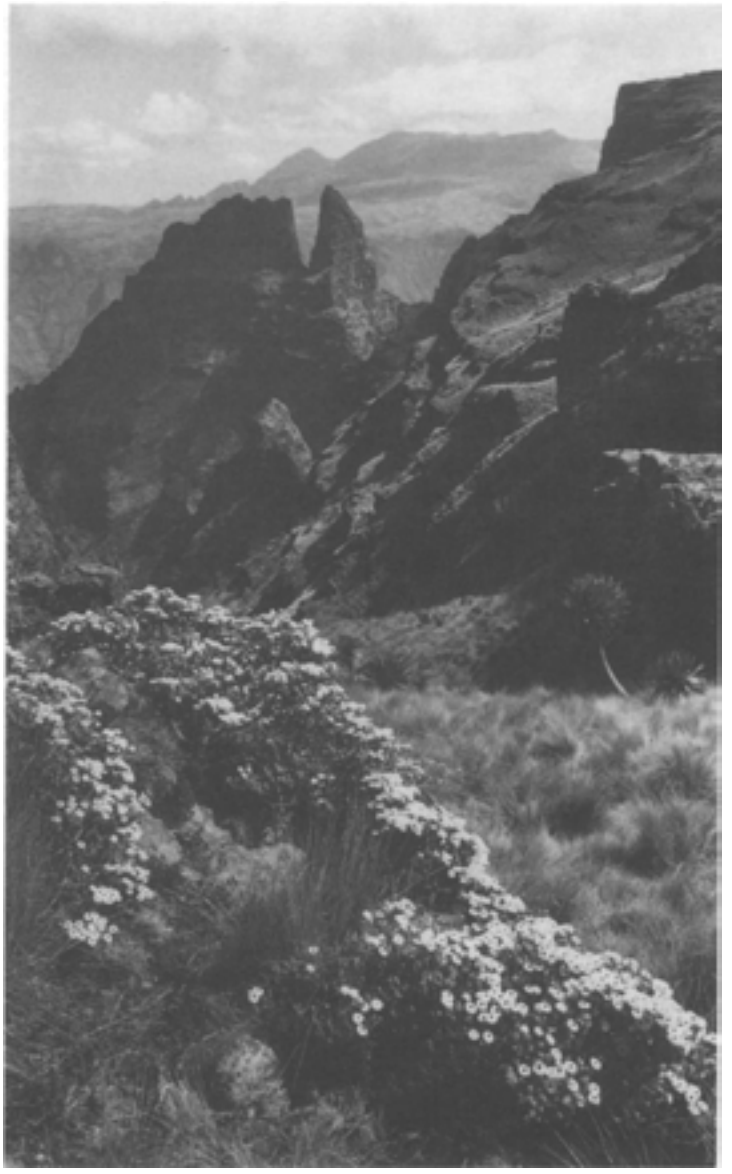
6. A number of important reserves exist in the southern lowlands, all of which lack formal legal status. These are important areas for large mammals, some of which are rare of absent in the remainder of the country: Omo and Mago National Parks, and Tama and Chew Bahar Conservation Areas.

7. All the lakes in the Rift Valley need some form of conservation measures. Lakes Abijatta and Shalla are included in the Abijatta-Shalla National Park (still ungazetted and

inadequately managed). Part of the Lakes Abaya and Chamo and the intervening area is protected in Nechisar National Park (also still ungazetted). Sufficient projection is lacking for Lakes Zwai, Langano and Awasa, and for wetland habitats in general in the Rift Valley. The Senkelle Swayne's Hartebeest Sanctuary is situated near Lake Awasa.

8. Very important wildlife populations exist in the Awash River Valley, including populations of the Somali wild ass. Protected areas, all lacking sufficient resources to ensure adequate protection, include Awash National Park, Awash West Conservation Area, Gewane Conservation Area, Yangudi Rassa National Park, and Mille Sardo Wild Ass Reserve (of these, only Awash National Park has been legally gazetted).

9. Further to the north, in Tigray and southern Eritrea, there is a similar array of species, likewise poorly protected. Probably little action can be taken on this during the current security situation, but this should remain a long-term goal.



A view of the rugged scenery of Simien Mountains National Park (Photo: WWF/Dr. B. Nievergelt).

10. Protection for seabirds, turtles and dugongs and of their habitats, including coral reefs and mangroves, is needed in the Dahlak Islands and there is a proposal for a marine park there.

11. The far northern Conservation Areas of Yob, Nafka, Gash Setit and Chire are very important for antelopes, though the security situation prevents conservation action.

12.The Gambella National Park in the west remains ungazetted and is threatened by adjacent agricultural development.

13. The Ogaden region of the southeast is important for a number of species, but has become severely degraded and lacks any effective protection. The Harrar Wildlife Sanctuary is on the edge of the Ogaden but lacks most of the highest priority species of the region.

Critical Species

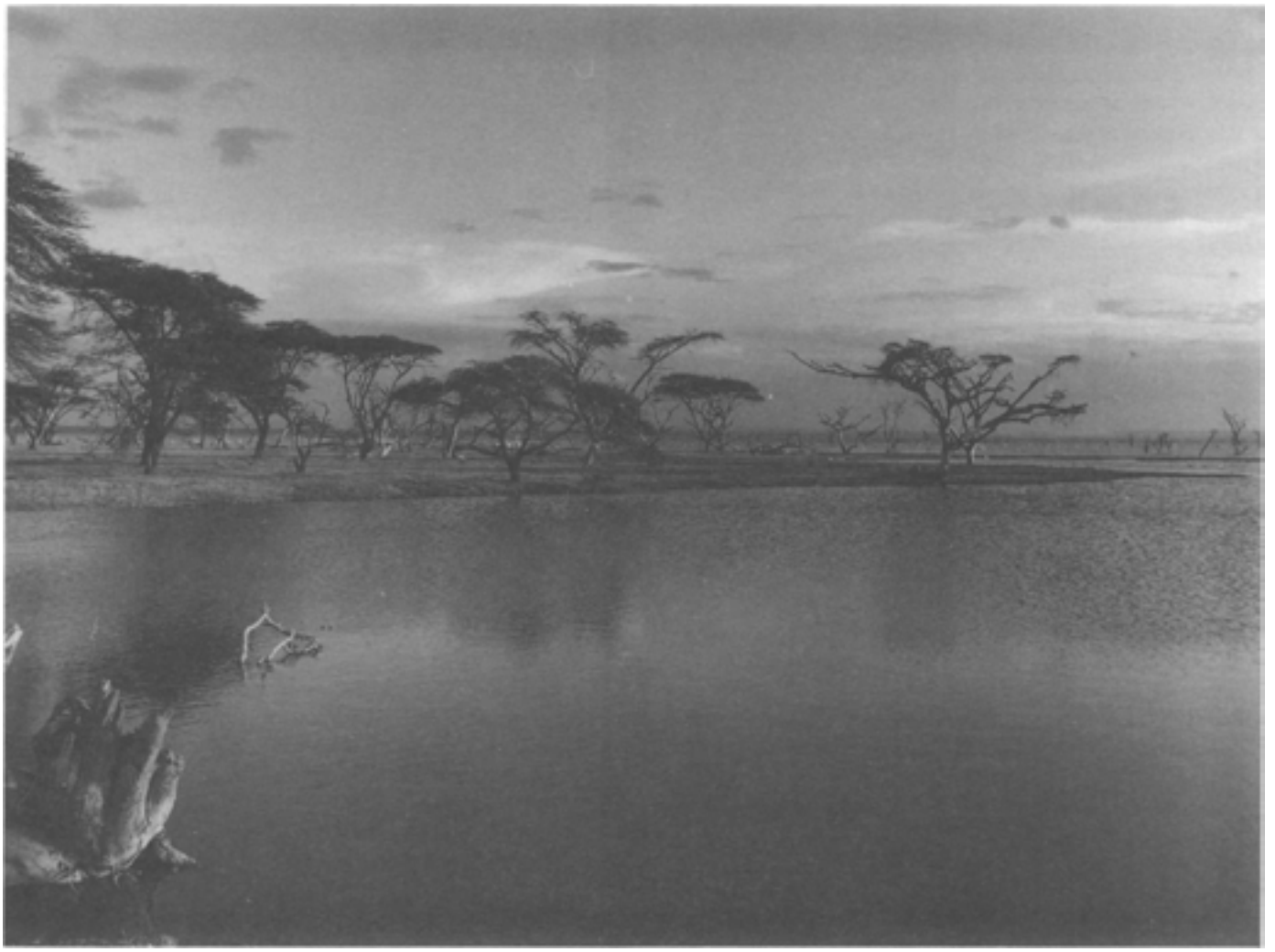
1. Plants. About 5,770 species occur, of which as many as 10% might be endemic. Most of the endemics probably occur in the mountain forests and in the afro-alpine zone, but there are others in the Ogaden, and in the forests of the southwest. Two particularly well known threatened plant species are the yahcb nut bush *Cordeawda edulis* (known from Gedlegube and Bokh in the Ogaden, as well as adjacent Somalia, threatened by overgrazing), and the Nubian dragon tree *Dracaena ombet* (occurring in the Eritrean Hills, as well as neighbouring Sudan, Djibouti and Somalia, but severely reduced).

2. Primates. The endemic gelada baboon occurs in the northern and western highlands, including Simien Mountains National Park. No particular conservation problems are known, but its status should be monitored. Similarly, the status of the hamadryas baboon needs monitoring; it is more of an arid country species, with 90% of its population occurring in Ethiopia. It is protected in Yangudi Rassa National Park and Harrar Wildlife Sanctuary.

3. Antelopes. About 29 species occur, including many populations of international importance. In the reserves of the Awash Valley there are sizeable populations of beisa oryx, Soemmerring's gazelle, greater kudu, lesser kudu, gerenuk and Waterbuck. Further to the north in Tigray and southern Eritrea there are concentrations of beisa oryx, dorcas gazelle, Soemmerring's gazelle, gerenuk and Salt's dik-dik. The Bale Mountains National Park possess an increasing population of the endemic mountain nyala, due to effective management. The world population of this species is 2,000-4,000 animals; increased protection is needed of the animals in the Arsi and

Chercher Mountains. In the south, in the Omo and Mago areas there are populations of topi, eland, beisa oryx, Grant's gazelle and Mongalla gazelle, and in the west at Gambella there are concentrations of topi, white-eared kob, Nile lechwe and lelwel hartebeest. In the Ogaden, antelope numbers are severely reduced, but there are scattered populations of beisa oryx, dibatag, gerenuk, Salt's dik-dik, Guenther's dik-dik, and possibly Speke's gazelle. Ethiopia deserves credit for its successful conservation programme for Swayne's hartebeest (now endemic) which number 2,400-2,700 animals, mainly in the Senkelle Reserve, with other populations in Awash and Nechisar National Parks, and Yavello Wildlife Sanctuary. Particular concern surrounds two rare and distinct subspecies, the tora hartebeest and Heuglin's gazelle, which occur in the far northern Conservation Areas of Yob, Nafka, Gash Setit and Chire. These areas have suffered from warfare and severe droughts, and so the current status of these species is not known. Some antelope surveys are needed in Ethiopia as follows: the far northern reserves (see above); for the rare beira near where Ethiopia, Somalia and Djibouti meet; for an undescribed form of red duiker recently found in the Bale Mountains; and for Speke's gazelle in the Ogaden. Captive breeding is recommended for Ethiopian populations of Swayne's hartebeest, tora hartebeest, Heuglin's gazelle and possibly the mountain nyala.

4. Rodents. Six species of conservation concern occur: a gerbil *Tatera minuscula* from Sheikh Hussein in the east and the lower Omo Valley in the south; *Megadendromus nikolansi* above 3,000 m on the southern slopes of the Bale Mountains in the afro-alpine vegetation; *Praomys ruppi* in the highlands of central and southwest Ethiopia, probably not in any protected areas; the aquatic *Colomys goslingi* which is very rare in the central highlands, as well as occurring in the Zaïre basin; *Lephuromys melanonyx* in the central and south-central highlands above 3,000 m in afro-alpine vegetation; and *Muriculus imbersus* between 1,900 and 3,400 m on both sides of the Rift Valley, possibly threatened

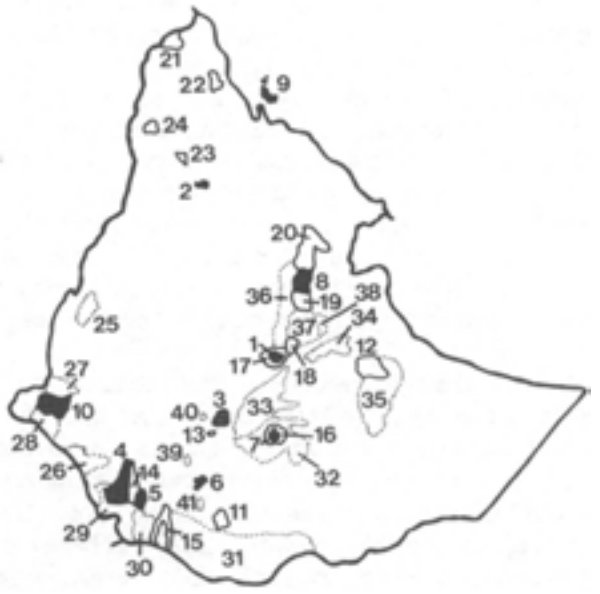


Lake Abijatta in the Rift Valley of Ethiopia (Photo: WWF/F. Vollmar).

by conversion to agricultural land. The extent to which the existing protected areas system safeguards these species is not fully known.

5. Fruit Bats. Nine species occur, including one of conservation concern: *Rousettus lanosus*, which occurs in scattered populations in montane areas in Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda, and Zaïre, and its status is very poorly known.

6. Other Mammals. The Walia ibex is only known from Ethiopia, with the only protected population occurring in the Simien Mountains National Park, hence underlining the need to rehabilitate this area. The only potentially viable population of the endemic Simien jackal (one of the world's most endangered canids) is in the Bale Mountains National Park but it is threatened by hybridisation with dogs. Important populations of the Somali wild ass survive in the Awash Valley, and parts of southern Tigray and Eritrea. Dugongs apparently still survive around the Dahlak Islands, thus emphasising the need for protection there. The rare Abyssinian genet has its distribution centred on Ethiopia, but it is so little known that it is not known whether it is a species of mountain forests, or the arid lowlands. Small numbers of Grevy's zebra occur in the south of the country and their range may be expanding there. Ethiopia is noted for its 180 civet farms, holding about 2,700 African civets, used for the production of musk, a raw material in the perfume industry. Over 1,000 tonnes are exported annually, mainly to France, and this represents a valuable source of foreign exchange earnings for Ethiopia. Illegal hunting has reduced the black rhinoceros to near extinction, and elephants now number only 6,650 animals, mainly in the lowlands of the south and west.



Conservation and controlled hunting areas of Ethiopia. ***National parks (gazetted and proposed)*** **— 1: Awash (720 sq km). 2: Simien Mountains (225 sq km). 3: Abiyatta-Shalla Lakes (800 sq km). 4: Omo (3450 sq km). 5: Mago (1500 sq km). 6: Nechisar (700 sq km). 7: Bale Mountains (2200 sq km). 8: Yangudi Rassa (formerly Danakil; 2000 sq km). 9: Dahlac Marine. 10: Gambella (2000 sq km; proposed).** ***Wildlife Reserves and Sanctuaries*** **— 11: Yavello. 12: Harrar Elephant (6000 sq km). 13: Senkelie (56 sq km). 14: Tama. 15: Chew Bahar. 16: Bale. 17: Awash West 18: Alledeghi. 19: Gewane. 20: Mille-Sardo. 21: Nakfa. 22: Yob. 23: Chire. 24: Gash-setit** ***Controlled Hunting Areas*** **— 25: Dabus Valley. 26: Akobo. 27: Jikao. 28: Tedo. 29: Omo West. 30: Murle-Kenya Border. 31: Borana. 32: Bale. 33: Arssi. 34: Tchercher and Arbagugu. 35: Harar-Wabi Shebelle. 36: Awash West 37: Afdem. 38: Erer-Gota. 39: Maze. 40: Boyo Swamp. 41: Segan.**

7. Birds. There are many bird species endemic to Ethiopia. Most of these are not currently threatened, and will be safe, providing that their habitats (mainly mountain forest and afro-alpine moorland) are protected. Eleven threatened birds species have been recorded from Ethiopia. The shoebill occurs in the proposed Gambella National Park where it depends on effective wetland conservation. The exceedingly rare northern bald ibis is still occasionally recorded wintering in the highlands from south Eritrea to near Addis Ababa; it is important that any birds encountered are not disturbed. The wattled crane occurs in wetlands in the west and southeast highlands and in the Rift Valley, and it requires conservation of its marshland habitat. The white-winged flufftail is a very little known and rarely recorded species, mainly from marshes near Addis Ababa. It is also occasionally recorded in southern Africa, and its conservation requirements are unknown throughout its range. Prince Ruspoli's turaco is endemic to montane forests in a small area of Sidamo and Bale Provinces, and is now seriously threatened by habitat destruction. If the proposed Yavello Wildlife Sanctuary is extended eastwards towards Arero, it could include the habitat of this species. Two species of lark are endemic to the Sidamo Province: the Degodi lark occurs in the Degodia region and the Sidamo long-clawed lark occurs around Negele. Work is needed to assess the conservation requirements of both these species. In the area around Yavello and Mega in the proposed Yavello Wildlife Sanctuary, two endemic species occur, the white-tailed swallow and the Ethiopian bush-crow. In Shoa Province two endemic canaries occur: the yellow-thoated serin in arid habitats in the east of the province, not far from Awash National Park (this species had not been recorded for nearly 100 years until 1989); and the Ankober serin in high rocky mountains near Ankober. The conservation requirements of these species are not clear. In addition, the possibly extinct Somali long-clawed lark (only known from Somalia) might occur in Ethiopia in the grasslands east of Jijiga. If it is found there, the establishment of a protected area should be considered.

The various Rift Valley lakes contain internationally important populations of greater and lesser flamingoes. Along with Somalia, Ethiopia is the most important country for bustards in the northern hemisphere, with restricted populations of Heuglin's bustard, Hartlaub's bustard and little brown bustard. Larger species, namely Arabian bustard and Denham's bustard (a declining species), are heavily hunted. Important scabird colonies exist in the Dahlak Islands, including the pink-backed pelican, red-billed tropicbird, brown booby, sooty gull, white-eyed gull, Caspian tern, white-cheeked tern, greater crested tern, lesser crested tern and bridled tern.

8. Reptiles. The Nile crocodile is greatly reduced, but good populations remain in the Mago, Omo and Nechisar National Parks. Initial attempts at fanning and ranching crocodiles have been begun in Ethiopia. Small populations of green and hawksbill turtles exist in waters around the Dahlak Islands. Some nesting probably takes place, but it is believed that exploitation has been heavy, since Ethiopia exports substantial quantities of bekko to Japan. The uncommon African spurred tortoise occurs in lowlands in the northern half of the country, but its conservation requirements are not fully known.

Lobelia sp. **in the Bale Mountains National Park, Ethiopia, a characteristic species of high altitudes (Photo: WWF/E. Coppola/Panda Photo).**

9. Amphibians. Thirty endemic species are recorded, ten of which are known only from a single locality. They mainly occur in the mountain forests (on both sides of the Rift Valley) though some also occur in forests in the southwest, in Rift Valley lakes, and the Omo River Delta.

Threats

1. Ethiopia's conservation efforts suffer from the serious drawback that only two of the country's protected areas are legally gazetted. The long-term future of the country's critical sites is therefore in question.

2. The proposed protected areas cover a good range of Ethiopia's natural terrestrial habitats. However, insufficient areas of forest, arid thornscrub in the Ogaden, and marine habitats are proposed for inclusion in the system, thus putting these ecosystems at great risk.

3. Protective measures in several areas have suffered because of the civil war. In several parts of the country, poaching, in particular of elephants, is out of control.

4. Habitat clearance for agriculture is destroying large areas of forest in the mountains, and of lowland woodland in the west. This is a serious threat, since no legal reserves exist to protect these habitats.

5. Overgrazing by livestock is leading to severe environmental degradation in many areas, including in the north, and in the Ogaden.

6. Rinderpest is endemic in southern Ethiopia and presents a threat to all susceptible ungulates.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Agriculture, in particular the Natural Resources Conservation and Development Main Department. Under this department, the Ethiopian Wildlife Conservation Organisation is responsible for wildlife conservation in general, and the management of national parks, wildlife reserves, sanctuaries, and controlled hunting areas. The department is also responsible for the management of forests.

2. Multi-agency Projects

(a) Development of National Conservation Strategy (Government/IUCN/ODA/UNSO/NORAD/ISF): provision of technical and financial assistance to the government for the strategy.

(b) Bale Mountains National Park development (EWCO/WWF).

(c) Wildlife survey of Nechisar National Park and assessment of conservation needs (FFPS/PTES).

3. DDA Projects

(a) Simien conservation and sustainable development project.

4. GTZ Projects

(a) Rehabilitation of degraded watershed areas through socially and ecologically acceptable forest management techniques.

5. WCI Projects

(a) Provision of wildlife conservation advisor to the EWCO.

(b) Study of Simien jackal ecology and conservation needs.

(c) Environmental education programme.

6. WWF Projects

(a) Conservation and environmental education on a national basis.

(b) Provision of wildlife conservation ecologist to EWCO.

Suggested Conservation Activities

1. Principal factors which need controlling in protected areas are overgrazing and habitat clearance for agriculture. Management of protected areas should aim to integrate human and conservation needs in places where these threats are present.

2. Ungazetted protected areas need their legal status changed as a matter of urgency. The following protected areas should be gazetted: Bale Mountains National Park (important for afro-alpine habitat, antelopes, the Simien jackal and rodents), Omo and Mago National Parks (important for antelopes), Tama and Chew Bahar Conservation Areas (all species of large mammals), Abijatta-Shalla National Park (lakes and wetlands), Awash West Conservation Area, Gewane Conservation Area, Yangudi Rassa National Park (important for primates), Mille Sardo Wild Ass Reserve, Gambella National Park (antelopes, birds, wetlands with associated species) and Nechisar National Park crocodiles.

3. Rehabilitation of protected areas needs undertaking in most cases, including already-gazetted areas. The Simien Mountains National Park (primates, Walia ibex, large mammals), Awash National Park (Somali wild ass, antelopes, birds), Omo and Mago National Parks, Tama and Chew Bahar Conservation Areas (large mammals), Nechisar National Park (wetlands and lakes) and the far northern Conservation Areas of Yob, Nafka, Gash Setit and Chire (antelopes, especially tora hartebeest and Heuglin's gazelle) are all in need of more resources and improved management and protection strategies. The Gambella National Park needs further development in the context of an integrated land-use plan for the region.

4. New reserves are urgently needed to protect forest habitats, especially montane forest. Integrated rural development projects may be the best approach for many of these as immigration to the mountains has increased. Areas of this type needing reserves are as follows: Sidamo, Gamo Gofa, Kefa, Ilubabor, Welega, Arsi Mountains, Shoa, Gojam, Amhara, Welo and Harerge.

5. A protected area in the Ogaden region should be established to replace the degraded Harrar Wildlife Sanctuary and should be based on integrated development, overgrazing being one of the primary problems of the region.

6. Reserves with an emphasis on large mammals are needed in Tigray and southern Eritrea, and should be established as soon as the security situation permits.

7. Anti-poaching measures need strengthening in all areas, particularly in relation to rhinos, elephants and other large mammals.

8. A Wildlife Sanctuary should be established in the Yavello region of Sidamo province (particularly important for five endemic bird species and Swayne's hartebeest).

9. Wetlands and lakes need increased protection, particularly Lakes Zwai, Langano and Awasa and wetland areas in the Rift Valley. Several species of birds are dependent on the effectiveness of such protection: see *Critical Species* 7 above.

10. A marine National Park should be established in the Dhalak Islands for seabirds, turtles and dugongs, and coral reefs and mangroves.

11. More resources are needed to improve protection in the various protected areas in the Awash River Valley (see *Critical Sites* 8 above).

12. Primate surveys are needed for the gelada baboon and the hamadryas baboon.

13. Surveys are needed for antelopes as follows: all species in the far northern reserves; for the beira near the Ethiopia/Somalia/Djibouti border area; for an undescribed form of red duiker in the Bale Mountains; and for Speke's gazelle in the Ogaden.

14. Captive breeding programmes should be established for Swayne's hartebeest, the tora hartebeest, Heuglin's gazelle, mountain nyala and Prince Ruspoli's Turaco.

15. Investigations are needed to identify possible solutions to the problem of hybridisation of the Simien jackal with domestic dogs.

16. Surveys are needed to assess current effective protection for a number of rodent species *(Critical Species* 4 gives details).

17. A survey is needed to determine the status and conservation requirements of the Abyssinian genet.

18. The elephant population needs urgent protective measures due to high levels of illegal hunting.

19. A number of rare bird species need action as fol-

lows:

(i) Assessment of conservation requirements of the white-winged flufftail.

(ii) Protection of Prince Ruspoli's turaco, by extension of the proposed Yavello Wildlife Sanctuary eastwards towards Arero in order to include its habitat and prevent further deforestation.

(iii) Assessment of the conservation requirements of the Degodi lark and the Sidamo long-clawed lark.

(iv) Assessment of the conservation requirements of endemic canaries.

(v) Survey to elucidate the status of the possibly-extinct Somali long-clawed lark.

20. Further development of crocodile farming and ranching is needed.

21. The conservation requirements of the African spurred tortoise should be surveyed in the northern half of the country.

Chapter 20: Gabon

Introduction

Area: 267,667 km^2. Cultivated: 2%. Pasture: 18%. Forest/woodland: 75%.

Population (1989 data): 1,132,000. Urban: 41%. Labour force in agriculture (1980): 75%. Density: 4/km^2. Annual growth rate: 1.9%, decreasing. Doubling time: 36 years.

Economy (1987 data): World Bank index: no data. GNP/capita: US$ 2750. GNP annual growth rate: 1.0%.

Major natural vegetation zones and geographical features of Gabon. Moist evergreen lowland forest dominates the country's forest zone, but there are also extensive areas of drier semi-deciduous forest, e.g., in the south, and large areas of seasonally inundated swamp forest. There are also extensive coastal mangroves, especially on the northern coast. 1: Ogooue River. 2: Lake Onangue. 3: Lake Nkomi (Fernan Vaz). 4: Libreville. 5: Port Gentil. 6: Lambarene. 7: Makokou. 8: Gamba. 9: Ndende. 10: Tchibanga. 11: Franceville. 12: Mouila. 13: Mekambo. 14: Belinga. 15: Booue. 16: Lastoursville. 17: Kango. 18: Atlantic Ocean.

Biogeographic affinities: Guinea-Congolian.

Vegetation: Predominately lowland rainforest (85%) of area, with swamp forest and mangroves near the coast, and patches of secondary grassland (especially in the south). There are also some savanna areas in the centre, southeast and southwest of the country.

Critical Sites

1. A number of protected areas have already been established in critical areas for biodiversity in Gabon. These include the Wonga-Wongué Presidential Reserve, the Ipassa-Makokou Nature Reserve, the Lopé-Okanda Faunal Reserves, the Moukalaba-Dougoula, and the reserves in the Sétté-Cama area (i.e. the Faunal Reserves of Iguela Petit Louango, and Ouanga Plain, and the Hunting Reserves of Iguela, Ngoué-Ndogo, and Sétté-Cama). All of these reserves lack management plans, staff training, and effective supportive legislation. Apart from the small Ipassa-Makokou Nature Reserve, there is no protected area in Gabon in which forest exploitation is prohibited. There is an urgent need to ensure the total protection of at least some sizeable areas of lowland rainforest in several of Gabon's protected areas. Despite this lack of official protection, the lowland forests of Gabon remain among the least disturbed in Africa, and are therefore of global importance for biodiversity conservation.

2. In addition to strengthening the existing protected areas network, some extensions of the system are needed. Of particular importance is Minkébé in the lowland forests of the northeast, which are particularly rich in species. The lake and river systems at Ogooué-Onangué also need a protected area. A *new* Faunal *Reserve for the* Forêt des *Abeilles* on the east of the Offoué River is an important priority for primate conservation. The Wonga-Wongué Presidential Reserve should also be extended to include some valuable areas of swamp forest Other important sites for which reserves are needed are Gamba (reserve already proposed), Tchimbé1é (Mont Cristal) and Milondo (Mont du Chaillu).

3. There are probably some important sites along the coast, but these are still very poorly known.

Critical Species

1. Plants. About 7,000 species are thought to occur, and the

level of cndcmism is probably high in the rainforests. In a study of 1,333 plant species in Gabon, 243 (22%) were found to be endemic.

2. Primates. 19 species occur, including one endemic, the recently discovered sun-tailed monkey. This species is known only from the Forêt des Abeilles, and this area needs protected status of its own or an extension of the Lopé-Okanda Faunal Reserve. Other threatened species of primate include the red-capped mangabey, mandrill and black colobus, which occur in a number of Gabon's protected areas. Gabon also has internationally important populations of chimpanzees (estimated to number 64,000 animals + 13,000) and gorillas (estimated to number 35,000 + 7,000).

3. Rodents. At least seven species of conservation concern occur in the lowland forests, including the African pygmy squirrel *Myosciurus pumilio*, the flightless scaly-tailed squirrel *Zenkerella insignis*, and two species of climbing wood mouse *Hylomyscus fumosus* and *H. parvus.*

4. Other Mammals. Gabon has one of Africa's largest populations of elephants, thought to be around 76,000. There is evidence that illegal hunting for ivory has recently started, and strict controls are necessary to prevent a severe population decline. 14 species of antelope occur, including major populations of Sitatunga, Bates' pygmy antelope and 7 species of duikers. There is an endemic subspecies of Ogilby's duiker in the west. The status of duikers and other forest antelopes in Gabon, in particular the endemic subspecies of Ogilby's duiker in the Moukalaba area, is not known. Appropriate protection measures for this subspecies should be enforced. The giant forest hog is found only in the northeast of the country and is believed to be rare. There are also important populations of manatees in coastal and riverine zones, which might need protection and appropriate management. The effects of incidental kills of dolphins and porpoises in coastal fisheries is not known.

5. Birds. The main ornithological importance of Gabon lies in the well developed rich tropical forest avifauna. There is one endemic species, the Gabon batis, which only occurs in the forests of the northeast. Other threatened species are the grey-necked picathartes (occurring in the forests of the north and northeast), the Dja River warbler (recorded from non-forest areas on Milondo (Mont du Chaillu) in the south, possibly more widespread but little information is available), the Loango slender-billed weaver (known from some southern coastal areas), and the Damara tern (which occurs as a non-breeding migrant along the coast).

6. Reptiles. All three species of crocodile occur, though populations are depleted except in the most remote areas. At least four species of sea turtle have been recorded in Gabonese waters, but identification and protection of nesting sites has not yet been possible.

7. Amphibians. Four endemic species occur, and two additional near-endemics also occur just across the border in Cameroon. Almost nothing is known of the distribution and conservation requirements of any of these species. The status and conservation needs of the hairy frog need to be assessed.

8. Invertebrates. The dragonfly *Palpopleura albifrons* is known only from forests in Gabon. The rare African giant swallowtail butterfly occurs in the lowland forests, and presumably requires the protection of this habitat for its survival.

Protected areas of Gabon. *Existing reserves* — 1: Lope Reserve (5000 sq km, including 1500 sq km "Domaine de Chasse de la Lope-Okanda", and 3500 sq km "Reserve de Faune de I'Ofoue-Okanda"). 2: Moukalaba Reserve (1000 sq km, including 800 sq km "Reserve de Faune de la Moukalaba-Dougoua", and 200 sq km "Domalne de Chasse de la Moukalaba"). 3: Sette-Cama Reserve (7000 sq km, including 2000 sq km "Domaine de Chasse de Sette-Cama", 2500 sq km "Domaine de Chasse de Ngove-Ndogo", 1800 sq km "Domaine de Chasse d'Iguela", 500 sq km "Reserve de Faune du Petit Loango", and 200 sq km "Reserve de Faune de la plaine Ouanga"). 4: Wonga-Wongue Presidential Reserve (4800 sq km). 5: Ipassa Biosphere Reserve (100 sq km). *Proposed reserves* — 6: Foret des Abeilles. 7: Mont Iboundji. 8: Mont Doudou (this area plus the existing Moukalaba and Sette-Cama Reserves comprise the proposed Gamba Reserve). 9: Tchimbele. 10: Milondo. 11: Lac Onangue. 12: Minkebe. 13: Djoua. 14: Mingouli. 15: Leconi.

Threats

1. Although the pressures on Gabon's natural resources have been less severe than those in many other countries, the evidence is that it is now increasing with improvements in transport and changes in logging practices. The protected area system does not yet include a representative coverage of country's ecosystems and in particular, there are no sizeable areas of lowland forest that receive total protection. Some habitats are under-represented in the existing network of reserves, especially those in the coastal zone.

2. The management of the existing reserves is not receiving priority attention by the government and more investment is needed. In particular it seems that the country is not prepared for the stronger measures that are required in order to control illegal hunting which is likely to become more serious in the next few years.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Forestry, Wildlife, National Parks and Fisheries, in particular its Departments of Hunting and Wildlife (responsible for all protected areas except forest reserves), Water and Forests (responsible for forestry activities), and Fisheries. There is a separate Ministry of Tourism.

2. Multi-agency Projects

(a) Promotion of forest conservation (Government/ IUCN/EEC): development of an action plan for forest conservation by: planning a protected areas system to include rainforest habitats; development of sustainable use programmes in the forest zone; assessing conservation needs of forest wildlife; and dissemination of results of research.

(b) Impact of selective logging on large mammals and the forest (Leverhulme Trust/WCI): this project is based in Lopé-Okanda Faunal Reserve.

(c) Research on the sustainable management of tropical forests (TROPENBOS/Netherlands Government).

(d) Surveys of elephants in the forest zone to establish baseline population data (WCJ/WWF/EEC).

3. MBG Projects

(a) Botanical survey and conservation of rainforests.

4. WCI Projects

(a) Habitat disturbance analysis in Makokou Reserve.

(b) Study of biological impacts of logging in Lopé Reserve.

(c) Advice on national park creation in Gabon.

(d) Radio-tracking of elephants in remote forest areas.

5. WHF Projects

(a) Training course on wildlife conservation and protected area management.

6. WWF Projects

(a) Material Support to the Lopé Reserve: supply of equipment to enable effective management of forest reserve to continue.

(b) Study of use of tropical rainforest by lowland gorillas and chimpanzees: assessment of impact of logging on gorilla and chimpanzee populations.

(c) Conservation and protected area development in northeastern Gabon: development of a tropical forest conservation strategy based on land-use planning.

Suggested Conservation Activities

1. All the established reserves in the country need management plans and staff training, backed up by appropriate legislation.

2. There is an urgent need to establish lowland National Parks and strict nature reserves. The proposed reserve at Minkébé should be established, as should a new reserve for the lake and river systems at Ogooué-Onangué.

3. The Forêt des Abeilles is important for primate conservation (the only known habitat of the sun-tailed monkey) and needs protection, as part of the Lopé-Okanda Faunal Reserve, which itself needs an upgraded conservation status.

4. The Wonga-Wongué National Park should be extended to include swamp forest areas.

5. Reserves should be created at Tchimbéle (Mont Cristal) and Milondo (Mont du Chaillu).

6. Strict controls are needed to prevent further illegal hunting of elephants: forward planning and increasing resource levels are necessary.

7. Surveys of duikers and other forest antelope species should be carried out and appropriate conservation measures implemented, particularly in relation to the endemic subspecies of Ogilby's duiker.

8. A survey of manatees in rivers and coastal waters is needed to determine conservation requirements.

9. A coastal fishery survey should be carried out to determine whether incidental kills of dolphins and porpoises present a conservation problem.

10. Conservation and management programmes are needed for all three species of crocodile.

11. Conservation recommendations of a recent survey of sea turtles should be implemented, particularly in relation to possible nesting sites.

12. Surveys of endemic amphibians and of the hairy frog should be carried out to determine their distribution and conservation needs.

Chapter 21: Gambia

Introduction

Area: 10,689 km^2. Cultivated: 15%. Pasture: 8%. Forest/woodland: 17%.

Population (1989 data): 835,000. Urban: 18%. Labour force in agriculture (1980): 84%. Density: 78/km^2. Annual growth rate: 2.5%, decreasing. Doubling time: 28 years.

Economy (1987 data): World Bank index: no data. GNP/capita: US$ 220. GNP annual growth rate: 1.8%.

Biogeographic affinities: Sudanian in the east, with Guinea-Congolian/Sudanian Regional Transition Zone in the west.

Vegetation: Predominately Sudanian woodland, with small areas of evergreen forest in the west, and mangroves on the coast.

Critical Sites

1. The Abuko Nature Reserve though very small (only 113 ha), is important as an example of well preserved coastal forest vegetation, with a number of interesting species.

2. The Gambia River (or Baboon Island) National Park is another small (627 ha), but interesting area, consisting of five islands in the Gambia River.

3. There is a much larger National Park at Kiangs West, where good populations of several species of large mammal occur.

4. The Gambia Saloum delta area on the border with Senegal is important for breeding waterbirds. Protection is afforded by the Sine Saloum-Niumi National Park, and cooperation with Senegal in the conservation of the area should continue.

Critical Species

1. Plants. About 530 species occur, including three endemics.

2. Primates. Important populations of Temminck's red colobus and the savanna baboon occur in most of the protected areas and proposed protected areas of the country. The chimpanzee became extinct in Gambia in the early part of this century, but has been reintroduced into the Gambia River National Park.

3. Antelopes. 9 or 10 species occur, though two of these, the roan antelope and western hartebeest, are almost, if not already, extinct. However, a small group of roan antelope is known to have recently entered and settled in the Kiangs West National Park and is being monitored carefully. Another five species are known to be extinct. Although most of the surviving species are rare, good populations of bushbuck, Sitatunga, bohor reedbuck and duikers occur in the Kiangs West National Park.

4. Other Mammals. Manatees survive in the Gambia River in the area of the Gambia River and Kiangs West National Parks. There is a population of between 50 and 100 hippos in the Gambia River National Park.

5. Birds. No threatened species occur in Gambia, but important populations of waterbirds breed in the Gambia Saloum delta area.

6. Crocodiles. All three species occur, but populations are severely reduced. The dwarf crocodile survives in the west of the country, but is nearly extinct.

Threats

1. Much of Gambia's biodiversity has probably already been lost because of habitat modification for agriculture and settlements. This is a continuing threat.

2. There is also the risk of extinction in some existing reserves because they are too small to protect viable populations of several species.

Current Conservation Measures

1. Government Administration of Conservation

(a) The principal Ministry responsible for the conservation of nature is the Ministry of Water Resources, Forestry and Fisheries. This has four departments covering the following sectors: Department of Forestry; Department of Water Resources; Department of Wildlife Conservation and

Management (including protected areas); and Department of Fisheries.

(b) The Ministry of Agriculture has a Department of Agricultural Services which is responsible for soil conservation and the protection of water catchments.

(c) The Ministry of Health and the Environment has an environmental unit responsible for environmental education.

2. GTZ Projects

(a) Assistance to the forestry service, with an emphasis on institution building and training, as well as the control of forest fires and illegal timber cutting.

3. WWF Projects

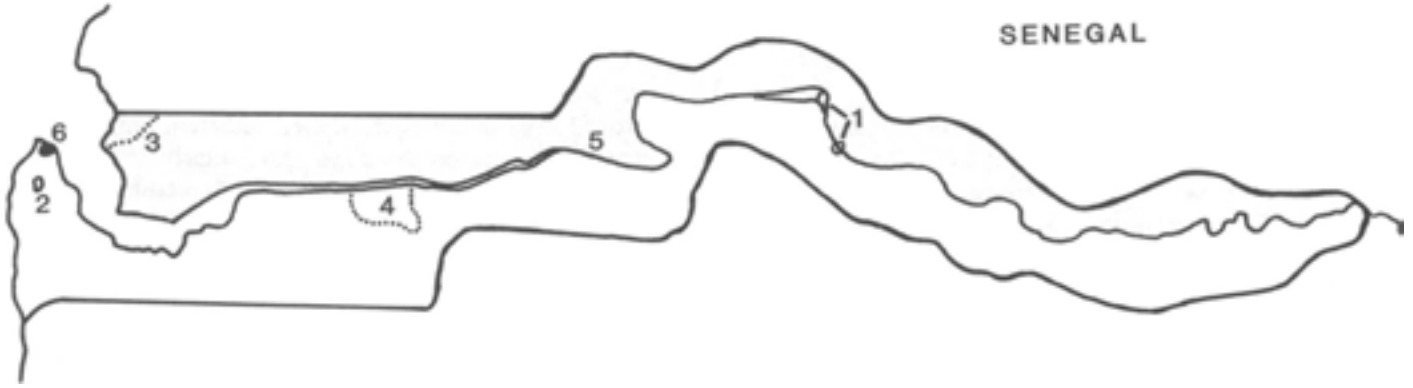
(a) "Simplified Tropical Ecology Manual" for rural schools: this project is developing and field-testing materials which will enable teachers to promote conservation as part of routine education in rural areas.

Suggested Conservation Activities

1. The principal general task is protection of habitats from modification for agriculture and settlements.

2. The Sine Saloum-Niumi National Park should be managed in close co-operation with Senegal.

3. Surveys to establish the conservation needs of all three crocodile species should be carried out, with particular emphasis on the dwarf crocodile.



Map of the Gambia. 1: Gambia River (Baboon Island) National Park (islands only; 25 sq km). 2: Abuko Nature Reserve (1.2 sq km). 3: Niumi National Park (proposed) (25 sq km). 4: Kiang West National Park (proposed) (100 sq km). 5: Gambia River. *6:* Banjul.

Chapter 22: Ghana

Introduction

Area: 238,305 km^2. Cultivated: 12%. Pasture: 14%. Forest/woodland: 36%.

Population (1989 data): 14,566,000. Urban: 32%. Labour force in agriculture (1980): 56%. Density: 61/km^2. Annual growth rate: 3.1%, decreasing. Doubling time: 22 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 390. GNP annual growth rate: -0.2%.

Biogeographic affinities: Guinea-Congolian in the southwest, Sudanian in the north, with Guinea-Congolian/Sudanian Regional Transition Zone in the centre and southeast.

Vegetation: The lowland forests of the southwest still survive in patches but are largely replaced by agriculture. Sudanian woodland covers most of the remainder, with patches of secondary grassland and cultivation. There are mangroves along the coast.

Critical Sites

1. Ghana has some fairly small but important sites in the lowland tropical forests in the southwest of the country. The Bia National Park and the adjacent Bia Game Production Area still include some good forest, although heavy logging is taking its toll and the populations of primates and other species are being depleted partly by hunting and partly by loss of food trees. There is a proposal to create the Kakum National Park to combine the Kakum and Assin Atandaso Forest Reserves in the forest zone in the southern moist semi-deciduous forest zone, which contains many less common forest species. In the extreme southwest of the country, the Nini-Souhien National Park and the contiguous Ankasa Game Production Area are of high priority, and there are proposals to gazette them as a single national park. Other Forest Reserves containing significant populations of large mammals are Draw River, Ebi Shelterbelt and Cape Three Points.

2. Ghana has three important savanna woodland national parks, Bui, Digya and Mole, all of which have important populations of large mammals. The management of all these needs strengthening, particularly Mole National Park, as poaching is prevalent and there is little effective control. The Kogyae Strict Nature Reserve is of importance for its antelope populations.

3. The Kalakpa Game Production Area in the southeast of the country contains some important forests and should be set aside as a nature reserve.

4. The forests on the southern escarpment of the Volta Basin, and in several areas to the south and southwest, are important as locations of breeding colonies of the remarkable white-necked picathartes but are currently unprotected.

5. In the western part of the high forest zone, the Brong Ahafo region may be important, especially for the long-term survival of the forest elephant. More information is needed about the status and conservation needs of this and other species in the region.

6. Some extensive coastal mangroves and lagoons occur in the southeast, and protection of this habitat needs to be improved. The effect of decreased sediment outflow and increased erosion on the coast, particularly in the Keta lagoon area since the construction of the Akosombo dam and creation of the Volta Lake, is not known.

Major natural vegetation zones of Ghana. 1: Lake Volta. 2: Black Volta River. 3: White Volta River. 4: Togo hill range. 5: Volta delta. 6: Atlantic Ocean. 7: Accra.

7. There is one Ramsar site in Ghana, at Owabi Nature Reserve surrounding the Owabi reservoir which supplies water to Kumasi.

Critical Species

1. Plants. A total of about 3,600 species occur, of which 43 are thought to be endemic. The greatest diversity is found in the forests of the southwest.

2. Primates. 15 species occur, mainly in the forests in the south. The Bia and the Nini-Souhien areas are the most important areas, and the red-capped mangabey, diana monkey, olive colobus, Waldron's red colobus and chimpanzee are of the greatest conservation concern but their status is insufficiently known at present.

3. Antelopes. 17 or 18 species occur. Typical forest species are present in the Bia and Nini-Souhien areas, and savanna species in Mole National Park. Bui, Digya and Kogyae have both savanna and forest elements in their antelope faunas. The status of bongo, bay duiker, Ogilby's duiker, yellow-backed duiker and water chevrotain are currently not known.

4. Rodents. Five species of conservation concern occur, including an African fat mouse *Steatomys jacksoni* (only known from Ghana and south-west Nigeria), an African climbing woodmouse *Hylomyscus baeri* (only known from the south of Ghana and Ivory Coast), and the Togo mole-rat *Cryptomys zechi* (restricted to a small area on the Togo-Ghana border).

5. Fruit Bats. 13 species occur, including two of conservation concern: *Epomops buettikoferi* (endemic to the West African forests of Ghana, Guinea, Ivory Coast, Liberia, Nigeria and Sierra Leone); and *Scotonycteris ophiodon* (known only from forest sites in Ghana, Cameroon, Congo and Liberia).

6. Other Mammals. Only about 1,000 elephants survive in Ghana, including both the forest and savanna sub-species. The forest elephant is found in five isolated areas - Mpameso-Krokosua Hills (probably around 250), Bia National Park and Game Production Area (no more than 150), Dadieso, Ankasa-Nini Suhien and Kakum-Assin Attandanso - while the distribution and numbers of the savanna species is less well-known but it is certainly under pressure from hunting and can number no more than a few hundred. The two largest populations noted above are considered to be of high priority within West Africa. Increasingly rare species include the giant forest hog, giant pangolin, leopard and golden cat The pygmy hippo may be present in small numbers and the status of manatees is not known, though the population might be significant. The extent and conservation impact of incidental killings of dolphins and porpoises in coastal fisheries is unknown.

Protected areas of Ghana of major importance for conservation and administrative regions. *Protected areas* — 1: Mole National Park (4921 sq km). 2: Bui National Park (3074 sq km). 3: Digya National Park (3126 sq km). 4: Bia National Park (78 sq km). 5: Nini-Suhien National Park (104 sq km). 6: Kogyae Strict Nature Reserve (324 sq km). 7: Bomfobiri Wildlife Sanctuary (73 sq km). 8: Owabi Wildlife Sanctuary (52 sq km). 9: Gbele Game Production Reserve (324 sq km). 10: Bia Game Production Reserve (228 sq km). 11: Ankasa Game Production Reserve (207 sq km). 12: Kalakpa Game Production Reserve (324 sq km). 13: Shai Hills Game Production Reserve (54 sq km). 14: Kakum National Park (proposed) (207 sq km). 15: Assin Atandaso Game Production Reserve (proposed) (140 sq km). *Regions* — A: Upper West. B: Upper East. C: Northern. D: Brong Ahafo. E: Ashanti. F: Eastern. G: Volta. H: Western. J: Central.

7. Birds. Six threatened species are recorded, of which one, the white-breasted guineafowl, is very rare in Ghana, and three, the rufous fishing-owl, western wattled cuckoo-shrike, and yellow-throated olive greenbul, have not been recorded for many years. If they survive, it will be in the forests of the southwest. The white-necked picathartes survives in small colonies, mainly in the forests of the Kwahu Escarpment along the southern edge of the Volta basin between Mampong Ashanti and the Akwapin Hills. Other colonies exist in forest patches to the south and southwest. The roseate tern winters along the Ghanaian coast, these birds being from the highly endangered population in northwest Europe. The current education campaign aimed at preventing the hunting of this and other tern species should be continued.

8. Crocodiles. All three species occur, especially in forest streams and rivers, and in Lake Volta. Their status is not known in detail, nor whether significant threats exist.

9. Marine Turtles. Five species occur in Ghanaian waters, the loggerhead, hawksbill, green, olive ridley, and leatherback, of which the last four have been recorded nesting. The identification of nesting beaches, and their effective protection, is an important priority, since local utilisation is known to be heavy.

10. Amphibians. Ten species of conservation concern occur, including four endemics. All ten species appear to be forest dwellers occurring in the south of the country, and all are very poorly known.

11. Invertebrates. The rare African giant swallowtail butterfly has been recorded from the forests in the south of the country.

Threats

1. Clearance of habitats has been, and continues to be, a serious threat to biodiversity in Ghana, especially of lowland rainforests. The existing rainforest reserves are probably too small to conserve viable populations of many species.

2. The management of some of the protected areas is not very effective, enabling illegal hunting of several species to take place.

3. Certain habitats are not sufficiently covered by the current protected area system, notably marine areas, and lowland rainforest.

4. Mining activities may be damaging some rarer forest types such as in the Atewa Range Forest Reserve.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Forestry Department in the Ministry of Lands and Natural Resources is responsible for the establishment and management of forest reserves, with a view to obtaining maximum timber production on a sustained yield basis. This department also provides technical advice, assistance, and seedlings to other agencies and nongovernmental organisations. Outside the forest reserves, the Lands Commission Secretariat also exerts some controls on the exploitation of timber.

(b) The Game and Wildlife Department, also in the Ministry of Lands and Natural Resources, is responsible for the management of national parks and game production areas.

Roads on laterite soils in African rainforests frequently suffer from severe erosion (Photo: WWF/Claude Martin).

(c) The Environmental Protection Council is responsible for promoting public awareness of environmental issues, monitoring the threats to the environment, and preventing the pollution of rivers.

(d) The newly established Rural Fire Department is responsible for the supervision and control of bush burning.

(e) The Fisheries Department in the Ministry of Agriculture is responsible for the conservation and management of fisheries.

2. Multi-agency Projects

(a) Implementation of the Tropical Forestry Action Plan in Ghana, including assistance to the Game and Wildlife Department in the management of reserves, and of forest resources in general (Government/IBRD/IUCN).

(b) Save the Seashore Birds conservation programme (Government/ICBP/RSPB): a campaign of education and public awareness to promote the conservation of the roseate tern and other seabirds.

(c) Strengthening the Environmental Protection Council (Govemment/UNDP/UNSO): emphasis on training, environmental education, and establishment of computer and library systems.

(d) Reversing of environmental degradation in the Vea and Tono areas through assistance to smallholders (Government/UNDP).

(e) Support for national agroforestry programme (Government/UNDP): long-term aim of reducing the country's tree loss, and resulting desertification and soil erosion.

(f) Assistance in forestry planning (Government/FAO/UNDP): development of policies and strategies for forest management, and a monitoring capability in the Ministry of Lands and Natural Resources.

(g) Integrated development of artisinal fisheries in Yeji (Government/FAO/UNDP): development of a community fisheries centre, together with a management plan and an information system.

3. FFPS Projects

(a) Wildlife resource inventory of Boabeng-Fiema Wildlife Sanctuary, and general research on rainforest ecology.

4. GACON Projects

(a) Education campaigns in schools.

(b) Setting up of locally managed "Sacred Grove" wildlife reserves.

5. ODA Projects

(a) Forest resources management project: includes identification of centres of plant diversity as a means of assessing the effectiveness of protected area coverage in the forest zone.

6. Wildlife Society of Ghana Projects

(a) Education programmes in schools in the Accra area.

Suggested Conservation Activities

1. The protection of small forest reserves at the village level, including the "Sacred Grove" concept for maintenance of bushmeat, medicinal plant and food resources, should be encouraged and research on the effectiveness of these should be carried out

2. The management of the Bia National Park and Bia Game Production Area needs improvement, particularly with regard to elephant protection and primate conservation.

3. Land-use conflicts threaten Atewa Range, Ankasa, Draw River, Asukese and Muro reserves and their protection should be strengthened.

4. The contiguous Nini-Souhien National Park and Ankasa Game Production Area should be gazetted as a single National Park (important for primates).

5. The management of Mole National Park needs improvement to assure the protection of its large mammal populations.

6. The management of other reserves and game production areas needs strengthening if wildlife resources are to continue to be used sustainably.

7. Education campaigns for protection of certain birds (the roseate tern in particular) and mammals need extension, given the heavy dependence of the Ghanaian people on bushmeat as a protein source.

8. Reserves should be established in forests on the southern escarpment of the Volta basin and other areas in the south and south-west (important for the white-necked picathartes).

9. Protected areas need to be established for coastal mangroves in the southeast of the country.

10. The Kalakpa Game Production Area should be regazetted as a Nature Reserve.

11. A survey of incidental killing of dolphins and porpoises in coastal fisheries should be carried out, and appropriate conservation measures taken.

12. Nesting areas for marine turtles need to be identified and protected.

13. Research on the conservation requirements of threatened amphibians should be carried out.

14. The status of all three species of crocodile should be assessed, and conservation action initiated if appropriate.

Rainforest in the Ankasa Game Reserve, Ghana (Photo: WWF/Claude Martin).

Chapter 23: Guinea

Introduction

Area: 245,855 km^2. Cultivated: 6%. Pasture: 12%. Forest/woodland: 42%.

Population (1989 data): 7,086,000. Urban: 22%. Labour force in agriculture (1980): 81%. Density: 29/km^2. Annual growth rate: 2.4%, increasing. Doubling time: 29 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: no data. GNP annual growth rate: no data.

Biogeographic affinities: Guinea-Congolian in the south and southwest, Sudanian in the northeast, with Guinea-Congolian/Sudanian Regional Transition Zone covering most of the country. There are Afromontane elements on Mount Nimba and Fouta Djallon.

Vegetation: Most of the country is a mosaic of forest patches and secondary grassland. Extensive lowland forests survive in the south near the Ivorian and Liberian borders, with montane forest at higher altitudes. Sudanian woodland occurs in the northeast, with extensive areas of mangroves along the coast

Map of Guinea. 1: Savanna woodland zone. 2: Moist lowland forest zone. 3: Fouta Diallon. 4: Ziama Massif. 5: Mount Nimba. 6: Niger River. 7: Falala River. 8: Konkoure River. 9: Badiar National Park. 10: Atlantic Ocean. 11: Conakry. 12: Kindia.

Critical Sites

1. Guinea is particularly poorly known biologically, and it is only possible to give a preliminary list of critical sites. The forest areas of the southeast are certainly important, especially Mount Nimba (shared with Ivory Coast and Liberia). The Reserve Naturelle Integrate de Monts Nimba is a World Heritage Site. Another important forest area in the southeast is the the Fouta Djalon Plateau, which is important both as a watershed and as a centre of endemism for plants and contains the small but important Massif du Ziama Biosphere Reserve. This whole area still needs to be gazetted properly, with clearly defined boundaries. Further surveys will no doubt identify other critical forest sites.

2. Even less is known about possible critical sites in the savanna woodlands, though the recently gazetted Badiar (or Tomine) National Park, adjoining the Niokolo-Koba National Park in Senegal, is clearly of importance, and the possibility now exists for the two countries to cooperate in anti-poaching activities. Other critical sites in the woodland savannas should be indentified.

3. There are probably also some important wetland and mangrove sites which need to be identified, with a view to appropriate conservation and rural development programmes.

Critical Species

1. Plants. The number of species is not known, though there are over 2,000 in the Mount Nimba area alone (including in Ivory Coast and Liberia). 88 endemic species are known from Guinea, with centres of endemism at Fouta Djalon and Mount Nimba.

2. Primates. 14 species occur, including the chimpanzee and diana monkey (especially in the forest zone), and two subspecies of red colobus: Temminck's red colobus in the northwest, and the bay colobus in the southeast.

3. Antelopes. The antelope fauna is very poorly known, with 16-17 species occurring. Rare forest species, such as Jentink's and the zebra duiker, probably occur in the south of the country, but have not been recorded.

4. Fruit Bats. Eight species occur, of which one is of conservation concern: *Epomops buettikoferi* (endemic to the West

African forests of Guinea, Ghana, Ivory Coast, Liberia, Nigeria and Sierra Leone).

5. Other Mammals. Elephants still occur, but only in very small numbers. The rare Johnston's genet occurs in the southern forests, including Mount Nimba, and the even rarer Liberian mongoose could possibly occur in the same area. The Mount Nimba otter-shrew is endemic to Mount Nimba (including Ivory Coast and Liberia) and is probably very rare. Good populations of pygmy hippopotamus probably survive in the southeast, and there might also be a significant manatee population. The extent and impact of dolphin and porpoise deaths in coastal fisheries is currently not known.

6. Birds. Three threatened species have been recorded, all from the forests in the southeast: the rufous fishing-owl, yellow-throated olive greenbul, and white-necked picathartes. Several other threatened species are recorded from the Ivorian and Liberian sectors of Mount Nimba, and these probably also occur in Guinea.

7. Reptiles. All three crocodile species occur, but there is no recent information on their status. Similarly, there is no information on marine turtles in coastal waters, though nesting is supected to occur.

8. Amphibians. Ten species of conservation concern occur, including three endemics. The southeastern forest zone is clearly particularly important for these species, especially around Mount Nimba. Of particular interest is the remarkable viviparous toad *Nectophrynoides occidentals,* which is known only from the Guinean and Ivorian sectors of Mount Nimba.

9. Invertebrates. The African giant swallowtail butterfly is known from the southeastern forests, near the Liberian border.

Threats

1. Despite recent advances, Guinea's protected area system does not yet cover a full representation of the country's ecosystems. Until the system is completed, several species and habitats must be considered to be at risk.

2. Because Guinea is so poorly known biologically, there is the possibility that critical sites could be destroyed before their value is known.

Current Conservation Measures

1. Government of Conservation

(a) The Ministry of Agriculture and Animal Resources is responsible for the management of forests, wildlife, protected areas, and fisheries.

(b) The Ministry of Mineral Resources and the Environment oversees the larger environmental questions.

2. Multi-agency Projects

(a) Development of an environmental action plan for Guinea (Government/IBRD/IUCN): this constitutes the beginning of a process to develop a National Strategy for Sustaxability.

3. GTZ Projects

(a) Assistance to improve forestry management, especially in rural areas, and to ensure that harvesting is at a sustainable level.

4. IBRD Projects

(a) Development of Man-and-Biosphere Reserve at Mount Nimba.

5. ICBP Projects

(a) Waterbird inventory in the coastal area, providing ornithological data in the context of a comprehensive coastal zone planning exercise, thereby pinpointing possible sites for reserves and Ramsar Sites.

Suggested Conservation Activities

1. The Massif du Ziama Biosphere Reserve needs to be gazetted, with boundaries including the Fouta Djalon Plateau.

2. Continued development of the protection afforded in the Mount Nimba National Park is essential for the habitat and for a number of rare or threatened species of viverrids, birds and amphibians.

3. Surveys to identify further critical forest sites need carrying out and appropriate protection established.

4. Surveys for the identification of critical woodland savanna sites should be carried out and appropriate protection established.

5. Critical sites for protection of mangrove and wetland areas need to be identified and integrated conservation measures initiated.

6. In all protective schemes, an emphasis on sustainable use of wildlife resources, particularly bushmeat as a protein source, is essential.

7. Surveys of forest antelope species should be carried out in the south of the country.

8. Investigations into the distribution of some mammals are needed, particularly rare viverrids (see *Critical Species 5* above).

9. Surveys of the status of crocodiles and marine turtles are needed, with conservation measures where necessary.

10. A survey of incidental killings of dolphins and porpoises in coastal fisheries should be carried out and conservation action taken if necessary.

11. Anti-poaching action needs to be strengthened, in co-operation with Senegal in the north.

Chapter 24: Guinea-Bissau

Introduction

Area: 36,125 km^2. Cultivated: 8%. Pasture: 35%. Forest/woodland: 30%.

Population (1989 data): 966,000. Urban: 27%. Labour force in agriculture (1980): 82%. Density: 27/km^2. Annual growth rate: 1.9%, increasing. Doubling time: 37 years.

Economy (1987 data): World Bank index: no data. GNP/capita: US$ 170. GNP annual growth rate: 1.6%.

Biogeographic affinities: Guinea-Congolian/Sudanian Regional Transition Zone.

Vegetation: Originally a mosaic of lowland forest and woodland, but now largely cleared and secondary grassland dominates in most places. There are very large areas of mangroves along the coast and on the offshore islands.

Critical Sites

1. A protected areas system has not yet been established in Guinea-Bissau, but a number of important areas are known. There are very extensive coastal and estuarine mangroves, inter-tidal mudflats, and coastal wetlands. These are of particular importance for migratory birds.

2. Interesting forest patches survive at Olon, Lagoa de Cufada, and Cantanhez. These are potential sites for protected areas.

3. The Bijagos Archipelago is of particular importance for mangroves and inter-tidal mudflats. Large numbers of wintering waders occur on these islands, which are also noted for their marine hippos.

Critical Species

1. Plants. About 1,000 species occur, with up to 12 endemics.

2. Primates. 11 species occur, including the savanna baboon, Temminck's red colobus and chimpanzee.

3. Other mammals. 13-14 species of antelopes occur, with both forest and savanna species. Elephants are now reduced to tiny numbers. Marine hippos occur around the Bijagos Archipelago. The status of manatees is of concern, and small numbers of dolphins are caught in the coastal fisheries.

4. Birds. No threatened species occur, but the mangroves and wetlands are important for migratory species, with huge numbers of waders occurring on the inter-tidal mudflats.

5. Reptiles. The Nile and African dwarf crocodiles both occur, but there is little information on their status. Three species of marine turtle nest: the green turtle, the hawksbill, and the leatherback. The loggerhead has also been reported from the coastal waters.

6. Amphibians. One threatened species occurs, *Pseudhymenochirus merlini*, which also occurs in Guinea and Sierra Leone.

7. Invertebrates. The dragonfly *Brachythemis liberiensis* is known only from Guinea-Bissau, though there are no recent records.

Threats

1. Guinea-Bissau does not yet have a protected area system (although six hunting reserves exist on paper), and until this is completed and properly implemented, several species and habitats must be considered to be at risk.

2. Because Guinea-Bissau is so poorly known biologically, there is the possibility that critical sites could be destroyed before their value is known.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Ministry of Rural Development and Agriculture is responsible for the management of forests and wildlife through the Directorate General of Forestry.

(b) The Ministry of Fisheries oversees the conservation and management of fisheries.

2. Multi-agency Projects

(a) Preparation of a National Conservation Strategy (Government/IUCN/EEC): provision of technical and finan-

cial assistance for development of the strategy.

(b) Conservation and sustainable development in the coastal zone (IUCN/DDA): includes surveys of natural resources (including crocodiles, turtle nesting sites, manatees, etc), establishment of protected areas (two planned in Bijagos Archipelago and one on mainland), and development of sustainable use programmes.

3. Netherlands Government Projects

(a) Forestry project at Pirada, including rural development and management of natural vegetation.

Suggested Conservation Activities

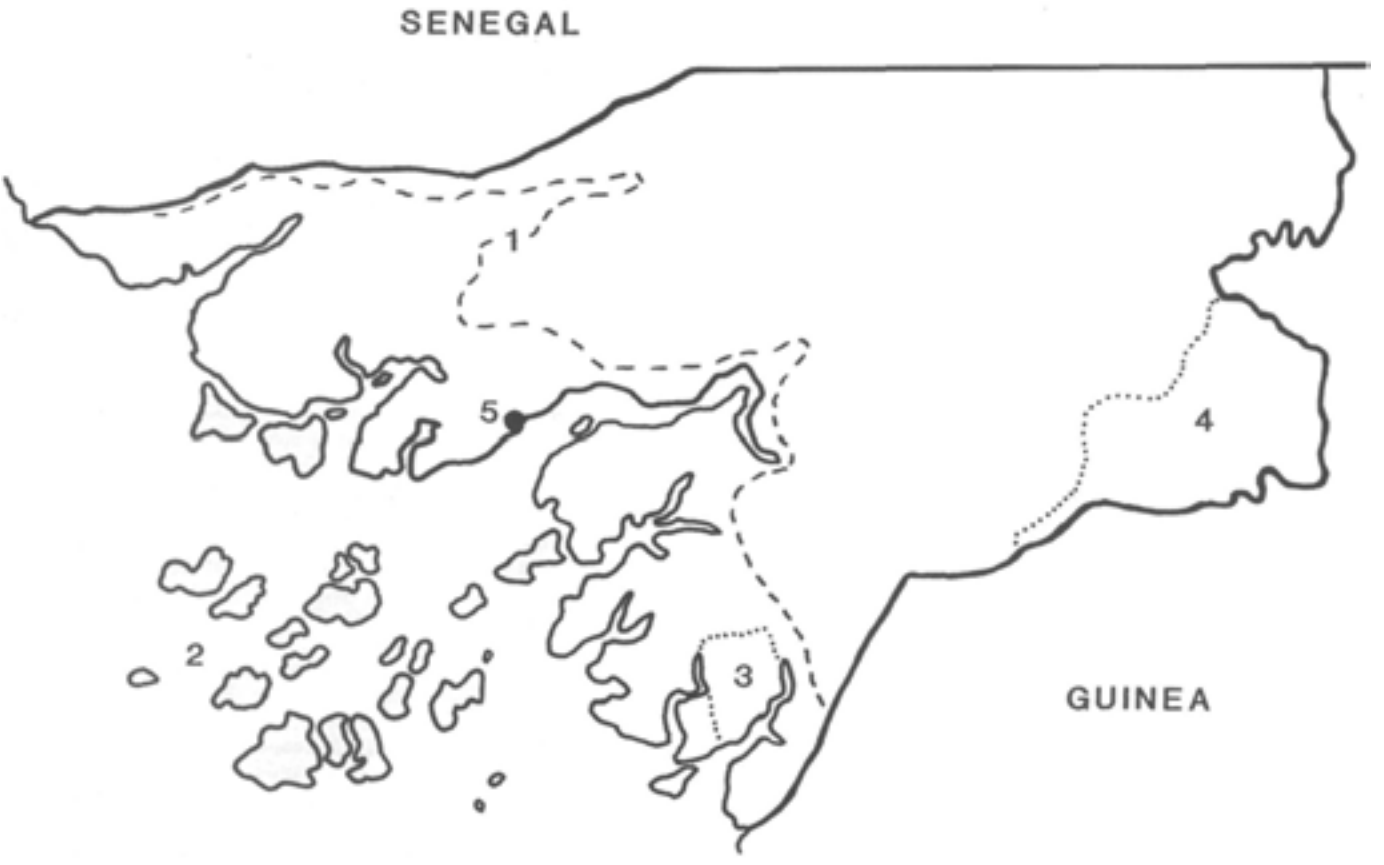
1. The country needs to establish a protected area system as a matter of urgency.

2. Protection of coastal and estuarine mangroves is needed. The Bijagos Archipelago, an important habitat complex for, most notably, migratory birds, waders and marine hippos, is proposed as a protected area, including mudflats.

3. Protection strategies should incorporate a strong emphasis on sustainable use of wildlife resources, particularly bushmeat as a source of protein.

4. A survey of coastal fisheries is needed to identify the extent and impact of incidental dolphin and porpoise deaths, and to propose appropriate conservation action.

5. Surveys of all three species of crocodile are needed, and of marine turtles with special reference to nesting sites.



Map of Guinea-Bissau. 1: Approximate inland limit of mangroves. 2: Bijagos Archipelago. 3: Cantanhez Forest. 4: Administrative sector of Boe. 5: Bissau.

Chapter 25: Ivory Coast

Introduction

Area: 322,463 km^2. Cultivated: 12%. Pasture: 9%. Foresl/woodland: 24%.

Population (1989 data): 12,097,000. Urban: 43%. Labour force in agriculture (1980): 65%. Density: 38/km^2. Annual growth rate: 3.6%, decreasing. Doubling time: 19 years.

Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: US$ 750. GNP annual growth rate: 3.8%.

Biogeographic affinities: Guinea-Congolian in the south, Sudanian in the north, with Guinea-Congolian/Sudanian Regional Transition Zone in the centre. Afromontane elements on Mount Nimba

Vegetation: Lowland forests are the natural vegetation of the south, though they are now much reduced in area. Sudanian woodland covers most of the northern part of the country, with forest patches interspersed with secondary grassland in the centre. There are small areas of mangrove and swamp forest along the coast, and montane forest on Mount Nimba.

Critical Sites

1. Ivory Coast possesses some of the most important sites for biological diversity conservation in West Africa. Of particular importance is the Tai National Park and the contiguous N'Zo Faunal Reserve. These include the largest area of undisturbed lowland rainforest in West Africa, and comprise an important centre of diversity for many species, including plants, birds, primates and large mammals. The area is designated as a biosphere reserve, but logging and poaching have been relatively uncontrolled for some time and management needs to be strengthened.

2. Several other smaller protected areas have been established in the forest zone, including the national parks of Azagny and Banco, the Divo Botanical Reserve (recently reduced by farming incursions), and the Mount Nimba Strict Nature Reserve (adjoining the reserve in Guinea). Of these, Mount Nimba is of particular importance for plants and a wide variety of other species, although in recent years it has suffered greatly from fire damage and poaching. Good opportunities for tourism development exist at Azagny. There is a need to establish a protected area in the forests of the southeast of the country, near the border with Ghana, which are slightly different in terms of their species composition from the more extensive forests in the southwest. The country's forest reserves are in general in need of much greater protection.

Major natural vegetation zones of Ivory Coast (Ss = Sudanian savanna; Sg/Fs = Guinean savanna and forest-savanna mosaic; Fd = Guinean dense moist forest), and protected areas including wildlife conservation areas (national parks, game reserves and nature reserves), and forest reserves of particular importance for wildlife conservation. *Protected areas* — 1: Tai National Park (3400 sq km), Buffer Zone (660 sq km) and N'Zo Game Reserve (727 sq km). 2: Haut Dodo (2000 sq km), Rapide Grab (2042 sq km) and Hana (720 sq km) Forest Reserves. 3: Cavally-Gouin Forest Reserve (1890 sq km). 4: Scio Forest Reserve (1338 sq km). 5: Mont Peko National Park (340 sq km). 6: Haut Sassandra Forest Reserve (1024 sq km). 7: Niegre Forest Reserve (1056 sq km). 8: Divo Botanical Reserve (73 sq km). 9: Azagny National Park (200 sq km). 10: Banco National Park (30 sq km). 11: Iles des Ehotiles National Park (about 5 sq km). 12: Songan-Tamin-Mabi-Yaya Forest Reserves (2307 sq km). 13: Beki-Bossematie Forest Reserves (389 sq km). 14: Mont Sangbe National Park (950 sq km). 15: Marahoue National Park (about 1010 sq km). 16: De Forest Reserve (129 sq km). 17: Fetekro-Laka-Mafa-Besse-Boka Forest Reserves (316 sq km). 18: Mont Nimba Nature Reserve (5 sq km). 19: Comoe National Park (11 500 sq km), Suitoro Forest Reserve (226 sq km) and Belagefima Forest Reserve (228 sq km). 20: Warigue Forest Reserve (621 sq km). 21: Nougbo Forest Reserve (208 sq km). 22: Leraba Forest Reserve (235 sq km). 23: Kinkene Forest Reserve (453 sq km). 24: Nyellepuo-Nzi Forest Reserves (1504 sq km). 25: Haut Bandama Game Reserve (1230 sq km). 26: Foumbou Forest Reserve (600 sq km). 27: Boundiali-Pale Forest Reserve (386 sq km). 28: Mont Gbande Forest Reserve (231 sq km).

3. Ivory Coast also has some very important protected areas in the savanna zone, in particular the large Comoe National Park, which includes a great variety of habitats, including some forest patches in the south. Significant populations of large mammals occur in the park. It has been created as a biosphere reserve, and there are good opportunities for tourism development, but a management plan is needed. Other important savanna reserves are the Marahoué National Park, the Haut Bandama Reserve, and in the forest-savanna mosaic zone, the Mount Peko and Mount Sangbe National Parks. The Marahoué National Park is suffering from extensive poaching, logging and settlements and a management plan is needed, with much stricter protection. The Haut Bandama Reserve is also lacking infrastructure and is threatened by illegal hunting.

Critical Species

1. Plants. Probably about 4,700 species occur, including around 90 endemics. Concentrations of species occur on Mount Nimba (about 2,000 species, including in adjacent Guinea and Liberia), and in Tai National Park (nearly 900 species).

2. Primates. 17 species occur, including sooty mangabey, diana monkey, olive colobus, red colobus and chimpanzee, including a well-known population of tool-using chimpanzees. All of these occur in Tai National Park. Some rare subspecies occur in the forests of the southeast: Waldron's red colobus *Procolobus badius waldroni,* diana monkey *Cercopithecus diana roloway,* and sooty mangabey *Cercocebus atys lunulatus.* All of these populations urgently need protection.

3. Antelopes. 19 species occur, with Tai and Comoe National Parks holding particularly important populations of forest and savanna populations respectively. Other important areas are Mount Peko and Marahoue National Parks, though protection needs to be improved, especially in the latter. Two particularly localised species, Jentink's duiker and zebra duiker, occur in the southwest.

4. Fruit Bats. 12 species occur, of which one is of conservation concern: *Epomops buettikoferi* (endemic to the West African forests of Ivory Coast, Ghana, Guinea, Liberia, Nigeria and Sierra Leone).

5. Other mammals. Ivory Coast holds important populations of several species of large mammal, including elephant (about 1,000, which is relatively high for West Africa), buffalo, manatee, hippopotamus, pygmy hippopotamus and giant forest hog (known to be threatened). The elephant populations in Tai and Comoe National Parks are considered to be priority baseline populations for West Africa. The wild dog is still known in the north of the country, but probably as a visitor rather than a permanent population. Two rare viverrids occur in the forest zone, Johnston's genet and Leighton's linsang. There is a possibility that the even rarer Liberian mongoose might occur in the southwest (possibly in Tai). Four rodent species of conservation concern occur, including a rare species of African climbing wood mouse *Hylomyscus baeri* in the south of the country, otherwise known only from southern Ghana. Important populations of manatees occur in the coastal lagoons. It is known that dolphins and porpoises are being killed unintentionally in the coastal fisheries but the scale and impact of the problem are unknown.

6. Birds. Seven threatened species occur in Ivory Coast, all in the forest zone. All have been recorded from Tai National Park, which might include the largest surviving population of the white-breasted guineafowl anywhere in the world. The other species are the rufous fishing owl, western wattled cuckoo-shrike, yellow-throated olive greenbul, white-necked picathartes, Nimba flycatcher and Gola malimbe. The last two of these are particularly restricted in distribution.

7. Reptiles. All three species of crocodile occur in depleted populations, though they are probably not threatened. Marine turtle populations are very poorly known: both olive ridley and leatherback have been reported nesting, and the loggerhead has also been recorded.

8. Amphibians. Eight species of conservation concern occur, all in the forest zone. There are two endemics, *Bufo danieli* and *Kassina lamottei,* both of which are restricted to the forests of the southwest. Of particular interest is the viviparous toad *Nectophrynoides occidentalis* on Mount Nimba (which also occurs in Guinea).

9. Invertebrates. The African giant swallowtail butterfly has been recorded from the forest zone.

Threats

1. The most serious threat to Ivory Coast's biodiversity comes from the clearance of lowland rainforest, which has been particularly severe in the south. The survival of forest under a sustainable management regime outside the protected areas appears to be in doubt.

2. The protected area system is well-developed, but not yet comprehensive, in particular, lowland forests in the southeast, and marine habitats are at risk and need to be included. Pollution and invasive species are a particular threat in marine areas.

3. In some areas the management of reserves is not sufficient, and there are serious poaching problems in Tai, Comoe, Azagny, Nimba and Marahoué.

Current Conservation Measures

1. Government Administration of Conservation

(a) The lead ministry in environmental matters is the Ministry of Agriculture, Water and Forests. The management of National Parks, other protected areas, and wildlife all come under this Ministry.

(b) The management and conservation of fisheries comes under the Ministry of Animal Resources.

2. Multi-agency projects

(a) Development plan for Tai National Park (WHF/WWF): park boundary clarification, improved surveillance and enforcement, and long-term resettlement for displaced people.

(b) Research on sustainable forest management (TROPENBOS/Netherlands Government).

3. GTZ Projects

(a) Development of sustainable, integrated forest management in the east of the country, in cooperation with local communities.

4. ICBP Projects

(a) Bird surveys in the Tai National Park to identify specific conservation needs for this important area.

5. UNDP Projects

(a) Remote-sensing and mapping to monitor habitat changes as a result of agriculture, logging and fires.

(b) Relocation and resettlement of farmers from protected areas.

(c) Development of rural fisheries to achieve self-sufficiency in the supply of animal proteins in diet

6. WCI Projects

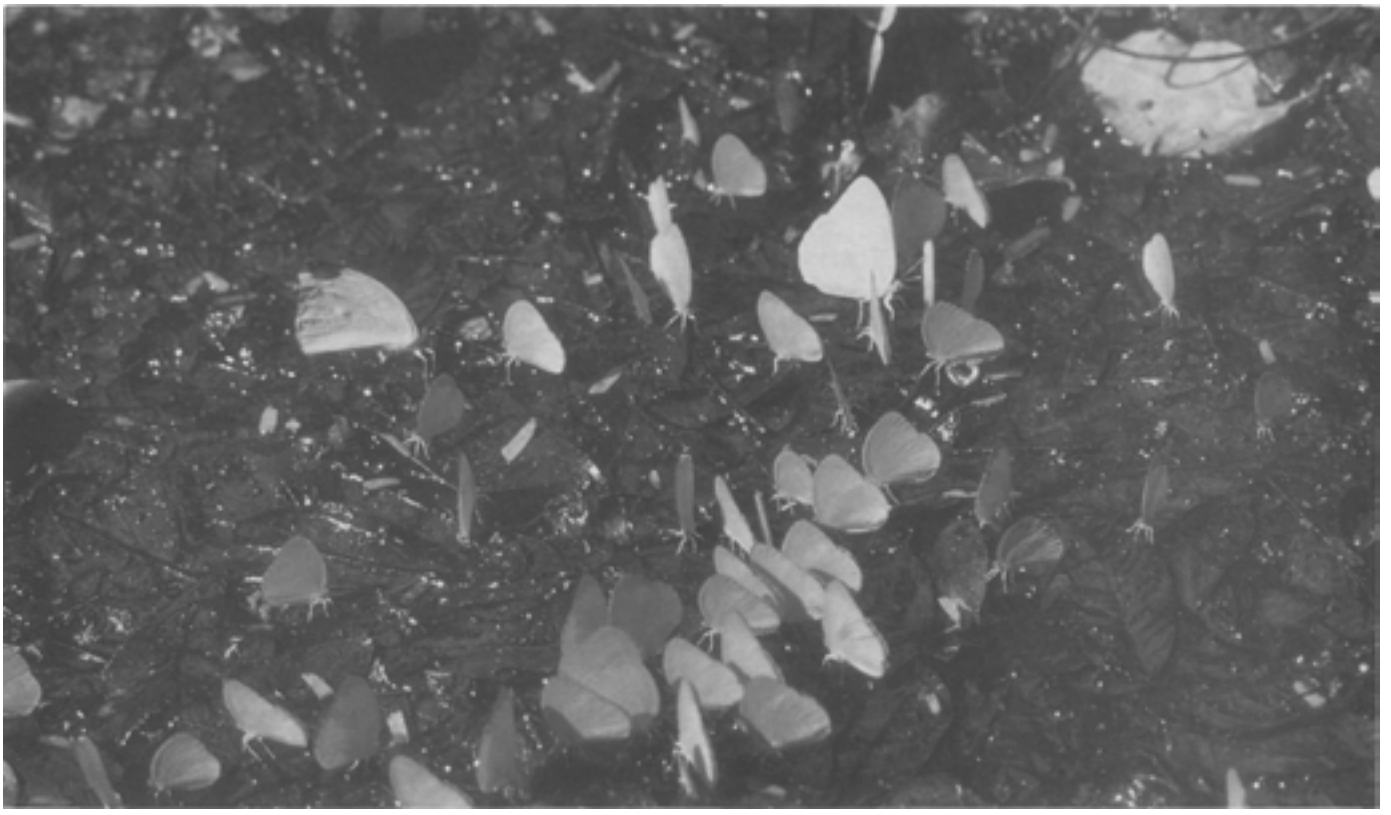
(a) Manatee and mangrove research and conservation.

7. WHF Projects

(a) Training course on national park management with emphases on park planning and development of local people.

Suggested Conservation Activities

1. The Tai National Park and adjacent N'Zo Faunal Reserve need management plans and stricter anti-poaching measures in order to preserve their uniqueness as habitats in West Africa. Also, management needs to be strengthened with a view to controlling gold prospectors, as well as the



Butterflies near a forest pond in western Ivory Coast (Photo: WWF/Philippe Oberlé).

provision of improved roads, patrol posts and rural development programmes for the people who have been displaced by the Park. Species-specific measures may be needed in relation to elephant, antelope, viverrids and birds (especially the white-breasted guineafowl).

2. The major forest reserves (see *Critical Sites* 2) should be priorities for conservation action. Control of deforestation in lowland forests needs urgent control, outside of protected areas as well as within them.

3. A new protected area should be established in the southeastern forests, near the border with Ghana, for rare primates and other species.

4. The impact of development projects on biological diversity should be assessed and appropriate modifications made where necessary: this is of particular urgency in the case of a proposed coast road which would have a devastating effect on some of the wetland and forest resources in the coastal area.

5. Although sustainable use of bushmeat as a protein source is desirable in many west African countries, it appears that game is so depleted in Ivory Coast that this is currently unrealistic in much of the country. Surveys and collation of existing data would be valuable to assess the status of species involved and to provide a basis for action such as ranching, game management areas etc.

6. Tourism development should be accelerated in Azagny National Park.

7. Protective measures in Mount Peko and Marahoue National Parks need to be increased, particularly in relation to antelopes. Marahoué National Park needs urgent action to reduce poaching.

8. A management plan, incorporating tourism development, is needed for Comoe National Park.

9. A survey of the effects of incidental dolphin and porpoise deaths in coastal fisheries is needed, with subsequent appropriate conservation action.

10. Marine turtle populations need a survey which should be followed by appropriate conservation measures, particularly at nesting sites.

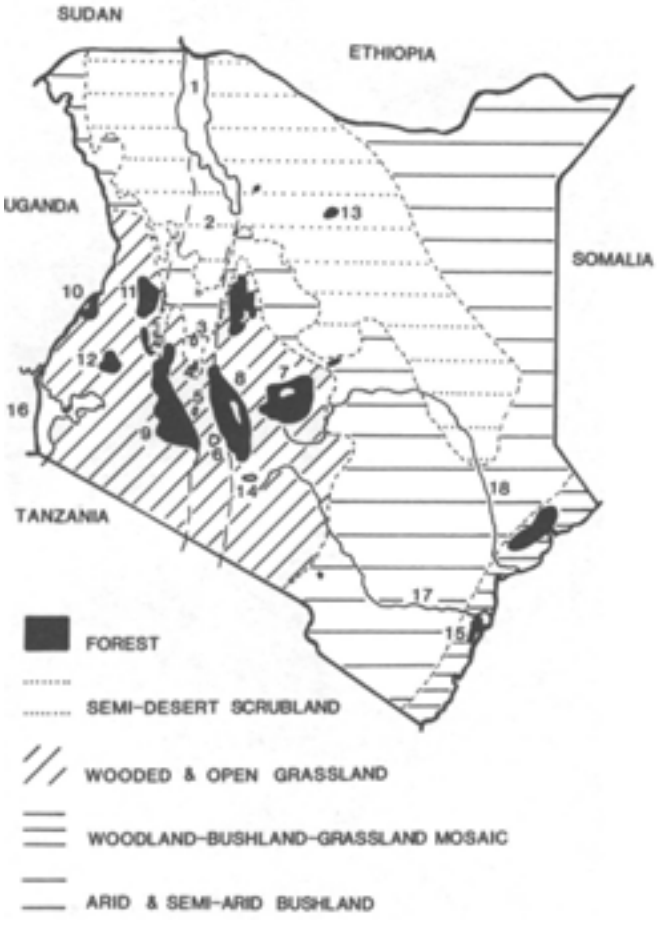
Chapter 26: Kenya

Introduction

Area: 582,644 km^2. Cultivated: 4%. Pasture: 6%. Forest/woodland: 6%.

Population (1989 data): 24,097,000. Urban: 19%. Labour force in agriculture (1980): 81%. Density: 41/km^2. Annual growth rate: 4.1%, increasing. Doubling time: 17 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 340. GNP annual growth rate: 4.3%.



Approximate major natural vegetation zones of Kenya. 1: Lake Turkana. 2: Rift Valley. 3: Lake Baringo. 4: Lake Bogoria. 5: Lake Nakuru. 6: Lake Naivasha. 7: Mount Kenya. 8: Aberdare Mountains. 9: Mau escarpment. 10: Mount Elgon. 11: Cherengani Hills. 12: Kakamega Forest. 13: Marsabit Mountain. 14: Nairobi. 15: Arabuko-Sokoke. 16: Lake Victoria. 17: Galana River. 18: Tana River.

Biogeographic affinities: Predominately Somali-Masai; Afromontane in the mountains with Afroalpinc elements on the highest peaks; Zanzibar-Inhambane Regional Mosaic along the coastal belt; Lake Victoria Regional Mosaic in the the west; and Guinea-Congolian in the Kakamaga area.

Vegetation: Predominately dry bushland in the north and east, giving way to grassy plains in the south and to a lusher strip along the coast, where there are a few remaining forest patches and some mangroves; the high central plateau is densely settled and now mainly under cultivation. The mountains arising from this were characterised by montane forests on their lower slopes giving way to heath and moorland above, but much of the forest has been replaced by plantations of exotic conifers. The west around Lake Victoria has been largely cleared for agriculture, though some swamps remain and forest survives in the Kakamega area.

Critical Sites

1. Kenya has a huge diversity of critical sites, many of which comprise protected areas. Best known are the savanna protected areas which encompass nearly all of the savanna habitat types within the country. Of particular importance is the huge Tsavo National Park with the surrounding South Kitui and Ngai Ndethya National Reserves, the Galana Ranch, and the Taita Hills Game Sanctuary (this is not part of the Taita Hills themselves), in the semi-arid east. To the north, the Meru and Kora National Parks with the contiguous Bisanadi, North Kitui and Rahole National Reserves form another large block of semi-arid lowland woodland. The Masai Mara National Reserve forms the northern extension of the Serengeti (the bulk of which is in Tanzania) and has the highest concentrations of wildlife in Kenya. Other savanna reserves with notable concentrationns of wildlife include Amboseli National Park, Lake Nakuru National Park, Nairobi National Park, and the contiguous Samburu and Buffalo Springs National Reserves. Many other reserves are important for the protection of particular ecosystems and species: Sibiloi National Park, Central Island and South Island National Parks (in Lake Turkana), Mount Kulal Biosphere Reserve, Marsabit National Park and Reserve, Losai National Reserve, South Turkana National Reserve, Nasolot National Reserve, Maralai Game Sanctuary, Shaba National Reserve, Lake Bogoria National Reserve, Hell's Gate National Park, Murea National Park, Lambwe Valley Nation-

al Park (important for roan antelope) and Arawale National Reserve (important for hirola antelope). In Kenya, a number of non-protected areas are important for wildlife, in particular the Loita Plains, north of Masai Mara, where there are very large concentrations of migratory animals at certain times of the year. Some areas of private land are also important, including several ranches on which black rhinos survive, most notably Solio and Laikipia.

2. Kenya also has extensive areas of montane forests and associated habitats. Several of these are in protected areas: Mount Kenya National Park, Aberdares National Park, Mount Elgon National Park, Ol Doinyo Sabuk National Park, Marsabit National Park and Mount Kulal Biosphere Reserve. In some of these areas there are important forests outside the protected areas, especially on Mount Elgon. In other important montane forest areas there is less effective protection at present: the Chcrangani Hills, Loita Hills, Nguruman Hills, Mau (the largest forest area in Kenya with a well-protected National Reserve in the south-west), North and South Nandi Forests (a high priority for a nature reserve), Chyulu Hills, Taita Hills (a unique area biologically in which very little forest survives), Kasigau and Mount Endau. This list is by no means exhaustive, and there are numerous other small patches of montane forest, many of which might prove to be important for biological diversity conservation.

One of the entrances of the Aberdare National Park, Kenya (Photo: WWF/F. Vollmar).

3. Some of the most interesting areas in Kenya biologically are the remnant patches of lowland forest. The Kakamega Forest (part of which is a national park) is the easternmost extension of the central African forests, and is of great biological interest, despite its small size. The eastern coastal forests are less biologically diverse than Kakamega, but have many more rare endemic species. The Arabuko-Sokoke Forest is one of the most important sites in Africa for threatened animal species, but is under pressure despite the Forestry Department's protection and management. Other important coastal forests include the Boni National Reserve, Dodori National Reserve, Tana River Primate Reserve (and other riverine forests along the Tana River), the tiny sacred "Kaya" forests in the area from Kilifi to Diani (of great interest botanically and for cave-dwelling bat species), the Shimba Hills National Reserve, and forest patches at Jadini, Shimoni, Muhaka, Gongoni, Kiruku, Mrima and Jombo. All Kenya's coastal forests are under serious threat, and in view of their uniqueness, all should be protected. There is also an interesting area of lowland forest at Kitovu near Taveta.

4. Kenya also has a wide array of lakes and wetland habitats. Lake Victoria is home to many endemic species of fish. In the Rift Valley there are many interesting soda lakes, including Lake Turkana, Lake Bogoria, Lake Nakuru, Lake Elmenteita and Lake Magadi, as well as two freshwater bodies, Lake Baringo and Lake Naivasha. These are important for waterbirds, and the soda lakes are well known for their concentrations of flamingoes. Lake Jipe and the Shompole Swamp, both on the border with Tanzania, are important freshwater site for birds. There are also a number of important swamps, including the small Saiwa Swamp National Park (noted for its Sitatunga), Litikiri Swamp, and the Yala Swamp (including Lake Kanyaboli) near Lake Victoria which is characteristic of the central African papyrus swamps. None of these wetland areas is protected adequately.

5. Kenya is probably the best endowed country in Africa for marine protected areas. These are the Kisite-Mpunguti and Malindi-Watamu protected area complexes, and Kiunga Marine National and Biosphere Reserve. Additional protected areas are proposed for Diani and Ras Tenewi. These areas include coral reefs, seagrass beds, dugong and turtle populations and seabird colonies of international significance but current levels of protection are limited.

The baobab *Adansonia digitata,* Kenya, is characteristic of large areas of Africa (Photo: WWF/G.W. Frame).

6. Kenya's desert areas are currently receiving no protection. The Chalbi and Karoli areas are particularly important as examples of this habitat.

Critical Species

1. Plants. Some 6,500 species are known, with at least 265 endemics. However, it is likely that the total is nearer 7,500 species in Kenya, of which 1,000 are likely to be of conservation concern. A preliminary list indicates 100 threatened plant species. In particular, the coastal forests are of interest botanically, especially those on limestone outcrops. Other important sites include inselbergs in semi-arid areas, and also riverine habitats. The tiny sacred "Kaya" Forests are also very important for endemic plants. The Tana River forests are also important, and a new species of ironwood tree, *Cynometra lukei*, was discovered there in 1988. Orchids, and particularly aloes, have been severely overexploited for trade.

2. Primates. 17 species occur. Of particular interest are the Zanzibar galago in the coastal forests, the Tana River mangabey and Tana River red colobus (for which the Tana River Primate Reserve was established). Despite the reserve, populations continue to decline, drastically in the case of the colobus. Declines are associated with forest fragmentation due to agricultural clearing, changes in the Tana River's course, the activities of Shifta terrorists, and possibly also decreased forest regeneration following the construction of dams upstream on the Tana River; the species is now under severe threat.

3. Antelopes. Up to 37 species occur, including the rare and declining hirola (Hunter's hartebeest) in Dodori and Garissa Districts (in particular the Arawale National Reserve), which otherwise occurs only in neighbouring Somalia, and Ader's duiker (in the Arabuko-Sokoke Forest), which otherwise occurs only on Zanzibar. The rare Soemmerring's gazelle may sometimes enter northern Kenya from Ethiopia, but it is unlikely that any permanent population occurs. Remnant populations of sable antelope occur in Shimba Hills National Reserve, and of roan antelope in Lambwc Valley National Park. The following areas are considered to be of highest priority for antelopes: the Tsavo area; the Meru and Samburu complexes of reserves; Amboseli, Sibiloi, Masai Mara and the Loita Plains; the Aberdare Mountains; Mounts Kenya and Elgon; the Kakamega and Nandi Forests; Arawale National Reserve and the Tana River area; the Boni and Dodori areas; the Arabuko-Sokoke Forest; and Shimba Hills National Reserve.

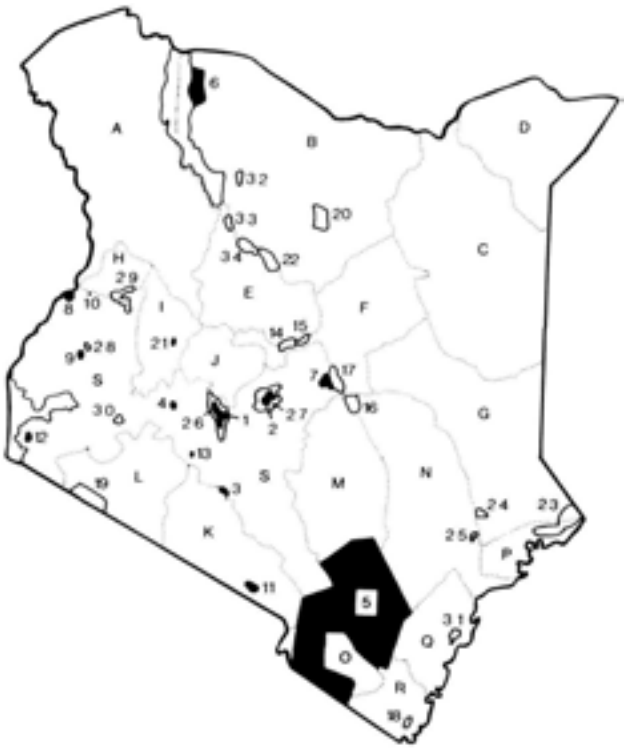
4. Elephants and Rhinos. Elephants are now reduced to fewer than 17,000 animals. The priority baseline populations

Lewa Downs Ranch, Kikuju, Kenya, one of the sites where black rhinos survive (Photo: WWF/Mauri Rautkari).

Four-toed Elephant Shrew, *Petrodromus tetradaclylus,* Kenya (Photo: WWF/Mark Boulton).

are in Tsavo, the Aberdares, Mount Kenya, Amboseli, Masai Mara, Samburu, Marsabit, Mount Elgon and Laikipia. The black rhinoceros is reduced to around 350 animals, scattered in about 17 populations, the most important being Tsavo, Nakuru, Nairobi National Park, Mount Kenya, the Aberdares, and the Solio and Laikipia ranches. Only about 65 of these animals are outside these sanctuaries. Efforts at consolidating these populations through the national rhino conservation strategy should be continued. The poaching of both elephants and rhinos has been a severe problem in many areas but is now believed to be under control.

5. Rodents. Six species of conservation concern occur, including the lesser hamster-rat *Beamys hindei* (in southeastern coastal Kenya as well as northeastern Tanzania), a pygmy species of multimammate mouse *Mastomys pernanus* (around Lake Victoria, also in Tanzania and Rwanda), an African pygmy mouse *Mus wamae* (only known from southeastern Kenya), and a mole-rat *Heliophobius spalax* (endemic to Kilimanjaro, just extending into Kenya).



Some Important conservation areas In Kenya, and districts which retain significant rangeland wildlife populations. *National parks* — 1: Aberdare (722 sq km). 2: Mount Kenya (588 sq km). 3: Nairobi (117 sq km). 4: Lake Nakuru (200 sq km; land area 157 sq km). 5: Tsavo (20 821 sq km). 6: Sibiloi (1570 sq km). 7: Meru (870 sq km). 8: Mount Elgon (169 sq km). 9: Kakamega Forest (97 sq km). 10: Saiwa Swamp (2 sq km). 11: Amboseli (392 sq km). 12: Lambwe Valley (Ruma) (120 sq km). 13: Hell's Gate (68 sq km). *National Reserves* — 14: Samburu-Isiolo (Buffalo Springs) (504 sq km). 15: Shaba (239 sq km). 16: Kora (1500 sq km). 17: Rahole (2820 sq km). 18: Shimba Hills (192 sq km). 19: Masai Mara (1510 sq km). 20: Marsabit (2088 sq km). 21: Lake Bogoria (107 sq km). 22: Losai (1806 sq km). 23: Boni-Dodori (2316 sq km, including 977 sq km Witu Forest Reserve). 24: Arawale (533 sq km). 25: Tana River (165 sq km). *Forest Reserves* — 26: Aberdare-Kinangop (1200 sq km). 27: Mount Kenya (1800 sq km). 28: Nandi (includes 34 sq km North Nandi Nature Reserve). 29: Cherengani-Kongelai (925 sq km). 30: South West Mau Nature Reserve (430 sq km). 31: Sokoke-Arabuko (includes 43 sq km Arabuko-Sokoke Nature Reserve). 32: Mount Kulal. 33: Mount Nyiru. 34: Ndoto Mountains. *Districts* — A: Turkana. B: Marsabit C: Wajir. D: Mandera. E: Samburu. F: Isiolo. G: Garissa. H: West Pokot. I: Baringo. J: Laikipia. K: Kajiado. L: Narok. M: Kitui. N: Tana River. O: Taita Taveta (includes Tsavo National Park south of Galana River.) P: Lamu. Q: Kilifi. R: Kwale. S: Area of dense human settlement and cultivation.

6. Fruit Bats: Ten species occur, including two of conservation concern: *Myonycteris relicta* (known only from the Shimba Hills and neighbouring Tanzania); and *Rousettus lanosus* (which occurs in scattered populations in montane areas in Kenya, Ethiopia, Rwanda, Sudan, Tanzania, Uganda, and Zaïre, where its status is very poorly known).

7. Other Mammals. Kenya has important giraffe populations, particularly the large population of Masai giraffe in Tsavo National Park and the reticulated giraffe in the northern half of the country. The Sokoke bushy-tailed mongoose is a distinct subspecies known only from the Arabuko-Sokoke Forest. Jackson's mongoose is restricted to the Aberdare Mountains, and possibly elsewhere in the highlands. The golden-rumped elephant-shrew is endemic to the Kenya coast from the Arabuko-Sokoke Forest north to Boni and the four-toed elephant-shrew subspecies *Petrodromus tetradactylus sangi* may still occur in the forests on the Taita Hills and around the Chyulu Hills. The golden cat has been recorded in the Mau forest and the Aberdares. Kenya is important for Grevy's zebra which occurs widely but in low population densities in the northern half of the country: threats include exclusion from water by nomadic pastoralists and, for the major breeding population (Samburu/Buffalo Springs/Shaba), uncontrolled tourism expansion. Important populations of the wild dog are also present: it is still widespread but is seriously declining. The dugong has been severely over-hunted along the coast in the past and may be approaching extinction in Kenya, although it is unlikely that this threat is now as great as incidental catches in coastal fisheries. The extent to which dolphins and porpoises are also being killed in coastal fisheries is unknown and the situation needs to be investigated for all marine mammals.

8. Birds. 15 threatened species occur, seven of which are restricted to the coastal forest, and six of these occur in the Arabuko-Sokoke Forest Two species, the Sokoke scops owl and Clarke's weaver are endemic to the Arabuko-Sokoke Forest, and another, the Sokoke pipit, is nearly so. Of the remaining threatened bird species, one occurs in Yala Swamp, two in Kakamega Forest, one in the highland forests, and one in grassland around the Tana River. The Taita thrush is endemic to the Taita Hills (where very little forest survives, and where some very distinctive bird subspecies also occur). Hinde's pied babbler is endemic to Kenya, and is mainly restricted to secondary habitat around Embu, south-east of Mount Kenya. Kenya has by far the largest breeding populations of the roseate tern in the world, concentrated on the Kiunga Islands, with occasional breeding on Kisile Islands and Whale Island (in Malindi-Watamu Biosphere Reserve). Kenya holds important populations of Hartlaub's and Heuglin's bustards.

9. Reptiles. The Nile crocodile occurs in good numbers, and there are two crocodile farms on the coast. Two species of marine turtle breed, but in very small numbers: the hawksbill is reduced to about 50 nests a year in the northern islands, and the green turtle to about 200 per year. They are utilised by local people. The pancake tortoise occurs only in southern and eastern Kenya and northern Tanzania, and is popular in the live animal trade. The implications of this trade for the conservation of the species need to be investigated.

Mt. Kilimanjaro, Tanzania, viewed from Kenya (Photo: WWF/N. Myers).

10. Amphibians. 22 species of conservation concern occur, of which 14 are endemics. Most of the species occur either in the highlands or in the coastal forest. The Aberdare Mountains and Shimba Hills appear to be of particular importance.

11. Fish. Lake Victoria is famous for its very large number of endemic fish species, especially cichlids. The effects of the introduction of the Nile perch into the Lake on the native fish fauna continue to cause concern, as do the effects of fisheries and pollution.

12. Invertebrates. The Taita swallowtail butterfly *Papilio desmondi teita* is endemic to the Taita Hills. Its survival depends on the conservation of the tiny remaining forest patches at Ngangao and Mbololo. Seashells such as cowries, cone shells and conchs are sold in large numbers to tourists, which has led to a serious depletion of a variety of marine gastropod species along the coast

Threats

1. The habitats and species of the arid northern part of the country, as well as those of the forests and wetlands, are not adequately represented in Kenya's protected area system. The country's forest habitats are particularly seriously threatened with encroachment, both in the mountains, and the lowlands (most notably Arabuko-Sokoke and Kakamega). The main causes are agricultural expansion, and the need for fuelwood and charcoal.

2. Illegal hunting has severely reduced the populations of several species of large mammal and continues to be a threat.

3. In many places the management of protected areas has not been maintained at a sufficient level.

4. The lack of control of tourism in some areas is seriously disturbing wildlife and causing habitat degradation, particularly in many of the smaller and more popular protected areas.

5. Water management projects are threatening several wetland areas, and the dams on the Tana River may have had such a serious effect on the gallery forest that two species of monkey could well become extinct in Kenya.

6. Rinderpest is still present in Kenya and presents a threat to all susceptible ungulates, especially those whose populations are small.

7. Trade might well prove to be a threat to certain species (for instance the pancake tortoise, orchids, and particularly aloes).

8. Fish introductions, pollution and over-fishing are probably having a major deleterious effect on native fish populations, especially in Lake Victoria.

9. Marine areas, particularly coral reefs, are under severe threat from siltation, dynamiting, pollution, over-collection of shells and corals and tourist pressure.

Current Conservation Measures

1. Government Administration of Conservation

(a) The two ministries involved in environmental matters are the Ministry of Tourism and Wildlife and the Ministry of Environment and Natural Resources. The Wildlife Conservation and Management Department of the Ministry of Tourism and Wildlife has recently been set up as a parastatal organisation, Kenya Wildlife Services, and is responsible for national parks (including marine national parks), national reserves, and all other wildlife matters.

(b) The Forest Department of the Ministry of Environment and Natural Resources is responsible for forestry, including the management of nature reserves and forest reserves.

2. Multi-agency Projects

(a) Assistance with National Conservation Strategy development (Government/IUCN/NORAD).

(b) Kenya Natural Resources Database Project (Government/IUCN/SIDA).

(c) Development and evaluation of Nakuru Rhino Sanctuary (KWS/WCI/WWF).

(d) Laikipia Ranch, black rhinoceros conservation (KWS/WCI/WWF/ZSL/EAWS).

(e) Development of Aberdares National Park rhino sanctuary (KWS/Rhino Ark/WCI/WWF).

(f) Nakuru National Park rhino translocation research (KWS/WCI/WWF).

(g) Survey of black rhinos (KWS/WCI/WWF).

(h) Tourist impact assessment in Masai Mara National Park (KWS/WCI/WWF).

(i) Publication on "Let's Conserve Our Wildlife" in Kiswahili for communities living around protected areas (Government/AWF).

0) Tana River primate conservation research (KWS/WCI/WWF/EAWS).

(k) Wildlife Clubs of Kenya support (EAWS/WCI).

(1) Assistance to Kenya Wildlife Services (Government/UNDP): establishment of a computerised database to assist in management, and an International Fund-raising Coordinating Unit

(m) Forest Inventory and Management (Government/UNDP): a programme to assess the status and management needs of Kenya's forests.

3. AWF Projects

(a) VHF radio network for anti-poaching in Tsavo National Park, and provision of vehicles and equipment for the rhino sanctuary within the park at Ngulia.

(b) Amboseli elephant research project, now running for 17 years and making major contributions to our understanding of the species.

(c) Publication of "Wild Lives", an educational book aimed at park wardens, students, wildlife clubs, etc., and distributed free.

(d) Community education project focusing on illegal grazing of cattle in Tsavo West National Park; aims at establishing good communication channels and reducing conflicts between cattle ranchers and park authorities.

(e) Institutional support for the Uvumbuzi Club, a conservation club for young Kenyan professionals.

4. DDA Projects

(a) Support for the Department of Forestry.

5. EAWS Projects

Numerous projects are supported, with some highlights given below:

(a) Support to Kenya Wildlife Services, including anti-poaching operations.

(b) Surveillance and maintenance of Nairobi National Park.

(c) Survey of medicinal plants in the family Liabiacae.

(d) Support for "Atlas of Rare Trees in Kenya".

(e) Research on the De Brazza monkey in Kisere.

(f) Support for Kora National Reserve.

(g) Demarcation of Mount Kulal Biosphere Reserve.

(h) Research on deforestation and decimation of plant communities in Kericho District.

6. EEC Projects

(a) Elephant monitoring programme.

7. FINNIDA Projects

(a) Bura Fuelwood Programme: development of a management plan for gallery forests to ensure a continuous, sustainable supply of fuelwood for local communities.

8. ICBP Projects

(a) Conservation of Arabuko-Sokoke Forest through a major programme of reserve infrastructure development, training and research.

9. Netherlands Government Projects

(a) Kenya Woodfuel Development Project, aimed at increasing efficiency of energy use.

(b) Improvement of fuel and fodder availability in Baringo district.

(c) Water and soil conservation in Machakos district.

10. NMK Projects

(a) Establishment of methodology for development of education programmes for sites of environmental importance.

(b) Endangered plant propagation and gene bank development

(c) Research on plant phytochemicals and animal nutrition.

(d) Molecular genetics research on species of conservation concern

11. ODA Projects

(a) Embu, Meru and Isiolo Forestry Project.

(b) Inventory and management of Mau Forest Reserve.

(c) Assessment of Forestry Department vehicle fleet.

(d) Moi University/Oxford Forestry Institute link.

(e) Environmental impact assessment of Molo and Litein roads project.

12. PTES Projects

(a) Soil analysis of Nakuru National Park to provide mangement guidelines for rhinos and other species suffering from mineral deficiencies.

13. WCI Projects

(a) Nairobi National Park training and monitoring.

(b) Nairobi National Park grassland research.

(c) Amboseli National Park monitoring and capital improvements.

(d) Research on elephant and rhino genetics.

14. WWF Projects

(a) Coastal forests: status, conservation and management

(b) Ngare Sergoi Rhino Sanctuary.

(c) Meru National Park Anti-Poaching Project (WWF).

(d) Lake Nakuru, Conservation and Development Project

(e) Lake Nakuru Environmental Education Centre.

(0 Conservation of elephants on the Laikipia Plateau.

(g) Crowned cranes as indicators of habitat quality in wetlands.

Suggested Conservation Activities

1. High priority needs to be given to forest conservation, by (a) upgrading the level of protection in existing reserves, to prevent further timber and agricultural exploitation and (b) creating new reserves.

(i) Montane forest is in need of additional protected areas (see *Critical Sites* 2 above).

(ii) Lowland forests need continued and improved protection, particularly the Arabuko-Sokoke Forest (see *Critical Species* 3, 7 and 8 above), and the Tana River Primate Reserve. The detailed conservation needs of some of the species in this forest need further assessment: see *Critical Species* 7 and 8.

(iii) Other coastal forests should all be adequately protected: *Critical Sites* 3 above lists key areas.

2. Wetland and lake habitats need improved protection, with particular reference to birds (see *Critical Sites* 4 and *Critical Species* 8 above).

(i) Protected areas should be chosen and gazetted as a matter of urgency, in the context of rural development programmes.

(ii) The impact of the Nile perch on native fish species in Lake Victoria needs continuous monitoring, as does the impact of fisheries.

(iii) No further alien fish introductions should be made to natural water bodies.

(iv) The planning of water management projects should include careful assessment of effects on wildlife, particularly where wetlands are affected.

3. Conservation requirements of desert areas should be assessed and appropriate protection established. Urgent action is needed for the Chalbi and Karoli areas.

4. Buffer zones should be maintained around all parks wherever possible and should involve sustainable-yield hunting. Uncontrolled development has in some cases allowed human land-use right up to park boundaries, with consequent conflicts.

5. Isolation of populations of species of conservation concern should be prevented by the maintenance of wildlife corridors between available habitats. This is particularly important around Nairobi Park and on the Laikipia Plateau.

6. The development of wildlife-related tourism needs to be carefully monitored and appropriate investment and controls introduced in order to ensure that reserves are properly maintained and the country's biological and economic assets are not eroded.

7. A coastal zone management programme needs to be established and enforcement of marine parks needs to be improved to prevent further deterioration of coral reefs and protect the few remaining undamaged areas.

8. Urgent conservation action is needed for some species of primates in the Tana River area (see *Critical Species 2* above), perhaps including captive breeding.

9. Consolidation of scattered black rhino populations should continue to be pursued through the national rhino conservation strategy.

10. Anti-poaching measures need urgent strengthening, particularly in relation to elephants and black rhinos.

11. The development of ranching for antelopes, ostriches and other suitable wildlife should be encouraged.

12. The wild dog population should be monitored and conservation requirements assessed with a view to appropri-

ate action. Existing research (NMK) should continue to be supported and its recommendations implemented.

13. The status and conservation requirements of Grevy's zebra should be assessed and appropriate conservation action taken.

14. Surveys of the status and conservation requirements of elephant-shrews (see *Critical Species* 7) are needed in coastal forests, the Taita Hills and Kibwezi forests.

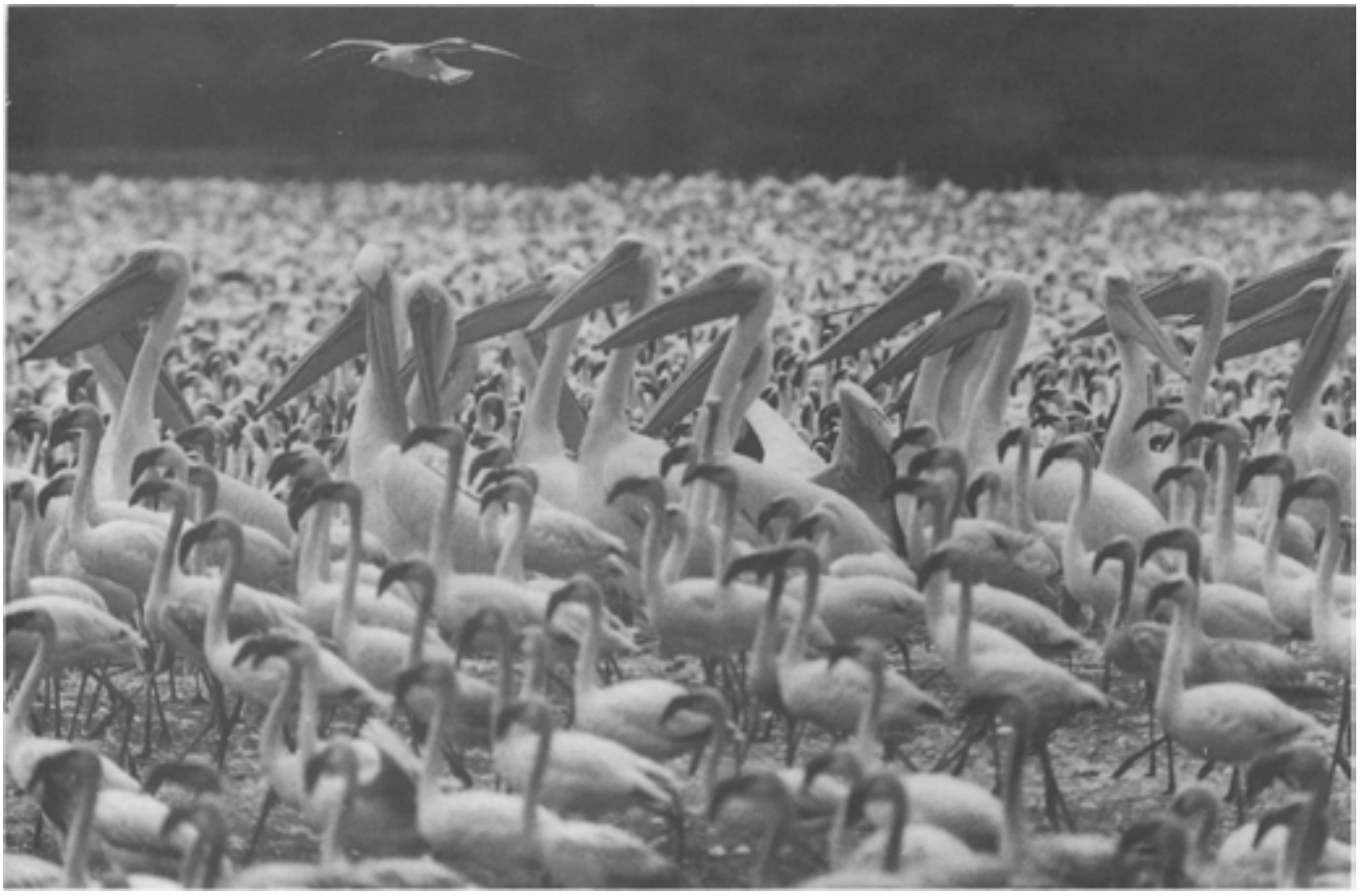
15. Coastal fisheries should be surveyed to determine the rate of killing of dugongs, dolphins and porpoises, and appropriate conservation action taken if necessary.

16. The trade in orchids, cycads, and particularly in aloes, needs to be brought under control. Species should be grown *ex situ* to create alternative sources of supply. CITES regulations on trade in wild specimens need to applied as carefully as possible.

17. The effects of the live animal trade on the pancake tortoise need assessment and appropriate action.

18. The viability of the population of the fruit bat *Myonycteris relicta* in the Shimba Hills needs to be assessed.

19. The invasion of introduced water weeds into lakes has become a problem. In particular, Lake Naivasha has been invaded by *Salvinia molesta.* Means of control and eradication need to be devised, and particular care must be paid to ensuring the such species do not spread further.



Pelicans and Flamingos, the famous spectacle of Lake Nakuru National Park, Kenya (Photo: WWF/A. Nilsson).

Chapter 27: Lesotho

Introduction

Area: 30,344 km^2. Cultivated: 10%. Pasture: 66%. Foresl/woodland: 0%.

Population (1989 data): 1,724,000. Urban: 17%. Labour force in agriculture (1980): 86%. Density: 57/km^2. Annual growth rate: 2.8%, increasing. Doubling time: 25 years.

Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: US$ 360. GNP annual growth rate: 6.7%.

Biogeographic affinities: Afromontane with Kalahari-Highveld in the lower lying areas of the west.

Vegetation: Predominately montane grassland, with wooded areas largely destroyed except in sheltered valleys and south-facing slopes. Almost all low altitude areas are under cultivation.

Lesotho. 1: Maseru. 2: Drakensberg Mountains. 3: Sehlabathebe National Park (65 sq km).

Critical Sites

1. Lesotho has few critical sites remaining, owing to long-term severe over-use of its natural resources. Its only protected area, Sehlabathebe National Park, protects a small high altitude area in Drakensberg Mountains, but there is concern that the National Park may be under threat. The high altitude regions are important for a number of species with restricted ranges, most of which are shared with neighbouring South Africa.

2. Some additional protected areas are recommended, in the Queme Plateau, Quthing Valley, Makhaleng, and in the Oxbow-Drakensberg area. This latter area is important as the watershed for the Lesotho Highland Water Scheme.

Critical Species

1. Plants. About 1,700 species occur, with very few endemics.

2. Antelopes. 7 to 9 species survive, four being extinct. There are populations of black wildebeest and grey rhebok in the Sehlabathebe National Park.

3. Birds. Four threatened species occur. The southern bald ibis probably still has some reasonable populations in the highlands. There are several colonies of Cape vulture, and a total population of some 250 breeding pairs. The South African long-clawed (or Rudd's) lark and the yellow-breasted pipit both occur in small numbers in high altitude grasslands. The southern African endemic bustard, the blue korhaan, occurs, and is not believed to be threatened at this stage.

4. Reptiles. One globally threatened species occurs, Lang's crag lizard *Pseudocordylus langi* (restricted to high altitude regions in the Drakensbergs of Lesotho and neighbouring South Africa).

5. Amphibians. Two species of conservation concern occur, the endemic Drakensberg frog *Rana dracomontana* (known only from the Sani Pass and the nearby Manaung River and tributaries), and the water frog *Rana vertebralis* (known from the Drakensberg and Lesotho Plateaus, also occurring in nearby South Africa).

6. Fishes. The Maluti or Drakensberg minnow *Pseudobarbus quathlambae* is endemic to Lesotho and occurs only in five high altitude source tributaries (Tsoelikana (in Sehlabathene National Park), Moremoholo, Senqu, Jordane, and Bokong) of the Orange River system. It is threatened by habitat degradation and pressure of introduced trout species on food supplies.

7. Invertebrates. Lesotho has some interesting and rare acanthodriline earthworms, two *Microscolex* species and six *Udeina* species. These depend on forest for their survival, and it is therefore likely that several species are already extinct. There are five globally threatened butterfly species, two of which are endemic: *Torynesis pringlei* (near Rafolatsane, endemic); *Lepidochrysops loewensteini* (near Rafolatsane, endemic); *L. oosthuizeni* (Bushman's Pass east of Maseru); *Aloeides dentalis* (Maseru); and *Metisella syrinx* (southern Lesotho).

Threats

1. Wholesale clearance of all types of habitats for agriculture and settlements has destroyed most of Lesotho's biodiversity. Much of what remains is under threat, unless some effective reserves can be established.

2. Overgrazing remains a serious threat while large numbers of herbivores continue to be kept

3. Hunting of all forms of wildlife, including by dogs which hunt independently of their owners, is a threat.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Agriculture and Marketing. Its Conservation Division is responsible for wildlife, national parks and forestry.

2. Multi-agency Projects

(a) Drakensberg/Maluti Mountain Catchment Conservation Programme (Government/Natal Parks Board, South Africa): promoting the conservation of these mountain areas as managed resource areas.

(b) The SOWACO project (Netherlands Government/ FAO): reforestation, and soil and water conservation.

3. FINNIDA Projects

(a) Environmental training course for African communicators: course available to nationals of English-speaking SADCC countries.

4. GTZ Projects

(a) Matelite Rural Development Project: includes programmes in forestry and erosion control.

5. ODA Projects

(a) Forestry development project: assisting Forestry Division in policy implementation.

Suggested Conservation Activities

1. Additional protected areas are urgently needed to preserve forest habitat: *Critical Sites 2* above indicates suitable sites.

2. Development of managed resource areas such as those proposed under Measure (1) above, to enable conservation to take place without direct competition for land use, the human needs being too great to permit strict reserves to be set apart.

3. The conservation needs of threatened fish and invertebrates should be assessed and appropriate action taken.

Chapter 28: Liberia

Introduction

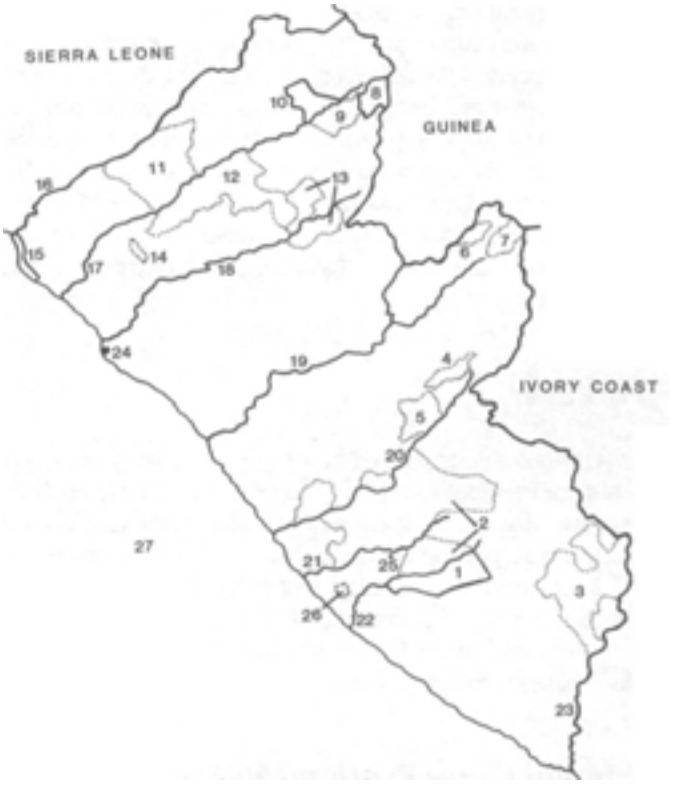
Area: 111,370 km^2. Cultivated: 3%. Pasture: 3%. Forest/woodland: 34%.

Population (1989 data): 2,476,000. Urban: 42%. Labour force in agriculture (1980): 74%. Density: 22/km^2. Annual growth rate: 3.2%, increasing. Doubling time: 22 years.

Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: US$ 440. GNP annual growth rate: -0.4%.

Biogeographic affinities: Guinea-Congolian with Afromontane elements on Mount Nimba.

Vegetation: Lowland forests cover most of the country, though have been cleared in many areas, resulting in a patchwork of cultivation and secondary bush. There is lower montane forest on Mount Nimba and small areas of mangroves along the coast.



Protected areas and geographical features of Liberia. 1: Sapo National Park (1308 sq km). 2: Krahn-Bassa National Forest (5140 sq km). 3: Grebo National Forest (2673 sq km). 4: Gio National Forest (329 sq km). 5: Gbi National Forest (610 sq km). 6: West Nimba National Forest (91 sq km). 7: East Nimba National Forest (96 sq km). 8: Wonegizi Nature Reserve (proposed) (261 sq km). 9: North Lorma National Forest (712 sq km). 10: Wologizi Nature Reserve (proposed) (202 sq km). 11: Gola National Forest (2070 sq km). 12: Kpelle National Forest (1748 sq km). 13: Lorma National Forest (435 sq km). 14: Yoma (Yormo) National Forest (26 sq km). 15: Cape Mount Nature Reserve (proposed) (224 sq km). 16: Mano River. 17: Lofa River. 18: Saint Paul River. 19: Saint John River. 20: Cestos River. 21: Sehnkwehn River. 22: Sinoe River. 23: Cavalla River. 24: Monrovia. 25: Plendiabo. 26: Buto Oil Palm Plantation. 27: Atlantic Ocean.

Critical Sites

1. Liberia has many important forest areas, but so far only one protected area has been established, Sapo National Park. This is an important area of lowland rainforest. Poaching is taking place and protection still needs improvement: however, the management plan, which includes development activities in the surrounding area, is being implemented and revised.

2. Some other areas have been proposed as reserves, and these are now very high priority: Mount Nimba Nature Reserve, Cavally Forest Nature Reserve, Wologisi Mountain Nature Reserve, North Lorma National Forest, Wonegizi Mountains and Cape Mount Nature Reserve. Together, these reserves would conserve most of the species occurring in Liberia. Much of the best forest on Mount Nimba has been lost due to mining, thus increasing the need to conserve the remaining area. It is believed that parts of the proposed Loffa-Mano and Cestos-Sankwen National Parks have now been given over to logging and mining, but it is still important that these be gazetted.

3. Liberia also has national forests for timber production. There is a need to improve the management of these to ensure that significant areas are kept in good condition. Priority should be given to ten national forests: Krahu Bassa, Belle, Grebo, Gola, Kpelle, North and South Lorma, Gbi, Gio, and East Nimba. In particular, areas of forest in Grand Gedeh county need to be conserved to safeguard two very rare endemic species not known to occur in any protected area (proposed or established): the Liberian mongoose and spot-winged greenbul.

Critical Species

1. Plants. The total number of species is not known, although there are 59 endemic species and one endemic genus. 2,000 species are known from the Mount Nimba area (though this includes the Guinean and Ivorian sectors).

2. Primates. 12 species occur, including the diana monkey, olive colobus, red colobus and chimpanzee. All these occur in Sapo National Park and several of the proposed protected areas.

3. Antelopes. Ten species occur, all forest species. There is severe huntingof all these species. Two rare species, Jentink's duiker and zebra duiker, have important populations in Liberia.

4. Fruit Bats. 12 species occur, including two of conservation concern: *Epomops buettikoferi* (endemic to the West African forests of Liberia, Ghana, Guinea, Ivory Coast, Nigeria and Sierra Leone); and *Scotonycteris ophiodon* (known only from forest sites in Liberia (Mount Nimba), Cameroon, Congo and Ghana).

5. Other Mammals. There are important populations of pygmy hippopotamus and giant forest hog in several parts of the country. Elephants are now considered to number less than 1,000 animals, though Loffa-Mano has one of the priority baseline populations for West Africa. Three rare viverrids occur in the forests, Johnston's genet, Leighton's linsang, and the endemic Liberian mongoose. This last species is known only from north-eastern Liberia, especially in Nimba and Grand Gedeh Counties. Two rodent species of concern occur. It is not known to what extent dolphins and porpoises are being killed in coastal fisheries, nor whether any remedial action needs to be taken. Manatee populations might be significant, though they are known to be under heavy pressure from poaching.

6. Birds. Nine threatened species occur, all in the forests. Mount Nimba, Sapo National Park, and Grand Gedeh County are of particular importance. Among these rare species are the white-breasted guineafowl, yellow-footed honeyguide, white-necked picathartes, Nimba flycatcher and Gola malimbe. The spot-winged greenbul is endemic to Liberia, and is only known from forest north-west of Zwedru in Grand Gedeh Country. The protection of its habitat is an urgent priority.

7. Crocodiles. All three species occur widely, and although they are protected they are still hunted for food and for their skins. It is thought that most of the large animals have been hunted out but further information would be desirable.

8. Marine Turtles. Four species have been recorded, with nesting records for all of them: olive ridley, green turtle, hawksbill and leatherback. There is some local-level utilization. However, more information is needed before priority populations can be identified and conservation recommendations can be made.

9. Amphibians. Seven species of conservation concern occur, including four endemics: *Cardioglossa liberiensis* (known from the St. Paul's River area), *Nectophrynoides liberiensis* (from Mount Nimba), *Leptopelis bequerti* (from Gbanga) and the caecilian *Geotrydes pseudoangeli.*

10. Invertebrates. The rare African giant swallowtail butterfly occurs in the forests, including at Mount Nimba

Threats

1. Liberia's biodiversity is at severe risk because of forest clearance for timber, agriculture and mining. Against this threat, only one protected area has been established. Without a full protected area system including a full representation of the country's species and habitats (including marine habitats), Liberia can be expected to lose a large proportion of its species. The resulting economic, climatic and ecological effects would be disastrous.

2. Uncontrolled hunting is a problem in many parts of the country, particularly the more remote areas, and the populations of many of the larger species are now seriously depleted.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Forestry Development Authority (FDA) is responsible for the conservation of both forests and wildlife. Protected areas (i.e. Sapo National Park) and wildlife come under the FDA's Wildlife and National Parks Section. The Wildlife and National Parks Act was enacted in 1988 but is not yet enforced because of a partial hunting ban imposed by the President in 1988. Further regulations concerning wildlife and protected area conservation are being prepared and will cover hunting, internal and international trade, and procedures for establishing new protected areas. The FDA is re-establishing its protection programme for the National Forests.

2. Multi-agency Projects

(a) Wildlife Survey of Liberia (FDA/WWF): surveys of the status, distribution and utilisation of wildlife (especially large mammals) in Liberia, plus research on public attitudes and awareness.

(b) Conservation and agricultural development around Sapo National Park (FDA/WWF).

3. GTZ Projects

(a) Advisory service in forest mangement: aims at sustainable forest management by developing techniques at selected sites.

4. Metro Toronto Zoo Projects

(a) Survey and captive breeding programme for Liberian mongoose and other species.

5. WPTI Projects

(a) Conservation Education: production of posters of protected wildlife.

6. WWF Projects

(a) Support for Society for the Conservation of Nature of Liberia.

Suggested Conservation Activities

1. The management plan and associated improved protection for Sapo National Park should be completely implemented. The revision of the management plan incorporating development in surrounding areas is particularly important.

2. A number of other reserves should be established as a matter of urgency: *Critical Sites 2* above gives details. In particular, the proposed Loffa-Mano, Cestos-Senkwen, and Cape Mount National Parks should be established, as well as the Wologisi-North Lorma-Wonegizi conservation area, which should comprise two fully protected core areas, with an adjacent utilisation area.

3. The wildlife population and utilisation survey should be continued and expanded to cover both economically important and threatened species. The data could be used to form the basis of realistic management plans and to enable the regular revision of the wildlife regulations.

4. A national land use policy and land tenure review should be generated to improve the tenure position of individuals and communities in forest areas and enable a coherent National Strategy for Sustainability to be developed.

5. Continuing control of hunting is needed, in the context of developing sustainable use of wildlife food resources. Hunting and protected area regulations deriving from the Wildlife and National Parks Act of 1988 need to be formulated and implemented.

6. Management of the timber-production forests (National Forests) needs improvement to ensure sustainable use: *Critical Sites* 3 above gives precise areas involved. Management plans should be developed for all National Forest areas to include protection and reconciliation of conservation and human needs.

7. A national campaign to educate the population on the new Wildlife and National Parks legislation is needed.

8. Several species of mammals and birds are rare or threatened, and should be included in protected area planning. *Critical Species* 2, 3, 5 and 6 give specific needs.

9. A survey of coastal fisheries is needed to determine the extent of dolphin and porpoise deaths, and whether conservation action is necessary.

10. A nationwide survey of crocodile populations (all three species) is needed to determine their conservation requirements.

11. Investigations of marine turtles are required to identify priority populations and prescribe appropriate conservation action.

12. Means of protecting manatees from being hunted out should be explored.

Chapter 29: Madagascar

Introduction

Area: 594,180 km^2. Cultivated: 5%. Pasture: 58%. Forest/woodland: 26%.

Population (1989 data): 11,602,000. Urban: 22%. Labour force in agriculture (1980): 81%. Density: 20/km^2. Annual growth rate: 3.1%, increasing. Doubling time: 22 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 200. GNP annual growth rate: -0.3%.

Biogeographic affinities: East and West Malagasy.

Vegetation: Rainforest (lowland and montane) in the north and east (now largely destroyed for agriculture on the severely eroded central plateau); dry deciduous forest in the west; dry xerophytic scrub (spiny desert) in the southwest.

Critical Sites

1. Madagascar is without doubt the most extraordinary country biologically within the Afrotropical Realm. Although not as diverse as some other countries, it has levels of endemism that are unrivalled elsewhere in Africa. For this reason, the general depletion of the country's natural resources has been viewed with particular alarm, and great efforts have gone into the identification of priority sites and critical species.

2. The rainforests, both lowland and montane, of the eastern side of Madagascar, are a particularly important centre for species endemism. Some high priority protected areas already exist, especially the Integral Reserves of Zahamena, Andringitra, Marojejy and Parcel 1 of Andohahela, as well as the very large Midongy du Sud Classified Forest in the South. Some smaller, but still important reserves in the eastern forest zone include the Special Reserves of Anjanaharibe

Vegetation map of Madagascar.

Protected areas of Madagascar.

Sud, Kalambatritra, Manombo, Nosy Mangabe, and Perinet-Analamazaotra. Improved protection of all these areas is a high priority.

3. There is an urgent need for several new protected areas in the eastern rainforests. Suitable sites are: the Masoala Peninsula, the Mananara area, Ranomafana, and forests around Maroantsetra and in the area east and south of Lake Alaotra.

4. In the far north of the country, there are some wet forests that are somewhat different biologically from those in the east. Of particular interest are the Montagne d'Ambre National Park and the nearby Forêt d'Ambre Special Reserve, the Tsaratanana Integral Reserve, the Analamera, Manongarivo and Ankarana Special Reserves, and the small Lokobe Integral Reserve on the island of Nosy Be. Each of these areas is of biological interest, and each is in need of improved protection, with Lokobe being particularly threatened at present.

5. In the west of the country, the forest is of a drier, deciduous type. Of particular interest are the Isalo National Park (now seriously degraded), the Integral Reserves of Ankarafantsika, Tsingy de Namoroka, and Tsingy de Bemaraha, and the Zombitse Classified Forest (under severe threat at the time of writing). There are also some small Special Reserves at Bora and Andranomena, and an interesting transition area between central plateau and western deciduous forests in the Ambohijanahary Special Reserve. Again, all these areas are in need of improved protection.

6. There is a need for more protection in other parts of the western deciduous forest, where important populations of rare species are currently at risk. The highest priorities are the Kirindy Forest, the Tsimembo Forest, and the forests/shrublands in the Soalala area.

7. Almost all the original vegetation of the central plateau of Madagascar has been destroyed. Three small relics of this forest are in particular need of protection: the Ambohitantely Special Reserve, the Anjorozobe Forest and the small vestige at the Manjakatompo Forest Station in the Ankaratra Massif. All these areas are in need of urgent conservation measures.

8. In the south and southwest of Madagascar is an extraordinary vegetation formation of succulent and spiny plants in a semi-arid environment. Important protected areas in this unusual environment are: Tsimanampetsotsa Integral Reserve, Parcel 2 of Andohahela Integral Reserve, the Special Reserves of Cap Sainte Marie and Beza-Mahafaly, and the Berenty Private Reserve. In addition, Parcel 3 of Andohahela Integral Reserve is intermediate between the southern semi-arid environment and the eastern rainforests, and has important stands of the endemic palm *Neodypsis decaryi.* However, the total area of the "spiny forest" protected remains a very small proportion of the total. Two important sites in need of more protection are Hatokaliotsy and the area around Lake Ihotry.

9. Also in the south and southwest of the country there are important riverine forests which need to be assessed for their conservation requirements.

10. Madagascar has some important lakes and wetlands, hardly any of which receive protection. Consequently they harbour some of the most threatened endemic species in the country. The priority area for conservation attention is Lake Alaotra, part of which needs to be set aside as a protected area. Other important areas are Lakes Anony, Ihotry, Itasy, Kinkony, Bemamba, Masama and Befotoka.

11. There are some important marine habitats and ecosystems in need of protection, including coral reefs in the southwest off Toliara (the proposed Grand Recife proposed Marine National Park), and the northwest (the sand cays of Nosy Foty, Nosy Anambo, Nosy Fasy, Nosy Faty, Nosy Faho and Nosy Langna, and the reefs around Nosy Be and Nosy Tanikely.

Critical Species

1. Plants. The number of species is not known, but is certainly high, believed to number in the order of 11,000. The level of endemism is very high: eight endemic families (Asteropeiacea, Didiereaceae, Didymelaceae, Diegodendraceae, Geosiridaceae, Humbertiaceae, Sphaerosepalaceae, and Sarcolaenaceae); 238 endemic genera (20% of the total); and estimates of species endemism ranging from 55% to 85%. It is clear that there are high levels of endemism throughout the country. Of particular interest is the diversity of baobab species. Also, there are many species of succulent (424 endemic taxa, of which 64 are definitely threatened), and palm (117 species in 21 genera, with 113 species and 13 genera endemic, and many species threatened). The conservation of Madagascar's remarkable flora requires the strict preservation of the full range of the critical sites listed above. Ethnobotanical research is beginning but needs to be developed.

2. Primates. Madagascar is famous for its extraordinary radiation of lemurs. Of 30 extant species, 24 are considered to be at risk. Among the most threatened are the hairy-eared dwarf lemur (from the Mananara area), broad-nosed gentle lemur (from the Ranomafana region), golden gentle lemur (recently discovered, also from Ranomafana), Sclater's lemur (northwest coastal forest between Maromandia and Befotaka), mongoose lemur (northwest), red-bellied lemur (eastern areas), indris (in several areas of the northeastern rainforests), aye-aye (less threatened, also being found in several areas in the northeast) and the black, black-headed and Tattersall's sifakas. Effective habitat protection is required for all the lemur species at risk.

3. Insectivores. Apart from two species of shrew (one intro-

The threatened aye-aye *Daubentonia madagascariensis,* the most extraordinary of all the lemurs of Madagascar (Photo: WWF/J.J. Petter).

duced, one endemic), the insectivores are represented on Madagascar by the tenrecs, a remarkable family consisting of a great variety of diverse life-forms. About 30 species occur, and several of these are threatened. Of particular interest are the aquatic tenrec (in fast-flowing streams around Antsirabe on the Ankaratra Massif, the Ranomafana area and in a few other localities), large-eared tenrec (in the west, southwest and northeast) and several species of shrew-tenrec known from only one or two localities.

4. Bats. 28 species occur, of which nine are endemic. One of these, the sucker-footed bat *Myzopoda aurita,* constitutes an endemic family. It occurs mainly in the eastern rainforests. The role of bats as forest seed dispersers should be recognised in forest management plans. There are three species of fruit bat, two of which, *Pteropus rufus* and *Roussettus madagascariensis,* are endemic. They are locally common but threatened by forest clearance and hunting.

5. Carnivores. Viverrids are the only carnivores present on Madagascar, and all are endemic, with the exception of the lesser oriental civet which is also found in Asia. Of particular conservation interest are the fanalouc (forests and the east and north-west), giant striped mongoose (recently described from Tsimanampetsotsa), Malagasy civet (eastern rainforests) and Malagasy brown-tailed mongoose (eastern forests at medium altitude).

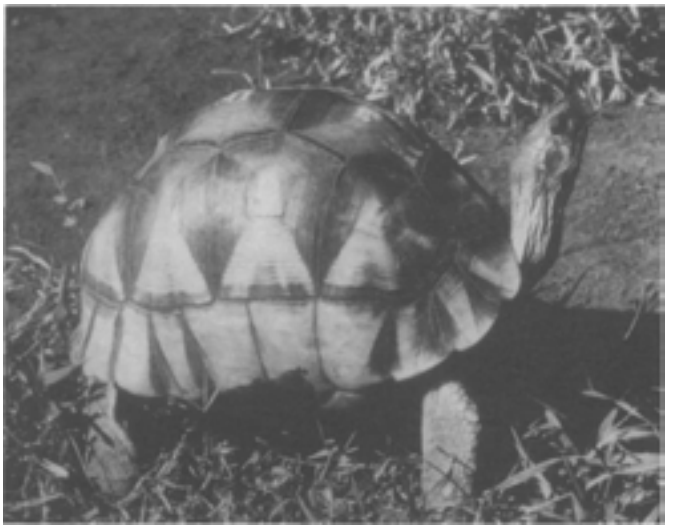
6. Rodents. Ten species occur, all of which are endemic. Of particular conservation interest are *Macrotarsomys ingens* (only known from Ankarafantsika), *Eliurus minor* (a few sites in the eastern rainforests), *Gymnuromys roberti* (also from a few sites in the eastern rainforest), and the Malagasy giant rat *Hypogeomys antimena* (only known from the Morondava region).

7. Marine Mammals. Populations of dugong survive on the northern and western coasts. The extent to which dolphins and porpoises are being killed in the coastal fisheries is unknown, and may constitute a conservation problem.

8. Birds. 250 species occur, of which 197 breed, 106 are endemic, and a further 25 are shared only with the Comoros. Three families are endemic (the mesites, asities, and ground-rollers), two are shared only with the Comoros (the vangas and cuckoo-rollers), 32 genera are endemic, with a further eight shared only with the Comoros. Two species, the snail-eating coua from Nosy Boraha and the Madagascar pochard from Lake Aloatra, have probably become extinct, the latter recently. Another 27 are considered to be threatened, most notably: the Alaotra grebe (Lake Alaotra, possibly extinct); Madagascar teal (west coast); Madagascar fish eagle (north-west coast); Madagascar serpent eagle (eastern rainforests, very seldom recorded); Madagascar red owl (eastern rainforests); yellow-bellied sunbird-asity (eastern rainforests, very rarely recorded); Appert's greenbul (Zombitse Forest); and red-tailed newtonia (eastern rainforests, very rarely recorded). For most of these threatened species, habitat protection is the top priority. For at least three, however, conservation efforts in the wild will be insufficient to ensure survival and will need to be supported by captive breeding programmes (Alaotra grebe, Madagascar teal and Madagascar pochard).

9. Crocodiles. The Nile crocodile has been reduced in numbers by persecution, though it is still widespread. Most animals probably remain in the north and west.

10. Marine Turtles. Five species occur, though the leatherback does not nest in Madagascar. Good numbers of hawksbills nest in the north and southwest, but persecution is



The angonaka *Geochelone yniphora,* northwestern Madagascar, the rarest tortoise in the world (Photo: WWF/Don Reid).

severe. The green turtle nests widely in small numbers. The olive ridlcy nests in small numbers in the northwest. About 300 loggerheads nest annually, around Taolanaro and on the west coast as far north as Morondava. For marine turtles, there is an urgent need for much clearer identification and protection of priority nesting beaches. This seems to be considerable exploitation, in particular of green turtles and hawksbills.

11. Tortoises and Freshwater Turtles. Four endemic tortoise species occur: the radiated tortoise (arid south and southwest); the angonoka (a very small area around Soalala in the northwest, very rare); the Madagascar flat-tailed tortoise (restricted to the Andranomena and Amborompotsy Forests); and the Madagascar spider tortoise (restricted to the semi-arid south and southwest). There is one endemic freshwater turtle, the Madagascar sideneck turtle, which occurs in the west of the country but which has declined seriously because of over-exploitation. All these species require habitat protection, captive breeding programmes (these already exist for the radiated tortoise) and, in the case of the turtle, attempts at sustained-yield management programmes.

12. Other reptiles. 182 species of lizard, most notably chameleons, and 60 species of snake occur on Madagascar, with over 90% endemism. Some 26 species of lizard and 34 species of snake are considered to be threatened at present. Many species are severely restricted in distribution, and a large proportion of the critical sites listed above have species of snake or lizard not known from anywhere else. There is a very large export trade in live reptiles which is of serious conservation concern.

13. Amphibians. 144 species occur, 142 of which are endemic. All of them are frogs, and 22 species are considered threatened. As with the snakes and lizards, a number of species are effectively restricted to one or more of the critical sites listed above.

14. Fishes. 34 endemic species occur, 29 of these being freshwater species, and five occurring in the coastal zone. 14 of these are considered threatened, (vulnerable or endangered) all of them being freshwater species. About 80% of Madagascar's annual fish harvest comes from the inland fishery.

15. Butterflies. Excluding the skippers, there are 260 species, of which 182 are endemic. Among the skippers, 7 of the 17 genera present are endemic. Some 45-50 species are considered threatened, many of these being restricted to one or more of the critical sites listed above.

16. Terrestrial Molluscs. Some 380 species are known, of which 361 are endemic. There is a particular concentration of endemic species in the north, especially at Tsaratanana. It seems that 64% of the species are forest-dwellers, and 24% are cave-dwellers. The principal threats are habitat clearance and the introduction of carnivorous snail species.

The emperor moth Argema mittrei, one of the most beautiful insects, whose wingspread is fifteen centimetres. It is only found in Madagascar (Photo: WWF/J.J. Petter).

17. Freshwater Molluscs. 29 species occur, of which 19 are endemic. Most of the endemic species are restricted to upland forest areas, where they are probably at risk from habitat destruction.

18. Marine Molluscs. About 1,020 species have been recorded, the fauna being typical of the Indo-Pacific. A number of species are used for food, and shells and shell products (mother-of-pearl) are exported. They are currently over-utilised and need to be managed sustainably.

19. Crustaceans. The fauna is poorly known, but it is clear that there is a high proportion of endemic freshwater species. Habitat alteration and pollution are the major threats. Freshwater shrimps and crayfish in particular are used for food. The marine crustacean fauna is typical of the Indo-Pacific. There are important lobster, crab and shrimp fisheries.

20. Other Invertebrates. About 70% of Madagascar's dragonfly species are endemic and most depend on the existence of rainforest habitat. Of particular importance are *Isomma hieroglyphicum* (only known from Nosy Be and Diego Suarez) and *Libellulosoma minuta.* There are important coral reefs in many areas, with characteristic Indo-Pacific species assemblages. Key areas for these reefs are the southwest coast of Toliara (the proposed Grand Recif Marine National Park), and the sand cays in the northwest (Nosy Foty, Nosy Anambo, Nosy Fasy, Nosy Faty, Nosy Faho and Nosy Langna).

Threats

1. The principal threats to Madagascar's extraordinary biodiversity come from small-scale but widespread clearance of habitats (in particular clearance of forest for firewood and agriculture) and severe disturbance of lakes and wetlands.

2. Despite some recent improvements, Madagascar's protected area system does not yet encompass anywhere near all the critical sites of the country.

3. Many of the existing reserves are too small to preserve viable populations of many of the more important species.

4. Attempts at the sustainable management of species and habitats outside the protected areas are not very far advanced.

5. Hunting pressure on certain species, notably crocodiles and marine and freshwater turtles, is very severe. In the case of crocodiles, there has been poor enforcement of trade controls in the context of the CITES quota system.

6. The live wildlife export trade, particularly in orchids and succulents (especially euphorbs), and in some species of amphibians, reptiles and birds (mainly parrots), is currently at a very high level and is almost certainly causing problems.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Animal Production, Fisheries, Water and Forests. Terrestrial ecosystems are under the jurisdiction of the Department of Water and Forests, in particular the regional offices of its Nature Protection Service. This service itself has three divisions: fauna, flora and the environment; soil conservation; and forestry. Freshwater and marine ecosystems come under the Department of Fisheries and Aquaculture in the same ministry.

2. Multi-agency Projects

(a) Biosphere Reserve development at Mananara North, Andasibe, and Ankarafantsika (Government/UNESCO /UNDP): conservation of primary forests and coral reefs; development of management plans; buffer-zone and tourist development, training and public awareness programmes.

(b) Northern Ecological Complex (Government/WWF): ecosystem preservation, tourism and education programmes, and development of the Montagne d'Ambre National Park and associated special reserves.

(c) Development of Parc Botanique et Zoologique de Tsimbazaza (JWPT/MBG/MFCPG/WPTI): includes institution building, training, captive propagation of threatened species, and conservation education.

(d) Forest protection and management projects (Government/ FAO/UNDP/IBRD etc.): diverse activities including crocodile farming, buffer-zone development around protected areas, reforestation programmes etc.

(e) Conservation of endemic tortoises (JWPT/WPTI/ WWF): captive breeding of the angonoka and kapidolo, plus related ecological studies and educational activity.

(f) Safeguarding two lacustrine bird species (WWF/ JWPT/ WWT): survey and captive breeding programme for the Aloatra grebe and the Madagascar pochard.

(g) Preparation of IUCN Lemur Red Data Book (IUCN/ MFCPG).

(h) Ivoloina Field Station (MFCPG/PZBM/Strasbourg University/WPTI): development of this station.

(i) Development of prawn aquaculture at Nosy Be (Government/FAO/UNDP).

(j) Development of expertise in fisheries management (Universite de Toiara/FAO/UNDP).

(k) Assistance to the Direction des Pêches et de l'Aquaculture in the overall development and management of Madagascan fisheries (Government/FAO/UNDP).

(1) Improvement of forestry management around Antananarivo to reduce soil erosion and improve the availability of forest products (Government/FAO/UNDP).

(m) Rural development programme, Masoala Peninsula (MBG/ WWF): biological diversity conservation by a variety of agricultural, social, health, conservation, national park establishment, education and tourism programmes.

(n) Study of conservation needs of aquatic tenrec (FFPS/ WWF).

(o) Survey of Tsaratanana Reserve (ICBP/FFPS).

3. Antananarivo University Projects

(a) The University is committed to a range of projects covering many aspects of conservation, from effects of shanty towns to soil chemistry.

4. DDA Projects

(a) Village-level reforestation programme, based at Andramasina.

(b) Support to forestry training centre in Morandava.

5. FFPS Projects

(a) Study of the ecological requirements of the sucker-footed bat *Myzopoda aurita* at Marojejy.

6. GTZ Projects

(a) Developing an integrated land-use system in the Ampahibato Region by means of agro-forestry.

(b) Promotion of fisheries with emphasis on long-term sustainable management.

7. JWPT Projects

(a) Effects of logging on reptile communities: plus making species list of reptiles present.

8. ICBP Projects

(a) Ecology and conservation of the long-tailed ground-roller and subdesert mesite, with the long-term aim of securing a protected area for these species.

9. MBG Projects

(a) Documentation of flora of Madagascar, with particular emphasis on threatened species and habitats, and important sites for biodiversity conservation.

10. MFCPG Projects

(a) Return of animal specimens from captive breeding to natural environment

(b) Veterinary staff training for Parc Botanique et Zoologique de Tsimbazaza and Ivoloina Field Station.

11. PTES Projects

(a) Survey of the status and conservation needs of the black lemur.

12. WPTI Projects

(a) Zoo Ivoloina: Captive breeding of primates and tortoises.

(b) "Lemurs of Madagascar" programme: production of educational materials.

13. WWF Projects

(a) Leaf litter invertebrate survey in western Madagascar: examines the impact of selective logging on leaf-litter invertebrate communities and their role in nutrient cycles in forest ecosystems.

(b) Impact of selective logging on mammals: effects of logging on mammals (focussing on lemur and tenrec species).

(c) Investigation of the ecology of two Malagasy carnivores: status and distribution of two viverrids with a view to their conservation requirements and longer term conservation studies of Madagascar carnivores.

(d) Ethnobotanical survey of northern Madagascar collection of botanical survey information and the improvement of public conservation awareness from the starting point of plants used by the local population.

(e) Protected areas management: development and implementation of NCS-based management plans for protected areas throughout the country.

(0 Southern Madagascar conservation programme: integration of local population needs with conservation priorities.

(g) Environmental education programme: integration of environmental education into the national education system.

(h) Monitoring primary vegetation by remote sensing: exploration of the use of satellite imagery for monitoring the extent of vegetation types.

(i) Icthyological survey of the Mangoro River: inventory of fish species in the Mangoro River to provide conservation baseline data.

Suggested Conservation Activities

1. Improved protection of montane and lowland rainforest protected areas in eastern Madagascar should be implemented urgently, in terms of both habitat conservation (prevention of further forest clearance) and species protection (anti-hunting measures, sustainable use approaches). *Critical Sites 2* above indicates specific locations.

2. New protected areas should be set up as follows.

(i) A National Park for the Masoala Peninsula.

(ii) A Biosphere Reserve (incorporating a National Park) in the Mananara area.

(iii) A National Park at Ranomafana.

(iv) Appropriately-designated protected areas for the forests around Maroantsetra and in the area east and south of Lake Alaotra.

3. Improved protection should be provided in protected areas in the far north, as specified in *Critical Sites* 4 above.

4. Western protected areas are all in need of improved protection: specific locations are listed in *Critical Sites* 5 above.

5. Additional protected areas are urgently needed in western deciduous forests, sites suggested as appropriate for species in greatest need being the Kirindy forest, Tsimembo forest and forests in the Soalala area.

6. There is an urgent need for protection of relics of central plateau vegetation, at Ambohitantely Special Reserve and Manjakatompo Forest Station (Ankaratra Massif).

7. There is a need for additional protected areas in the semi-arid zone at Hatokaliotsy and around Lake Ihotry.

8. Wetland sites are in urgent need of conservation and protected areas should be established as soon as possible at a number of sites (see *Critical Sites* 10 above).

9. Marine areas should be surveyed in more detail, particularly the more accessible reef areas of Nosy Be, Toliara and Nosy Borah and the establishment of suitable types of protected areas should be pursued. See *Critical Sites* 11 and *Critical Species* 20 above for other areas of concern.

10. Protection of lemurs should be improved by strict habitat protection at all the sites indicated above plus prohibition of all further hunting.

11. The effects of export trade in live reptiles and amphibians, particularly to Europe, should be investigated urgently and appropriate conservation action initiated.

12. The export trade in many orchid and succulent species should be reviewed as a matter of urgency, and appropriate action taken.

13. Surveys of bat fauna, especially rain forest fruit bats, are needed, with particular reference to their role as seed dispersers.

14. A survey of coastal fisheries is required to determine the extent of dolphin and porpoise deaths, and whether remedial action is required.

15. Bird protection needs improvement by strict habitat conservation in protected areas and, in some cases, captive breeding programmes. *Critical Species* 8 above specifies detailed requirements.

16. A survey of crocodile distribution is needed, and appropriate protection provided if necessary.

17. Nesting sites for marine turtles should be identified and adequate protection provided, as a matter of urgency.

18. Habitat protection and captive breeding programmes should be established for some tortoises and the sideneck turtle. Sustained-yield programmes for the latter should be explored. Species involved are listed in *Critical Species* 10 above.

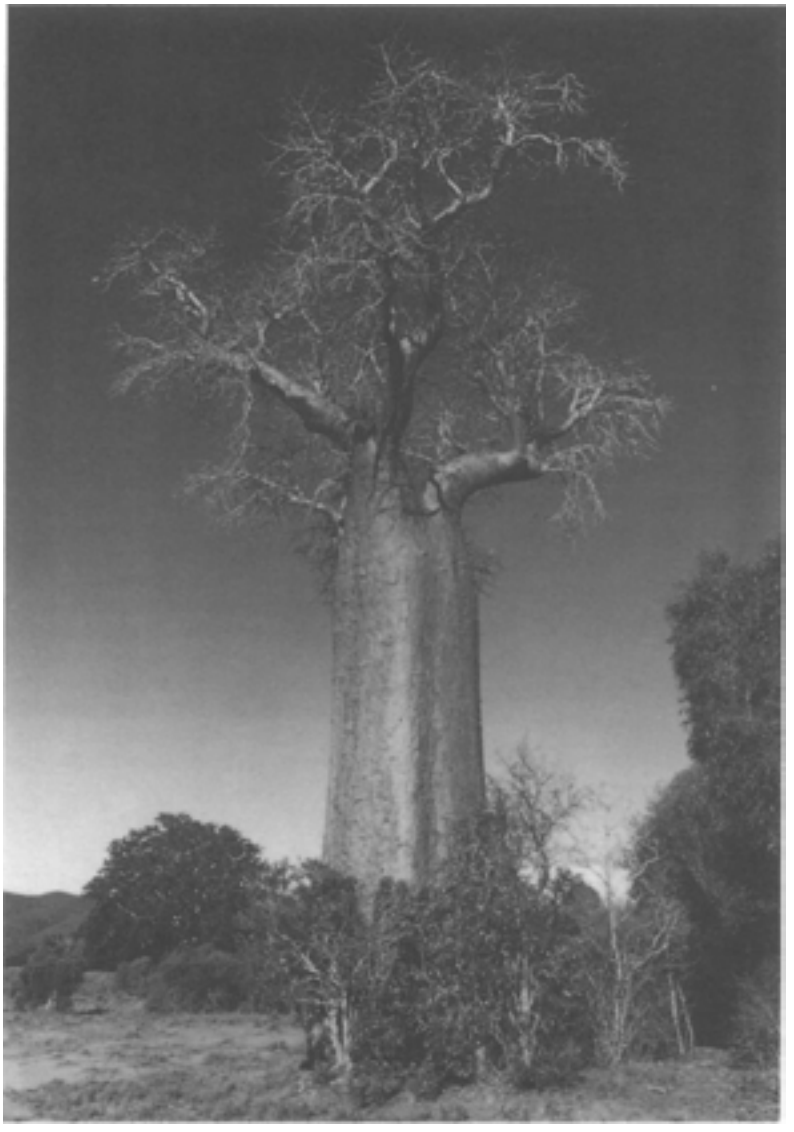
19. Habitat protection in critical sites indicated above is needed to ensure survival of a number of endemic lizard and snake species.

20. The introduction of carnivorous snails should be prevented in order to protect indigenous terrestrial molluscs.

21. Management strategies should be developed to prevent over-utilisation of marine molluscs.

22. Surveys are needed of crustacean fauna to specify major threats (in particular, overfishing should be examined) and conservation requirements.

23. Explorations into sustainable-use programmes for many species are needed, particularly in zones surrounding current protected areas.



Baobab, Madagascar (Photo: WWF/Russell A. Mittermeier).

Chapter 30: Malawi

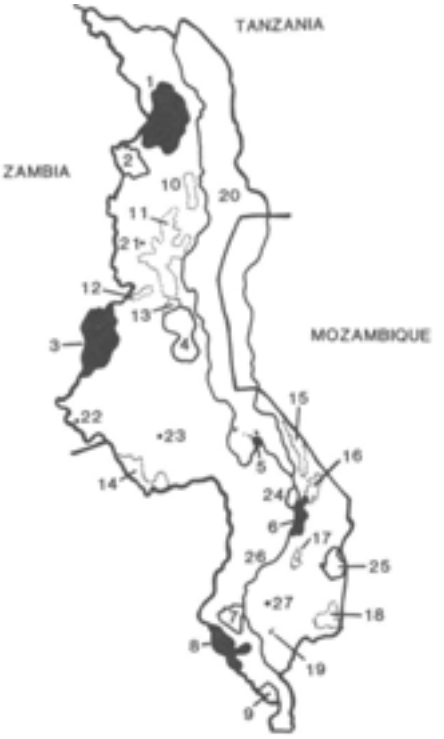
Introduction

Area: 117,112 km^2. Cultivated: 20%. Pasture: 16%. Forest/woodland: 39%.

Population (1989 data): 8,737,000. Urban: 13%. Labour force in agriculture (1980): 83%. Density: 93/km^2. Annual growth rate: 3.3%, increasing. Doubling time: 21 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 160. GNP annual growth rate: 2.5%. Biogeographic affinities: Predominately Zambezian, with Afromontane elements in the mountains.

Vegetation: Predominately miombo woodland, with drier Zambezian woodland in the south, montane forest and grassland at higher elevations, and patches of lowland forest on the shores of the northern part of Lake Malawi and on the lower slopes of Mount Mulanje.



Conservation areas of Malawi. 1: Nyika National Park (3134 sq km). 2: Vwaza Marsh Game Reserve (986 sq km). 3: Kasungu National Park (2316 sq km). 4: Nkhotakota Game Reserve (1802 sq km). 5: Lake Malawi National Park (94 sq km). 6: Liwonde National Park (548 sq km). 7: Majete Game Reserve (682 sq km). 8: Lengwe National Park (887 sq km). 9: Mwabvi Game Reserve (340 sq km). 10: North Viphya Forest Reserve & Army Range. 11: South Viphya Forest Reserve. 12: Chimaliro Forest Reserve. 13: Dwambezi Forest Reserve. 14: Dzalanyama Forest Reserve. 15: Namizimu Forest Reserve. 16: Mangochi Forest Reserve. 17: Zomba Forest Reserve. 18: Mulanje Mountain Forest Reserve. 19: Thyolo Mountain Forest Reserve. There are numerous other, mostly small forest reserves. *Other localities:* 20: Lake Malawi. 21: Mzimba. 22: Mchinji. 23: Lilongwe. 24: Lake Malombe. 25: Lake Chilwa. 26: Shire River. 27: Blantyre-Limbe.

Critical Sites

1. The natural vegetation of Malawi is dominated by deciduous miombo woodlands, and some important areas of this habitat are included in the protected areas of the country. The most important sites are Kasungu National Park, Nkhota-kota National Park, Lengwe National Park (predominantly thicket and woodland savanna), Liwonde National Park (predominantly mopane rather than miombo), Majete Game Reserve and Vwaza Marsh Game Reserve. Collectively, these areas hold the bulk of the large mammal populations within the country. Several forest reserves also conserve sizeable areas of miombo woodland habitat: Chimaliro, Chongoni, Dedza-Salima Escarpment, Dwambazi, Dzalanyama, Kaningina, Malosa Complex, Mangochi, Mchinji, Namidzimu, Tuma and North and South Viphya.

2. Some of the most important sites for biological diversity in Malawi are in the highlands. Of particular interest is the Nyika National Park in the north, a large plateau consisting of forest fragments and high altitude grasslands. In the south, Mount Mulanje represents the largest area of montane forest. Biogeographically, Malawi's forests can be divided into three distinct groups: those north of 14 degrees South; those south of 14 degrees South, west of the Rift Valley; and those east of the Rift Valley. Important sites north of 14 degrees South are: the Misuku Hills, Mafinga Mountains, Jembya Plateau, Musisi Hill, Nyika Plateau (including its eastern escarpment), North Viphya Plateau, Kaningina Hills, South Viphya Plateau, the lakcshore forests (at Kalwe, Nkuwadzi, Mzuma and Kuwilwe Hill), Chipata Mountain and Ntchisi Mountain. Important sites south of 14 degrees South, west of the Rift Valley, are: The Dzalanyama Range, Chongoni Mountain, Mlunduni Mountain, Dedza Mountain, Chirobwe Mountain, the Kirk Range, Thambani Hill and the Malawi Hills. Important sites east of the Rift Valley are: the Namizimu Hills, Mangochi Mountain, Chikala Hill, the

Shire Highlands (including Malosa Mountain, Zomba Mountain, Chiradzulu Mountain, Lissau Saddle, Ndirande Mountain, Soche Mountain, Bangwe Hill, and most importantly Thyolo Mountain and associated tea estates), and Mount Mulanje (including lowland forest in the foothills). Most of the forest patches in Malawi are now very small, and conservation measures are particularly urgent.

3. Malawi also has some important lake and wetland habitats. Lake Malawi has a large number of endemic fish species, especially cichlids. Lake Malawi National Park (which includes a small land area, some islands and a small part of the lake) needs to be expanded to include a greater diversity of the lake's habitats. Lake Chilwa, a soda lake, is another important site, especially for waterbirds. Vwaza Marsh (within the game reserve) is an important wetland site, as are Lake Chiuta, Mpatsanjoka Dambo (marsh) and Matope Marsh, Elephant Marsh, and Ndinde Marsh (in the Shire Valley).

Critical Species

1. Plants. 5,500 species occur, with 69 known endemics, mainly in the highlands (about 30 of these on Mount Mulanje).

2. Antelopes. 18 species occur, and one, the blue wildebeest, is extinct. Most species occur in good populations in the protected areas, but are either extinct or present in low numbers outside. There are important populations of nyala at Lengwe, Mwabvi and the Sucoma Game Ranch, and of Lichtenstein's hartebeest in Vwaza Marsh and Kasungu. The Livingston suni is only found in the thicket vegetation cover of Lengwe National Park and Mwabvi Game Reserve.

3. Elephants and Rhinos. Elephants have been reduced to less than 2,000 animals, with about 300 at Kasungu (a priority baseline population for southern Africa), and smaller numbers in other protected areas. Black rhinos are now reduced to a tiny remnant of about five animals at Mwabvi. Poaching constitutes a severe threat to both species.

4. Other Mammals. The blue monkey *Cercopithecus albogularis,* which occurs as three subspecies, *moloneyi, francescae,* and *nyasae,* is threatened in Malawi and its continued survival depends on protection of evergreen forest patches. The cheetah only occurs in Kasungu and Nyika National Parks, where its numbers are limited. Its restricted distribution is attributed to loss of habitat for agriculture. There are important lion populations in Liwonde, Kasungu and Nkhota-kota, and a high concentration of leopards on the Nyika Plateau. The wild dog is greatly reduced in Malawi, though a viable population might survive in Kasungu National Park; it also occurs at Vwaza and Nkhotakota. The chequered elephant-shrew subspecies *Rhynchocyon cirnei hendersoni* is endemic to the forests on the eastern side of the Nyika Plateau. Two hyrax subspecies, *Procavia capensis johnstoni* and *Heterohyrax brucci manningi,* are restricted to southern Malawi. The greater hamster-rat *Beamys major* is restricted to montane forest in northern Malawi and adjacent south-western Tanzania and northeastern Zambia.

5. Birds. Five threatened species occur. The wattled crane has declined greatly in Malawi, and now breeds only in Kasungu and Nyika National Parks. The east coast akalat occurs in forests in and around the Nkhata Bay district including the lakeside forests. The remaining three species occur in the small forest patches east of the Rift Valley. Of greatest importance is the Thyolo alethe, nearly endemic to Malawi (with two populations in Mozambique). The Malawi population is about 1,500 pairs, distributed in 13 sites, with 1,000 pairs on Mulanje, 200 on Thyolo, and 300 elsewhere. Of similar importance is the white-winged apalis which is rare (about 100 pairs on nine sites). The spotted ground-thrush is particularly rare with only 30-40 pairs in four sites (Soche, Thyolo, Lisau and Mulanje). Forest protection measures are essential for these species. Lake Chilwa is important for wetland birds and migratory waders. The world's largest population (about 5,000 pairs) of the blue swallow lives in the Nyika Plateau and the continued protection of the montane grassland habitat of this species is of great importance.

6. Crocodiles. The Nile crocodile has declined, but is still widespread with reasonable populations in the Shire River.

7. Other Reptiles. Several forest species may be threatened by habitat destruction. Of particular concern are the chameleon *Chamaeleo muelleri,* endemic to the Shire Highlands, and the four species endemic to Mount Mulanje: the gecko *Lygodactylus rex*; the chameleons *Chameleo mlanjensis* and *Rhampholeon platyceps*; and the lizard *Platysaurus mitchelli.* There are an additional four reptile subspecies endemic to Mount Mulanje. It is the clearance of the foothill forests around the mountain that gives the greatest cause for concern.

8. Amphibians. 12 species of conservation concern occur, mainly in the highlands. There are four endemics; *Phrynobatrachus stewartue* from Rumpi (near the Nyika Plateau); *Hyperolius mertensi* from the Nyika Plateau; *Ptychadena broadleyi* from Mounts Mulanje and Zomba; and *Arthroleptisfrancei* from Mount Mulanje. Six of the other species are shared only with Tanzania, including the caecilian *Scolecomorphus kirkii* from Mount Mulanje.

9. Fish. Lake Malawi has the highest number of endemic fish of any lake in the world, between 400 and 500 species.

The Lake Malawi cichlids, in particular, demonstrate high *endemicity and, in the case of certain species, extremely* restricted local endemicity. They figure prominently in the international hobby-fish trade and the implications of this for the species' conservation may be serious. There are several relict species in the Ruo River which drains from Mount Mulanje and these may be under threat from the intensive agriculture in its catchment

10. Invertebrates. The dragonfly *Teinobasis malawiensis* is endemic to montane streams in northern Malawi.

Threats

1. Most of Malawi's protected areas are reasonably well managed, but not to the level necessary to prevent serious poaching of elephants and rhinos.

2. Species outside the protected areas are at considerable risk from habitat clearance, expanding agriculture and illegal hunting.

3. Although Malawi's forests are protected by law, many are at risk because of their smallness: Some may not be large enough to hold viable populations of certain important species.

4. Fish introductions into Lake Malawi are a potential threat to the indigenous fauna, as are over-fishing (for both subsistence use and commercial trade) and pollution.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Forestry and Natural Resources. At present, natural resource management is governed by six separate Acts of Parliament, but these are currently being rationalised into a single new Act. Three particular departments are of importance: the Forestry Department; Fisheries Department; and Department of National Parks and Wildlife.

(b) Specific activities of the Department of National Parks and Wildlife include: law enforcement and anti-poaching operations; public education (operating out of three centres: Blantyre, Lilongwe, and Mzuzu); zoning of protected areas and their surroundings to provide good habitat management while meeting needs of local people; habitat management (including burning and provision of water); animal population management (including culling, translocations, fencing and pest control); regulation of hunting quotas; and provision of oversight to game ranches.

2. Multi-agency Projects

(a) Environmental education centres in Nkhota-kota Game Reserve and Lengwe and Nyika National Parks (WSM/WWF): supports efforts at environmental education.

(b) Chambo fisheries research (Government/FAO/ UNDP): the four species of chambo represent the most important fish species in the Lake Malawi and Upper Shire River fisheries, and this project seeks to develop and long-term sustainable management programme.

(c) Wildlife management and crop protection (Government/ FAO/UNDP): development of wildlife management strategies around Kasungu and Liwonde National Parks, including training and institution building.

(d) Assistance in soil conservation (Government/FAO/ UNDP): developing soil conservation measures with small-scale farmers, in collaboration with the Land Husbandry Branch of the Ministry of Agriculture.

(e) Study of Lake Chilwa with a view to its possible nomination as a Ramsar Site (Government/FFPS).

(f) Southern African Wetlands Project (SADCC/IUCN/ NORAD): aims to develop a regional wetlands strategy based on a review of the status of wetland resources, the identification of priority conservation actions, and the development of integrated land-use in wetlands management

3. EWT Projects

(a) Assistance to Department of National Parks and Wildlife: provision of computer.

4. FINNIDA Projects

(a) Environmental training course for African communicators: course available to nationals of English-speaking SADCC countries.

5. NFINP Projects

(a) Survey of type localities of terrestrial molluscs in Malawi and an assessment of the possibilities for protecting these species.

6. WSM Projects

(a) Provision of student hostel accommodation in Lengwe, Kasungu, and Nyika National Parks.

(b) Production of educational magazines.

(c) Annual Lengwe National Park game count and refurbishment of nature trail.

(d) Development of Michiru Mountain Conservation Area.

(e) Production of various educational and guide books.

Suggested Conservation Activities

1. Firm measures are needed to conserve the remaining forest areas in Malawi, and a number of threatened species depend on forest conservation for their survival (see *Critical Species* 4, 5, 7 and 8 above). Existing protected areas should be protected against further agricultural or timber-producing incursions and new protected areas should be established as

a matter of urgency. *Critical Sites* 1 and 2 above list important potential locations.

2. Lake Malawi National Park should be expanded to include a greater diversity of lake and wetland habitats, which are critical for fish in particular (see *Critical Species 9* above).

3. Cooperation with neighbouring countries in anti-poaching efforts is a high priority, especially with Zambia.

4. Stricter anti-poaching measures for elephant and black rhino are urgently required.

5. Surveys of populations of the wild dog and cheetah are needed to assess viability and indicate conservation action. These populations will probably need to be managed in conjunction with those in neighbouring Zambia if they are to be viable in the long-term.

6. The status and conservation requirements of forest reptile species, particularly in the lowland forests on Mount Mulanje, should be assessed and appropriate conservation action initiated.

7. Existing measures should continue to be applied to ensure that no fish species are introduced to Lake Malawi, with possible catastrophic effects on the indigenous fauna.

8. The impact of the hobby-fish trade on endemic cichlids should be assessed, also the effect of catchment changes on fish populations in the Ruo River.

9. The possibility of developing integrated rural development programmes that include a provision for local communities to benefit directly from wildlife conservation, should be considered, especially in the Lower Shire Valley.

Lake Malawi rockfish (Mbuna) swarm over lake floor in Lake Malawi National Park (Photo: WWF/J. Trendall).

***P. Tropheops* (lilac), Lake Malawi (Photo: WWF)**

Chapter 31: Mali

Introduction

Area: 1,240,142 km^2. Cultivated: 2%. Pasture: 24%. Forest/woodland: 7%.

Population (1989 data): 8,918,000. Urban: 18%. Labour force in agriculture (1980): 86%. Density: 7/km^2. Annual growth rate: 2.9%, increasing. Doubling time: 24 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 200. GNP annual growth rate: 2.8%.

Biogeographic affinities: Saharan in the north, Sahel Regional Transition Zone in the centre, and Sudanian in the south.

Vegetation: Desert and semi-desert in northern half of the country; *Acacia* wooded grassland in the Sahel zone, and Sudanian woodlands in the south. Around the Inner Niger Delta, there are large areas of swamps, floodplains and lakes.

Critical Sites

1. Mali is one of the Sahel countries that has suffered most severely from drought and from overgrazing by livestock, and consequently its natural resources are now severely depleted. There are, however, some important sites in need of improved conservation measures. In the west of the country is an important reserve complex, centered on the Boucle du Baoule National Park, with the contiguous Fina, Badinko and Kongossambougou Faunal Reserves and Bossofola Forest Reserve. This complex includes dry wooded savanna, thorn scrub, and riverine forest, with a large proportion of the remaining large mammal populations in the country. Further to the west are the small, isolated reserves of Kenie-Baoule, Sounsan and Faya, and the forest reserves of Talikouron, Nafadji and Banifeng-Baoule.

2. Further to the east are two large Faunal Reserves, Gourma Elephant and Ansongo-Menaka, both in need of improved management. The Gourma Elephant reserve needs a combination of multiple-use and strict sanctuary areas. The Ansongo-Menaka reserve needs to be consolidated, with protection and management improved.

3. The lakes, wetlands and floodplain (inundation zone) forming the Inner Niger Delta collectively form what is probably the most important site within the country. This is another area which would best be managed through a carefully designed multiple-use programme, with reserves at a few well chosen localities, such as Lake Debo, Lake Horo and Seri, where Ramsar Sites have been established. Other important sites in the area include Lake Faguibuine and the middle section of the Diafa River floodplains. The delta is particularly important for wintering palearctic birds and manatees.

4. There is a new reserve in the woodlands in the south near the Guinea border, the Bafing-Makana Faunal Reserve, where some large mammals (perhaps including the giant eland) survive. A new reserve is also proposed at Sikasso, where some isolated forest fragments occur and chimpanzees reach their northern distributional limits.

5. The desert areas in the northern half of the country currently receive no protection. It is here that the last addax and slender-horned gazelle populations might still survive.

Critical Species

1. Plants. 1,600 species occur, with only 11 endemics.

2. Antelopes. 15 species survive, with two recent extinctions, the scimitar-horned oryx and the korrigum. All species are severely reduced in numbers, and four are severely endangered: the giant eland might still occur in the west near the borders with Guinea and Senegal; the addax survives in very small numbers near the borders with Mauritania and possibly Algeria; the slender-horned gazelle is probably nearing extinction in the northern desert region; and the dama gazelle (severely depleted in the Sahel zone, with small populations in the Gourma Elephant and Ansongo-Menaka Faunal Reserves).

3. Other mammals. Elephants survive principally in the Gourma Elephant Faunal Reserve (about 600 animals), and this is considered a priority baseline population for West Africa. Urgent measures are needed to secure this population against poaching and to resolve human-elephant conflicts. In the inundation zone, important populations of manatees and warthogs survive, but hippos are nearly extinct, as are giraffes and wild dogs throughout the country. One rodent of conservation concern occurs, a species of gundi *Felovia vae*, which is known only from western Mali, southern Mauritania and eastern Senegal. It frequents rocky areas near dry forest. Chimpanzees survive in forest and woodland in the south of the country.

Major natural vegetation zones of Mali. 1: Niger River. 2: Bani River. 3: Niger Delta inundation zone (floodplain grassland and swamp). 4: Senegal River. 5: Baoule River. 6: Faleme River. 7: Mandingues Mountains. 8: Adrar des Iforhas. 9: Bamako. 10: Gourma (Malien region south of the bend of the Niger River. 11: Araouane. 12: Laga Koundiri

4. Birds. No threatened species occur, but ostriches survive in a few places, notably the Ansongo-Mcnaka Faunal Reserve. The Inner Niger Delta is one of the most important sites in Africa for wintering palearctic birds, in particular ducks, herons, waders and certain passerines. The rational management of this area should include measures to safeguard these important populations.

5. Reptiles. The African spurred tortoise occurs widely but thinly. Surveys are needed to assess its status and conservation requirements. The Nile crocodile is now seriously depleted throughout the country, though some farms are now being started. The slender-snouted crocodile occurs in the south, where it is apparently declining.

6. Amphibians. Two endemic species occur, *Schoutedenella milletihorsini,* known only from a stony region from Benedougou to Kati (12 kms north of Bamako); and a toad *Bufo chudeaui,* known only from Bata Pool, Sahel de Nioro.

Threats

1. Mali's ecosystems are severely degraded through prolonged droughts and overgrazing by livestock. As a result, several species have been, or are in the process of being, lost.

2. Protected area management in the country has not been very effective, with resulting encroachment on reserves, and illegal hunting of several species taking place.

3. The country's wetlands are at risk from excessive and unsustainable use of their resources - a result of drought, water diversion and changing patterns of resource use.

4. Mali is a major exporter of parrots, and it is possible that this trade is having a negative impact on wild populations.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Natural Resources and Animal Husbandry, which includes the Directorate of Water and Forests. Both the National Parks Department and Forestry Department come under this Directorate, The National Parks Department is responsible for protected areas and wildlife in general, and the Forestry Department is responsible for the management of the Classified Forests.

Bozo fishermen emptying net in Niger River, Mali (Photo: WWF/Hartmut Jungius).

Conservation areas of Mali. 1: Boucle du Baoule National Park (3500 sq km). 2: Kongossambougou Faunal Reserve (920 sq km). 3: Badinnko Faunal Reserve (1930 sq km). 4: Fina Faunal Reserve (1360 sq km). 5: Kenie-Baoule Faunal Reserve (675 sq km). 6: Faya Forest Reserve (800 sq km). 7: Elephant Faunal Reserve (12 000 sq km). 8: Ansongo-Menaka (17 500 sq km). In addition, there are several other relatively small faunal and forest reserves in the western part of the savanna woodland zone.

2. Multi-agency Projects

(a) Integrated wetland management and sustainable development at Youvarou in the Inner Niger Delta (IUCN/ISF).

(b) Schools education project (IUCN/BMZ).

(c) Support to Sahel Vert bulletin (IUCN/NORAD).

(d) Wildlife survey to investigate possibilities for sustainable utilisation (IUCN/NORAD).

(e) Development of integrated conservation programme for the Gourma Region (IUCN/NORAD).

(f) Development of forest management by villages, including reforestation at Koulikoro (FAO/Netherlands Government).

(g) Erosion control around Koutiala (Netherlands Government/Royal Institute of the Tropics).

3. DDA Projects

(a) General programme of forestry support

4. EEC Projects

(a) Conservation of elephants in the Gourma region.

5. Netherlands Government Projects

(a) Village forestry at Segou, including wood-stove improvement, management of natural vegetation, and reforestation.

(b) Village forestry at Koulikoro, with emphasis on wood-stove improvement and extension work.

(c) Support for the Tropical Forestry Action Plan process in Mali.

6. WWF Projects

(a) Development of reserves in the Niger delta: a combination of approaches to improve conservation in the Inner Niger Delta.

Suggested Conservation Activities

1. A number of existing protected areas are in need of improved conservation measures: *Critical Sites* 1 above lists key locations.

2. The Gourma Elephant Faunal Reserve needs improved management based on carefully controlled multiple use with strict sanctuaries in high-priority areas and improved anti-poaching measures, particularly with respect to elephants.

3. The Ansongo-Menaka Faunal Reserve needs to be consolidated with protection and management improved, particularly in relation to antelopes and birds, notably ostriches (see *Critical Species 2* and 4 above).

4. The Inner Niger Delta complex needs a combination of controlled multiple-use programmes with carefully-selected reserve areas, particularly in relation to birds. See *Critical Sites* 3 and *Critical Species* 3 and 4 above for priorities.

5. A number of new reserves in the south should be selected and gazetted (see *Critical Sites* 4 above).

6. A major emphasis in conservation programmes in the south of the country should be on the sustainable use of bushmeat as a source of protein for local residents.

7. Surveys of antelope populations are needed, particularly in relation to species known to be threatened (see *Critical Species* 2 above).

8. The impact of the parrot export trade on wild populations needs to be assessed.

9. The African spurred tortoise should be surveyed to assess its status and conservation requirements.

10. Crocodile conservation (for both Nile and slender-snouted) needs improvement, preferably through expansion of farming.

Chapter 32: Mauritania

Introduction

Area: 1,030,700 km^2. Cultivated: 0%. Pasture: 38%. Forest/woodland: 15%.

Population (1989 data): 1,969,000. Urban: 35%. Labour force in agriculture (1980): 69%. Density: 2/km^2. Annual growth rate: 2.7%, increasing. Doubling time: 26 years.

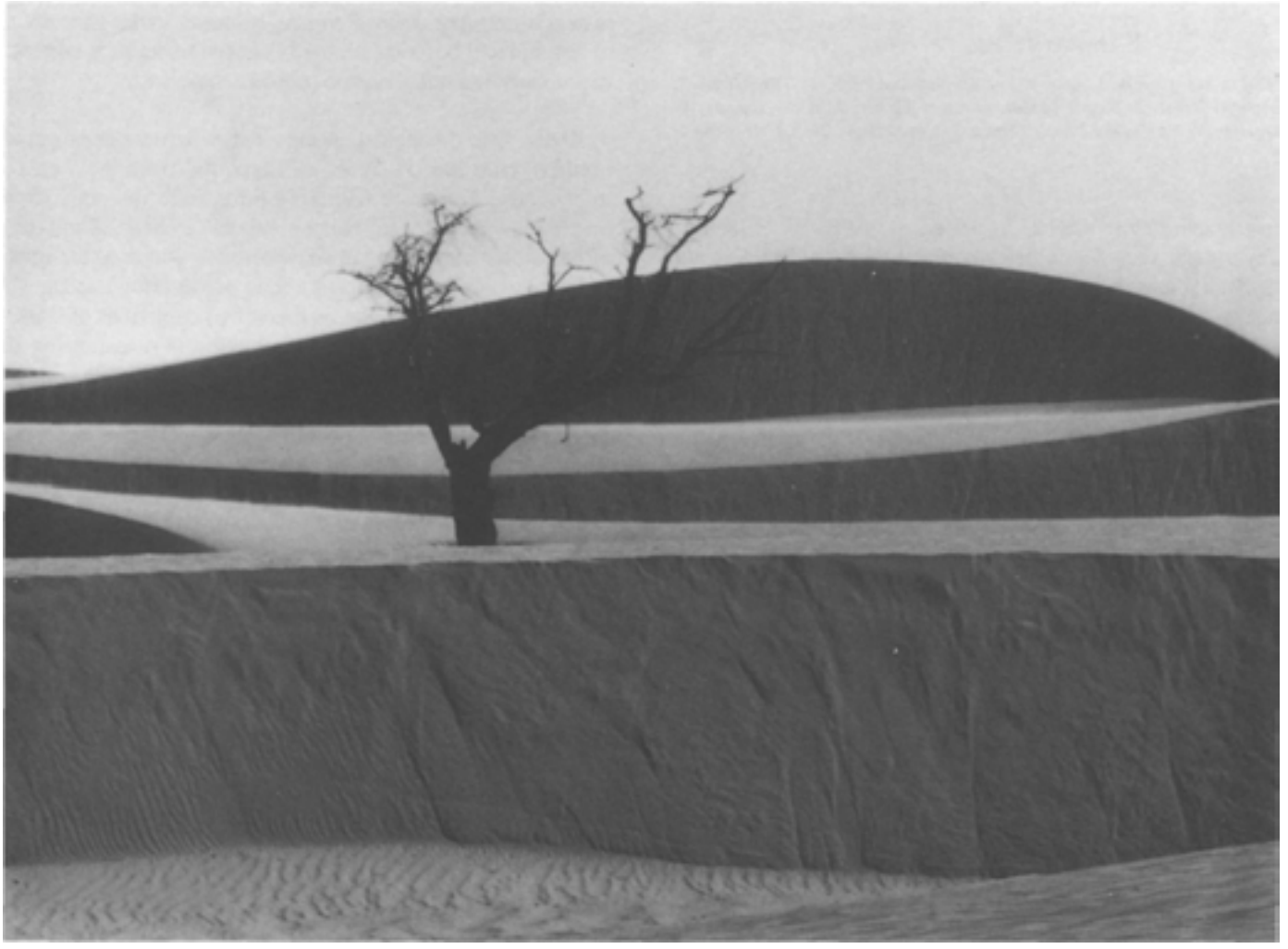
Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: US$ 440. GNP annual growth rate: 1.9%.

Biogeographic affinities: Saharan in the north and centre, Sahel Regional Transition Zone in the south.

Vegetation: Desert and semi-desert in north and centre of the country; *Acacia* wooded grassland in the south; large areas of wetland along the coast.

Critical Sites

1. As with most other countries in the Sahel, Mauritania's habitat's are severely degraded owing to droughts and



Banc d'Arguin National Park, Mauritania (Photo: WWF/Pierre Campredon).

Map of Mauritania. 1: Banc d'Arguin National Park (11 730 sq km). 2: Senegal River. 3: Erg d'Iguidi. 4: Dhar Tichit. 5: Akle Aouana. 6: Oualata. 7: Nema. 8: Atlantic Ocean. 9: Nouakchott. 10: Le Mreyye.

overgrazing by livestock. At present it is difficult to identify any critical sites within dry woodland savanna, Sahelian and desert habitats, but location of particularly important areas is necessary before further degradation occurs. Most of the formerly important sites in the Senegal Valley have now been degraded.

2. Mauritania's most important sites for the conservation of biological diversity are wetland and coastal sites. Paramount among these is the Banc d'Arguin National Park, with the contiguous Côte des Phoques (or Las Cuevicillas Integral Reserve) and Cap Blanc. This is one of the most important sites in Africa for waterbirds and palearctic migrants and the management plan needs to be implemented. The other important wetland sites are Lac d'Aleg and the proposed Diawling National Park, adjacent to the Djoudj National Park in Senegal.

Critical Species

1. Plants. 1,100 species occur. Endemicity is not known, but is believed to be very low.

2. Antelopes. 7 or 8 species survive. Another three, the scimitar-horned oryx, korrigum and dama gazelle are now extinct. All the surviving species are severely threatened, and most of them are restricted to parts of the Senegal Valley, or near the Mali border, where they receive no protection. It is possible that addax survive near the Mali border, and that there are still slender-horned gazelles in the northern deserts (perhaps at the Erg d'Iguidi). The dorcas gazelle occurs in the Banc d'Arguin National Park where it has been reduced to less than 200 individuals by illegal hunting, which continues to be a problem within the Park.

3. Other Mammals. The elephant used to occur in the south, but is believed to have become extinct during the last few years. There are two rodent species of conservation concern, a gerbil *Gerbillus mauritaniae,* apparently endemic to one locality in the south of the country, and a gundy *Felovia vae,* which occurs in southern Mauritania, as well as western Mali and eastern Senegal. It frequents rocky areas near dry forest. A very important non-breeding population of Mediterranean monk seals occurs at Cap Blanc; these animals come from the population that breeds along the coast of the Western Sahara. A number of species of dolphin, porpoise and whale occur off the Mauritanian coast and some of these visit the waters within the Banc d'Arguin National Park. The extent of dolphin and porpoise deaths in coastal fisheries is currently not known: a conservation problem may exist

4. Birds. One threatened species, the extremely endangered northern bald ibis, is sometimes reported from the west of the country. These are wintering birds from the population that breeds in Morocco. Huge numbers (around 2.5 million) of palearctic waders and other waterbirds winter at the Banc d'Arguin, with large concentrations of waterfowl at Diawling. There are also substantial breeding populations of waterbirds at these sites. Habitat conservation is essential for all these species.

5. Reptiles. The slender-snouted crocodile occurs in the south of the country, but its populations are now severely at risk. The African spurred tortoise occurs widely but thinly and its exact status and conservation requirements are not known. Four species of marine turtle are known from Mauritanian waters, the loggerhead, olive ridley, green, and hawksbill. All occur in the Banc d'Arguin-Baie du Levrier-Cap Blanc area. The green turtle is known to nest, and the hawksbill is believed to do so. Clearer identification of nesting beaches and conservation requirements is needed, since there is known to be considerable local utilisation.

Threats

1. Mauritania's ecosystems are severely degraded through prolonged droughts and overgrazing by livestock. As a result, several species have been, or are in the process of being, lost.

2. Protected area management in the country has been inadequate, with illegal hunting of several species taking place.

3. The country's wetlands are at risk from drought and increasing human use, as well as irrigation.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Ministry of Rural Development is responsible for the conservation of nature through the "Direction de Protection de la Nature".

(b) The Ministry of Fisheries oversees all aspects of the conservation and management of fisheries.

(c) The Banc d'Arguin National Park is managed under the Presidency.

2. Multi-agency Projects

(a) Development of National Conservation Strategy (Government/IUCN/EEC): provision of technical and financial assistance to the government for the strategy.

(b) Banc d'Arguin National Park (IUCN/Netherlands Government/Fondation Internationale du Banc d'Arguin/WWF): implementation of the Park's management plan and support of staff training, equipment and promotion of the park.

3. GTZ Projects

(a) Establishment of a coastal fisheries control system to prevent the fish stocks off Mauritania from becoming depleted by foreign fishing fleets.

4. WWF Projects

(a) Establishment of Diawling Reserve: establishment of protected areas, staff training and public awareness promotion.

(b) Cap Blanc, conservation and management of monk seals: focusses on the small local population of monk seals, includes development of protective measures, training of staff and public awareness programmes.

(c) Impact of pesticides on Palearctic migratory birds in the Senegal delta.

Suggested Conservation Activities

1. Surveys should be carried out to identify remaining important areas of natural habitat, with a view to establishing protected areas.

2. The coastal Banc d'Arguin National Park, together with the Cote des Phoques and Cap Blanc, needs its management plan implementing, in view of its importance for birds, antelopes, marine mammals and reptiles (see *Critical Species* 2, 3, 4 and 5 above).

3. The proposed Diawling Strict Nature Reserve should be established as a matter of urgency, particularly in relation to mammals and waterfowl (see *Critical Species* 3 and 4 above).

4. A major emphasis in all conservation projects should be on sustainable use of wildlife resources, especially bushmeat, by local communities.

5. Stricter anti-poaching measures need urgent implementation, particularly in relation to antelopes, other large mammals and crocodiles.

6. A survey of coastal fisheries is required to determine the extent of dolphin and porpoise deaths, and whether cof protected areas should be pursued.

7. Surveys of the status and conservation needs of the African spurred tortoise should be carried out.

8. Identification of the nesting beaches and conservation requirements of marine turtles is needed.

Chapter 33: Mauritius

Introduction

Area: 1,865 km^2. Cultivated: 58%. Pasture: 4%. Forest/woodland: 31%.

Population (1989 data): 1,121,000. Urban: 41%. Labour force in agriculture (1980): 28%. Density: 601/km^2. Annual growth rate: 1.3%, increasing. Doubling time: 54 years.

Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: US$ 1470. GNP annual growth rate: 3.7%.

Biogeographic affinities: Mascarene, with some Malagasy links on the main islands; Indo-Pacific Oceanic on remote coralline islands.

Vegetation: Formerly evergreen rainforest and dry lowland palm savanna on Mauritius and Rodrigues; now severely degraded almost everywhere, though there are a few patches of less disturbed vegetation in some of the reserves. More remote oceanic islands such as St Brandon are vegetated with characteristic Indo-Pacific scrub.

Map of Mauritius (including Rodrigues).

Critical Sites

1. The country of Mauritius includes the larger islands of Mauritius and Rodrigues, and numerous smaller islands. With the exception of some of the more remote oceanic islands, the natural vegetation of the country, including the evergreen forests, is largely destroyed, and there have been large-scale extinctions, especially of plants, birds and reptiles. The nearest thing to natural habitat remaining on Mauritius itself is the Macchabee-bel Ombre Nature Reserve, which includes the Black River Gorge. It is here that many of the endemic species survive, mainly in very small numbers. The integrity of the reserve is threatened by invasive introduced species, both plants and animals. Other mainland nature reserves of significance include Combo and Corps de Garde.

2. The island of Rodrigues is even more degraded than Mauritius, and its surviving endemic species are generally very seriously threatened. Remaining areas of thicket and forest, especially in the north of the island, are in urgent need of protection.

3. A number of the smaller islands host seabird colonies of international significance, and are also the only places where some of the rarer reptiles survive. The following are nature reserves: Coin de Mire, Ile Plate, Round Island, Ile aux Serpents, Ilot Gabriel, Hot Marianne, Ile aux Aigrettes, Ile aux Sables, and Ile aux Cocos (all these being satellite islands of Mauritius).

4. Mauritius has some important marine resources. The fisheries are managed and regulated within six fishing reserves, although the prohibitions on large net and gill net fishing are rarely enforced. Some well preserved coral reefs occur in a number of locations, although many of the reefs are under threat from siltation, pollution, tourist trade exploitation and increased coral mortality, the exact cause of this last being currently unknown. The St Brandon group is an important nesting site for marine turtles. There are specific proposals (1974) for improving the marine protected area system.

Critical Species

1. Plants. About 800-900 species occur on Mauritius island, about one third of which are endemic. There are eight endemic genera. The most important area for threatened endemic species is the Black River Gorge in the Macchabee-bel Ombre Nature Reserve. On Rodrigues, 145 indigenous species occur, of which 40 are endemic. Many endemic plant species are already extinct, and several of these which do survive are known from only a very small number of individuals, as the following examples indicate: *Crinum mauritianum* (100 plants on Mauritius, all threatened by reservoir plans), a species of *Diospyros* (one female tree known), *Drypetes caustica* (two individuals on Mauritius, twelve on Réunion), *Tetrataxis salicifolia* (seven individuals on Mauritius), and *Xanthophyllum paniculatun* (two individuals on Rodrigues).

2. Mammals. Two threatened species of endemic fruit bat occur, the Rodrigues flying fox (which is extremely rare and threatened by deforestation, cyclones, and hunting) and the Mauritius flying fox (which is also threatened by hunting and cyclones). Another species on Mauritius is now extinct.

3. Birds. Most of the more spectacular endemic bird species on Mauritius are already extinct (including the famous dodo). Most of those that survive are seriously threatened. Seven threatened species occur on Mauritius island, and all of these are effectively restricted to the Macchabee-bel Ombre Nature Reserve. These are the Mauritius kestrel, pink pigeon, Mauritius parakeet, Mauritius cuckoo-shrike, Mauritius black bulbul, Mauritius olive white-eye and Mauritius fody. The first three of these are particularly seriously threatened and are the subject of captive breeding programmes. On Rodrigues, the Rodrigues warbler and the Rodrigues fody are both very seriously threatened, and the latter is the subject of a captive breeding programme. A race of herald petrel breeds on Round Island (120 pairs) but is otherwise known only from Trinidade/Martin Vaz off south-eastern Brazil. A small colony of roseate terns nests on the Ile aux Sables (off Rodrigues). There are a number of important seabird colonies, which include wedge-tailed shearwater, red-tailed tropicbird, white-tailed tropicbird, masked booby, sooty tern, brown noddy, lesser noddy and white tern (in Rodrigues).

4. Marine Turtles. Over-exploitation has led to the extirpation of the green turtle as a nesting species on Mauritius and Rodrigues in recent times (though it is just possible that a few still nest on Ile Plate). Green turtles still nest on St Brandon where the annual nesting population was estimated at 300 in the early 1970s. This population has been subject to intense exploitation in the past, but there are few recent data. Over-exploitation appears to have resulted in the extirpation of the hawksbill turtle as a nesting species on St Brandon. Small numbers of green turtles and hawksbills still forage around Mauritius and Rodrigues.

5. Other Reptiles. There are several endemic species, with concentrations of threatened species on the smaller islands, especially Round Island. These are the Serpent Island gecko (Round Island and Ile aux Serpents), Gunther's gecko (Round Island), Macabe forest skink (Mauritius), Round Island skink (Round Island), Round Island burrowing boa (Round Island, but probably extinct), and Round Island keel-scaled boa (Round Island). These last two represent a unique family. The reptiles on Round Island are being conserved through ecological restoration of the island (through elimination of introduced rabbits) and captive breeding programmes. The status of introduced chameleons is in need of clarification.

6. Amphibians. The status of the introduced mantella is in need of clarification.

7. Invertebrates. An endemic nemertine worm *Geonenertes rodericana* occurs in damp woods on Rodrigues. It is believed to be threatened. The swallowtail butterfly *Papilio manlius* is endemic to Mauritius, where it remains common in natural habitat along the Black River Gorge. The dragonfly *Platycnemis mauriciana* was endemic to southeast Mauritius, but is now feared extinct. The dragonfly *Argiocnemis solitaria* is endemic to Rodrigues and may be extinct. One hundred and thirty species of land snail are native to Mauritius, of which 30% have become extinct and another 30% are severely endangered, due to a combination of habitat destruction and the introduction of the carnivorous snail *Euglandina rosea.*

Threats

1. The devastating rate of species extinction on Mauritius is being driven by two factors, loss of natural habitat and introduction of alien species. Invasive plant species are themselves one of the agents of habitat modification, as were rabbits on some of the smaller islands. What is left of the natural habitats on Rodrigues is still not protected.

2. The surviving populations of many of the endemic species (especially of plants and birds) are so low there their chances of recovery are very slim.

3. Small populations of animals and plants are particularly vulnerable to cyclones, that can destroy entire populations of species.

4. Some species are directly exploited, notably fruit bats, green turtles and hawksbills.

Current Conservation Measures

1. Government Administration on Conservation

(a) Environmental matters come under the Ministry of Agriculture, Fisheries and Natural Resources. This includes the Forestry Service (which is responsible for the management of nature reserves and the sustainable use of forests) and the Fisheries Division (which includes marine reserves in its responsibilities). There is also a Nature Reserves Board which advises the government on the establishment of reserves, and provides a means for the participation of local people and conservation bodies in the selection and management of protected areas.

2. Multi-agency Projects

(a) Restoration of Ile aux Aigrettes (Government/JWPT/ New Zealand Department of Conservation): elimination of introduced herbivores on offshore islands.

3. ICBP Projects

(a) Support for the wildlife research and conservation programme of the Wildlife Clubs of Mauritius.

4. WPTI Projects

(a) Black River project: breeding of pink pigeons, kestrels and fruit bats.

Suggested Conservation Activities

1. The Macchabee-Bel Ombre Nature Reserve (on Mauritius Island) needs urgent measures to combat the worst effects of established introduced species of plants and animals. It should be declared a National Park.

2. Protected areas should be urgently established in the remaining thicket and forest areas in the north of Rodrigues Island.

3. Continuing intensive conservation measures are needed to prevent further extinctions of endemic plants and birds (see *Critical Species* 1 and 3 above).

4. The proposals for marine protected areas should be implemented as soon as possible to prevent current threats from further reducing their biological resources.

5. The level of harvesting of green turtle and hawksbill populations on St Brandon should be assessed; these populations need to be brought under careful, sustainable management.

6. The status and impact of introduced mantellas and chameleons needs investigation.

7. Ecological restoration of Round Island needs to be intensively pursued within the context of the 1989 management plan in order to ensure survival of endemic reptiles *(Critical Species* 5 above). The same type of restoration should also be activated on Ile aux Aigrettes, Coin de Mire and Ile Plate.

8. A coastal zone management plan should be developed to deal with mounting pressure on coastal wildlife, and should include marine parks to protect coral reefs. The Cargados Carajos (St Brandon Islands) are a high priority for reserve status to protect birds, turtles, and other marine life.

Chapter 34: Mozambique

Introduction

Area: 784,754 km^2. Cultivated: 4%. Pasture: 55%. Forest/woodland: 19%.

Population (1989 data): 15,248,000. Urban: 20%. Labour force in agriculture (1980): 85%. Density: 19/km^2. Annual growth rate: 2.6%, increasing. Doubling time: 27 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 150. GNP annual growth rate: no data.

Biogeographic affinities: Predominately Zambezian, with a broad band of Zanzibar-Inhambane Regional Mosaic along the coast and in some of the larger river valleys in the north. There is a small area of Tongaland-Pondoland Regional Mosaic in the extreme south, and Afromontane elements on higher ground.

Vegetation: Predominately miombo woodland, with mopane woodland in the Zambezi and Limpopo Valleys. There is a mosaic of woodland habitats along the coast, as well as patches of forest and mangroves. Montane forests and grasslands occur on the mountains.

Approximate major vegetation zones of Mozambique.

Critical Sites

1. Many of the critical sites for biodiversity conservation in Mozambique are under severe threat, owing to the minimal levels of protection that are currently in force. These is in large part a reflection of the security problems in the country. Nevertheless, Mozambique possesses some important sites, and most of its protected areas are concentrated in the savanna woodlands. These are the Banhine National Park, Gorongosa National Park, Zinave National Park, Niassa (Rovuma) Game Reserve, Maputo Special Reserve, Zambezi Wildlife Utilisation Unit, Marromeu Game Reserve and Gile Game Reserve. Together, these comprise a good cross-section of the miombo, mopane and acacia woodland types in Mozambique. Greatly improved protection and management is required for all of them. Next to the Niassa Game Reserve is the unprotected Lugenda Valley, which is important for wildlife populations.

2. Mozambique has some interesting, though poorly known, areas of forest, none of which currently receive any protection. In the highlands, the most important areas are Mount Namuli, Mount Chiperone, the Njesi Plateau, Mount Gorongosa (not within the national park), the Vumba Highlands, and Chimanimani Mountains. Mozambique's coastal forests are very poorly known, but it is clear that they are home to a number of important species. Identification of the most important sites in the north, centre and south of the country is needed. A network of well managed protected areas is needed in Mozambique's forests, as well as other conservation measures aimed at reconciling *competing* demands on forest resources.

3. Part of Lake Nyasa is included within Mozambique, and there is a need to conserve some of the unique biological resources of this area. Important artificial lake habitat has been created on the Zambezi River by the construction of the Cabora-Bassa Dam. Some valuable coastal wetland habitats are preserved in the Marromeu Game Reserve, which supports large populations of buffalo and Waterbuck.

4. Mozambique also has important marine biological resources. Some important areas are protected in the Bazaruto National Park, the Islas da Inhaca e dos Portugueses reserve and the Pomene Game Reserve. Additional marine

reserves to protect coral reefs, seabird colonies, seagrass beds, and turtle nesting beaches are needed at Quirimba Island, Primeiras Islands, Segundos Islands, and Nacala-Mossuril. A system of coastal zone planning is being set up an this will provide an overall development context within which marine protected areas will fit effectively.

Critical Species

1. Plants. 5,000 species occur, of which 219 are thought to be endemic. The endemics are, for the most part, concentrated in the northern coastal forests.

2. Antelopes. 21 species occur, with one, the tssessebe, recently extinct. Nine of the extant species are considered threatened, mainly owing to excessive hunting resulting from the minimal protection being afforded to the national parks and reserves. Mozambique's population of the nyala, particularly in Gorongosa and Zinave National Parks, is of international importance. The Gorongosa and Zinave National Parks, the Marromcu and Niassa Game Reserves, and the Zambezi Wildlife Utilisation Unit are considered to hold the most significant antelope populations in the country.

3. Elephants and Rhinos. Between 1981 and 1987, illegal poaching reduced elephant numbers to one-third of their previous level. Probably fewer than 18,000 now animals occur, with reasonable populations in Gorongosa National Park and Niassa Game Reserve, but with most animals concentrated outside protected areas in the north of the country. The Gorongosa, Niassa, Maputo and Zambezi Wildlife Utilisation Unit populations have been selected as priorities for conservation attention. The white rhinoceros is now extinct in Mozambique, and the black rhinoceros is very nearly so. The protection of these commercially valuable species will be a high priority once the security situation in the country improves.

4. Other Mammals. There is a major hippo population in Gorongosa National Park and a very large buffalo population in Marromcu Game Reserve. The wild dog has been severely persecuted and is considered to be nearing extinction. Two rodent species of conservation concern occur, the Selinda veld rat *Aethomys silindensis,* which is only known from the Mozambique-Zimbabwe border area in rocky areas at 700-800 m in miombo woodland, and a species of woodland mouse, *Grammomys comestes,* only known from the costal forest belt (also in Tanzania and South Africa). The chequered elephant shrew subspecies *Rhynchocyon cireni cireni* is known only from Quelimane. Its occurrence and conservation requirements in the coastal forest belt require investigation. Dugongs occur widely along the coast, but their populations are believed to be severely depleted. The extent of dolphin and porpoise deaths in coastal fisheries is not known, nor whether a conservation problem exists.

5. Birds. Eight threatened species occur. There is a large colony (200 pairs) of Cape vultures in the Lebombo Hills in the extreme south of the country. The wattled crane is severely reduced, but still occurs in wetlands in the centre of the country, especially in Gorongosa National Park and Marromcu Game Reserve. The east coast akalat occurs in coastal forest. Current records are from the centre and south of the country, but it might occur in the north as well. More information is needed to identify its main populations, the only recent records being from the Inhamitanda Forest between Beira and the mouth of the Zambezi River. The remaining five species all occur in the montane forests: the Thyolo alethe on Chiperone and Namuli Mountains (and Malawi); the dappled mountain-robin on Namuli Mountain (and Tan-

Proclaimed conservation areas and provinces of Mozambique. *Conservation areas* — 1: Niassa (= Rovuma) Game Reserve (10 500 sq km). 2: Gile Game Reserve (2100 sq km). 3: Marromeu Game Reserve (1500 sq km). 4: Gorongosa National Park (3770 sq km). 5: Zinave National Park (5000 sq km). 6: Banhine National Park (7000 sq km). 7: Bazaruto National Park (150 sq km). 8: Pomene Game Reserve (1000 sq km). 9: Maputo Game Reserve (800 sq km). 10: Zambezi Valley Wildlife Utilization Unit (14 700 sq km). *Other areas* — 11: Lebombo Mountains. 12: Chimanimani Mountains. 13: Save River. 14: Buzl River. 15: Zambezi River. 16: Rovuma River. 17: Lugenda River. 18: Lake Malawi. 19: Limpopo River. 20: Maputo. *Provinces* — A: Niassa. B: Cabo Delgado. C: Nampula. D: Tete. E: Zambezia. F: Manica. G: Sofala. H: Gaza. I: Inhambane. J: Maputo.

zania); Swynnerton's forest-robin on Gorongosa Mountain and the Vumba Highlands (also Zimbabwe and Tanzania); the white-winged apalis on Chiperone Mountain (also Malawi and Tanzania); and the long-billed apalis on the Njesi Plateau (and Tanzania). The importance of improved forest conservation in these critical sites is clear. Seabird colonies exist on offshore islands, but there is no recent information on the most important sites, or the species concerned.

6. Crocodiles. The Nile crocodile is probably still widespread, but its populations are depleted. It is probably most secure in the Gorongosa National Park.

7. Marine Turtles. Five species breed. About 300 loggerheads nest annually on Paradise Island and at places on the mainland. About 200 green turtles nest on the Primeiras and Segundas Islands, and also along the northern coast. About 100 hawksbills nest annually on offshore islands, mainly in the north. Olive ridleys nest along the northern coast (500-1,000 annually). Small numbers of leatherbacks (about SO) nest in the country. Better identification of priority nesting beaches, and tighter conservation measures, are needed, since there is known to be considerable exploitation.

8. Other Reptiles. The Natal hinge-back tortoise occurs in a small area in the south. A survey is needed to assess its status and conservation requirements, plus liaison with conservation authorities in Swaziland and Natal (South Africa) regarding appropriate concentration of conservation efforts. One globally threatened snake species is known to occur, the Transvaal quillsnout snake *Xenocalamus transvaalensis* (southern Mozambique and neighbouring South Africa). The dwarf chameleon subspecies *Rhampholeon marshalli gorongosae* is endemic to the forests on Gorongosa mountain and is therefore vulnerable to habitat destruction there.

9. Amphibians. Five species of conservation concern occur, including two endemics, two shared with South Africa, and one with Malawi.

10. Fishes. Lake Nyasa has the greatest diversity of fish species (including endemics) of any lake in the world (see Table 4.2). It is important to safeguard habitats, and to prevent any fish introductions that could have disastrous consequences. Information on freshwater fish in other sites is limited but there is known to be one endemic species, *Parakneria mossambica,* in the Mutzambidzi River, Gorongosa National Park. At least two other threatened freshwater species occur in the south along the border with South Africa: the orange-fringed largemouth *Astatotilapia brevis* and the lowland largemouth *Serranochromis merridianus.* One globally threatened estuarine fish, the checked goby *Redigobius dewaali* occurs from the lower Limpopo southwards, and two other threatened species known from South African estuarine waters, the freshwater mullet *Myxius capensis* and the Sibayi goby *Silhouetta sibayi,* might occur in Mozambique.

11. Invertebrates. The dragonfly *Ceriagrion mourae* is endemic to Mozambique and is very little known. A dragonfly subspecies *Eleuthemis buettikoferi quadriguttata* is known only from the Mozambique-Zimbabwe border area.

Threats

1. The civil war in Mozambique has led to a breakdown in the protection measures being applied in the country's parks and reserves. As a result, most of these important sites are suffering from encroachment and very severe illegal hunting of large mammals. Mozambique's wildlife populations are now seriously at risk.

2. The current protected area system, when re-established, lacks important sites for montane and lowland forest and coastal and marine habitats. Such sites are therefore especially at risk.

3. Fish introductions into Lake Nyasa are a potential threat to the indigenous fauna, as are over-fishing and pollution.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Government focal point for environmental matters is the Ministry of Mineral Resources and the Ministry of Construction and Water is the deputy focal point. However, the responsibility to coordinate administrative action in the environment, and to implement decisions of the ministers in charge of environment, are vested in the National Institute of Physical Planning (INPF), a section of the Ministry of Planning. The INPF has four departments: regional planning, urban planning, housing, and training.

(b) Responsibility for wildlife and forestry rests with the Ministry of Agriculture, especially the the National Directorate for Forestry and Wildlife.

(c) The National Water Directorate (NWD) in the Ministry of Construction and Water has some environmental responsibilities, and is government focal point for the Zambezi River Basin Action Plan that was developed in collaboration with UNEP.

2. Multi-agency Projects

(a) Bazaruto Archipelago development (Government/ EWT/WWF): inventory of the natural resources of the islands, construction of facilities and preparation of an integrated development plan.

(b) Development of new infrastructure, including anti-poaching squad, survey work and library development (Government/EWT).

(c) Coastal zone management project (Government/IUCN/NORAD): this project, aimed at improving coastal zone conservation, has been approved in principle and is now in the planning stage.

Suggested Conservation Activities

1. Protection in all current reserves urgently needs great improvement as the security situation permits.

2. Protected areas in both highland and coastal forests need establishing as soon as possible, with particular reference to birds (see *Critical Species* 5 above).

3. The Niassa Game Reserve should be extended southwards to include the Lugenda Valley.

4. The Gorongosa National Park should be extended to include wildlife habitats to the north of the current boundary, and should be rehabilitated to allow wildlife levels to begin to recover from the effects of the civil war.

5. Surveys of coastal forest areas are needed to identify key conservation sites, particularly in relation to threatened mammals and birds (see *Critical Species* 4 and 5 above). A survey of the conservation requirements of elephant-shrews is needed in this context, and also of the east coast akalaL

6. A protected area should be established to conserve the biological resources in Mozambique's part of Lake Nyasa. Introductions of alien fish species should not take place.

7. An appropriate management plan for Bazaruto National Park needs to be worked out and implemented.

8. Additional marine reserves should be established in the context of the coastal zone planning system. Surveys of marine turtle nesting beaches, coral reefs and seabird colonies should influence the choice of sites for protected areas. *Critical Sites* 4 above indicates some suitable sites. Increased protection of dugongs is needed.

9. Illegal hunting and poaching are urgently in need of control, especially in relation to elephants, rhinos, wild dogs, antelopes and crocodiles.

10. A coastal fisheries survey is needed to determine the extent of incidental dolphin and porpoise deaths and whether conservation action is required.

11. Surveys of a number of critical bird species are required in a variety of sites, to enable appropriate conservation action to be taken. See *Critical Species* 5 above for details.

12. Surveys of a number of endemic and/or threatened reptiles are needed, with appropriate conservation following (see *Critical Species* 8).

13. Surveys of freshwater fishes are needed to establish species present, distribution, and conservation needs.

14. An increasing emphasis on sustainable use of wildlife resources, particularly bushmeat, is needed. Hence the Zambezi Wildlife Utilization Unit needs improved management followed by extension of the model into other areas. In this context, illegal settlements in Maputo Reserve should be transferred to alternative sites.

Chapter 35: Namibia

Introduction

Area: 824,293 km^2. Cultivated: 1%. Pasture: 64%. Forest/woodland: 22%.

Population (1989 data): 1,817,000. Urban: 51%. Labour force in agriculture (1980): 43%. Density: 2/km^2. Annual growth rate: 3.1%, decreasing. Doubling time: 22 years.

Economy (1987 data): World Bank index: no data. GNP/capita: no data. GNP annual growth rate: no data.

Biogeographic affinities: Zambezian in the north and north-east, and Karoo-Namib in a belt from the south to the north-west. Between these two is the Kalahari-Highveld Transition Zone. Marine biota include a small tropical West African element in northern Namibia.

Vegetation: Dry Zambezian woodland in the north-east, becoming progressively drier towards the south and the coast, through bushland and wooded grassland to desert.

Vegetation zones of Namibia. *Desert biome* — 1: Namib. 2: Desert and succulent steppe. 3: Saline desert with dwarf savanna fringe. *Savanna biome* — 4: Mopane savanna. 5: Mountainous savanna and Karstveld. 6: Escarpment zone. 7: Thornbush savanna (tree and bush savanna). 8: Highland savanna. 9: Dwarf shrub savanna. 10: Camelthorn savanna. 11: Mixed tree and shrub savanna. *Woodland biome* — 12: Forest savanna and woodland.

Critical Sites

1. Most of Namibia is dry woodland savanna, and the country possesses some major protected areas in this habitat type. The most important of these is the Etosha National Park, which includes the remarkable, seasonally flooded, Etosha Pan. Other important sites in the dry savannas are Fish River Canyon Nature Reserve, Tsaobis-Leopard Nature Reserve (privately owned), Hardap Nature Reserve, and the Namib-Naukluft, Waterberg Plateau, Kaudom, and Mahango Parks and the privately-owned Omaruru Nature Reserve in the National West Coast Tourist Recreation Area. In addition, some of the farmland in the centre of the country has

Major land-use categories of Namibia. *Intensive farming districts* — A. Tsumeb. B: Outjo. C: Grootfontein. D: Otjiwarongo. E: Omaruru. F: Okahandja. G: Karibib. H: Windhoek. J: Gobabis. K: Maltohöhe. L: Mariental. M: Bethanien. N: Keetmanshoop. O: Karasburg. P: Lüderitz (largely comprises Diamond Areas). *Communal areas* — I: Kaokoland. II: Ovamboland. III: Kavango. IV: Eastern Caprivi. V: Damaraland. VI: Bushmanland. VII: Hereroland. VIII: Rietfontein. IX: Aminuis. X: Rehoboth. XI: Namaland. *Conservation areas* — 1: Namib-Naukluft Park (49 768 sq km). 2: Skeleton Coast Park (16 390 sq km). 3: Etosha National Park (22 270 sq km). 4: Waterberg Plateau Park (405 sq km). 5: Von Bach Recreational Resort (43 sq km). 6: Daan Viljoen Game Park (40 sq km). 7: Hardap Game Reserve (250 sq km). 8: Fish River Canyon Nature Reserve (461 sq km). 9: Khaudom Game Park (3841 sq km). 10: Mahango Game Park (244 sq km). 11: Western Caprivi Game Reserve (1750 sq km). *Other areas* — 12: Windhoek. 13: Swakopmund (National West Coast Tourist Area). 14: Walvis Bay.

been converted into valuable ranches.

2. Some less common habitat types in the country include the more moist, open savannas of the Caprivi Strip. The Caprivi Game Reserve is in need of improved management and protection. There are also some open montane savannas, that are represented in the small Daan Viljocn Game Park. In eastern Caprivi, the Linyanti Swamp carries substantial populations of large predators and other large mammals and reptiles. It is currently unprotected and has an increasing poaching problem. Two new National Parks have just been established in the eastern Caprivi: Mamili and Madumu.

3. The Namib Desert is an important and unusual area for species. It is protected in the Skeleton Coast Park, National West Coast Tourist Area, the Namib-Naukluft Park, and Diamond Areas 1 and 2 which have been protected by a diamond mining company in the past but which have recently become the responsibility of the Department of Nature Conservation. These areas contain almost all the Namib species with a high level of endemism.

4. Namibia has some important coastal sites, especially for Cape fur seals and seabird colonies. Critical Sites include the Cape Cross Seal Reserve, Wolf Bay south of Luderitz and Sylvia Hill on the mainland, and a number of other islands. The Walvis Bay lagoon is an important coastal wetland with up to 120,000 wading birds.

5. Important freshwater sites exist at the karstveld sinkholes of Lake Guinas and Otjikoto, and Aigamas Cave.

Critical Species

1. Plants. 3,159 species occur. The level of endemism is not known, though there are 11 species endemic to the Brandberg.

2. Antelopes. 20 species occur, ten of which are mainly of entirely restricted to the Caprivi Strip. Namibia has the world's largest and best protected population (900) of the black-faced impala in the Etosha National Park. A major population of dik-dik occurs in Darmaraland. Many of the species that are not at risk occur in large populations on the country, not least on farms. The country has particularly large populations of gemsbok, red hartebeest, greater kudu, steenbok and springbok. The most important sites for antelope conservation are Etosha National Park, Namib-Naukuluft Park, Skeleton Coast Park, Waterberg Plateau Park, Kaudum Park and Hardap Nature Reserve. Some of the threatened species (e.g. roan, sable, tsessebe) have been established in more secure areas and are breeding successfully.

3. Elephants and Rhinos. Elephants currently number about 5,000 animals, and are increasing, though certain popula-

Cheetah *Acinonyx jubatus* with cubs (Photo: WWF/Norman Myers)

tions are probably at risk from poachers. About half the animals are in the Etosha National Park, and the remainder are in unprotected areas in the north of the country, including animals adapted to arid conditions in the Kaokoland. The Etosha and Kaokoland populations are considered priority baseline populations for southern Africa. There are two important black rhinoceros populations, one numbering at most 300 animals in Etosha National Park, and another numbering 85-100 in Damaraland; a further 8-10 live in Kaokoland. There are about 28 white rhinos in the Waterberg Plateau Park, and a further 35 on private land. Continued vigilance will be needed if the currently effective conservation measures being taken on behalf of these species are to be maintained.

4. Other Mammals. Namibia has internationally significant populations of giraffe (especially in Etosha National Park), common zebra, Hartmann's mountain zebra, brown hyaenas, cheetah and wild dog (though the latter is declining through persecution, its population in Namibia is, at around 550 animals, one of the most important in Africa). About 60% of the world population of the Cape fur seal breeds along the Namibian coast (the remainder being in South African waters), where it is generally well-protected and increasing in number (see *Critical Sites* 4 above). The extent of dolphin and porpoise deaths in coastal fisheries is not known, nor whether a conservation problem exists. Two rodent species of conservation concern occur, Woosnam's desert rat *Zelotomys woosnami* (in the north and east of the country in riparian acacia woodland, also in Botswana and South Africa), and the Namaqua dune molerat *Bathyergus janetta* (in the south, as well as nearby South Africa).

5. Birds. Five threatened species occur. The Jackass penguin breeds at Sylvia Hill (on the mainland) and the South African-governed islands of Mercury, Ichaboe, Halifax, North Reef, Possession, Plumpudding, and Sinclair. Colonies north of Luderitz are increasing; those to the south are decreasing. The slaty egret (about 17 pairs) breeds in the Mahango Game Reserve and the Nkasa-Lupala Park, and the wattled crane (about 10 pairs) breeds in Bushmanland, but the number of breeding birds can increase dramatically in wet years. In Bushmanland the seasonal pan system supports post-breeding wattled cranes with their fledgling young, as well as great snipe and other species. The Cape vulture breeds in the Waterberg Plateau Park, but has decreased to only about 15 adults and although it appears to be doomed to extinction as a breeding species in Namibia, the population has stabilised as a result of public education and a weekly feeding programme. The bulk of the world population of the Damara tern breeds in Namibia. Colonies are scattered widely, but some birds nest in the Skeleton Coast Park. The Etosha Pan provides a breeding ground for up to a million lesser flamingoes in wet years. There are a number of endemic or near-endemic birds for which Namibia has an international responsibility, though they are not currently threatened. These include Hartlaub's francolin, Ruppell's korhaan, Ruppell's parrot, rosy-faced lovebird, violet woodhoopoe, Monteiro's hornbill, dune lark, Carp's black tit, Herero chat, rockrunner and white-tailed shrike. There is an important population (around 80 birds) of blue cranes in Etosha NP. There are important colonies of other seabird species, most notably of white pelican, Cape gannet, African cormorant, Cape cormorant, bank cormorant, crowned cormorant, kelp gull, Hartlaub's gull, Caspian tern and greater crested tern. The bulk of the world populations of the Cape and bank cormorants nests in Namibia

6. Reptiles. The Nile crocodile occurs in the extreme north, in the Cunene and Okavango Rivers, and the Zambezi, Chobe and Linyate flood plains. Populations appear to be reasonable, but vulnerable. The endemic Berger's tortoise occurs near Aus in southern Namibia but its status and conservation requirements are not currently known. Loggerhead turtles nest in the Skeleton Coast Park and green turtles and leatherbacks occur in the coastal waters. The status and conservation requirements of marine turtles in Namibia is not known at present, nor of the Angolan python *Python anchietae.* The desert-adapted reptiles of the southern coasts in the diamond areas are believed to have suffered but their current status is not known: species of particular concern are the Namaqua dwarf adder *Bitis schneideri,* Meyer's blind legless skink *Typhlosaurus meyeri,* Smith's desert lizard *Meroles octenodactylus,* and Namaqua day gecko *Phelsuma ocellata.* The status and conservation needs of these four species need to be assessed.

7. Amphibians. 32 species occur, of which four are of conservation concern occur, including two endemic toads, *Bufo hoeschi* (which occurs in the southern highlands), and *Bufo jordani* (which occurs in the southern highlands). Another species, *Bufo dombensis,* is restricted to northwestern Namibia and in Angola. The desert rain frog *Breviceps macrops* occurs in a very small area in southern coastal Namibia and nearby South Africa.

8. Freshwater Fish. 97 species occur, including six globally threatened species: the cave catfish *Clarias cavernicola* (only known from Aigamas Cave); rock catfish *Austroglanis sdateri* (Orange River along border with South Africa); broad-headed catfish *Clariallabes platyprosopos* (known from Katima Mulilo and Impalila on the Zambezi River, and Popa Rapids and Namatuntu on the Okavango River); Otjikota tilapia *Tilapia guinasana* (from Lake Guinas and Lake Ojikota, and translocated to five reservoirs in northern Namibia); striped killifish *Nothobranchius* sp. (Gunkwe and Bunkalo in the Caprivi Strip, translocated to one nearby site); and ocellated spiny-eel *Afromasculatus vanderwaali*

(known from Katima Mulilo and Impalila on the Zambezi River, and Popa Rapids on the Okavango River).

Threats

1. Namibia's living natural resources are generally well managed, and the pressures on its biodiversity are not too great at present. A few sites are vulnerable, in particular Damaraland and Kaokoland, where poaching of large mammals has been a problem. *Some of the* seabird nesting colonies also lack sufficient protection.

2. Destruction of riverine woodland is a major threat to bird species in the northeast of the country.

3. Some important species are being persecuted, mainly by poisoning by farmers, in particular the cheetah and wild dog which have major populations in the country. The large amounts of poison used have had devastating effects on scavenging animals, particularly birds of prey.

4. Over-fishing has resulted in serious declines at several seabird colonies south of Luderitz, as well as depleting the fish resource.

5. International pressure to spray against tsetse fly is currently being resisted but constitutes a potential threat.

6. The last stage of the Orange River project may have an adverse effect on the river ecology of its lower reaches and estuary: an environmental impact study is in progress to determine the amount of water that can be removed before the ecology is seriously affected.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Ministry of Wildlife, Conservation and Tourism is responsible for National Parks, Game Reserves, and wildlife on state-owned land. This Ministry is also responsible for all aspects of tourism, including the registration of private game ranches, guest farms, hunting farms, safari companies and professional hunters. It is not yet clear how many Directorates will be established under this Ministry, though there may well be one each for wildlife, conservation, and tourism.

(b) The Ministry of Agriculture, Fisheries, Water and Rural Development is responsible for the Directorates of Agriculture, Inland and Sea Fisheries, Veterinary Services, Forestry, Water Affairs, and Rural Development.

2. Government and Directorate of Nature Conservation Projects

(a) The national constitution adopted at independence has the conservation of biological diversity as being an essential component of state policy. Also the role of the Ombudsman includes investigation of complaints about over-use of natural resources, degradation of ecosystems and protection of beauty.

(b) Inspection of farms and determination of game quotas.

(c) Regular aerial game counts with appropriate research into trends, e.g. declines in blue wildebeest numbers, lion fertility, heavily-browsed tree species, etc.

(d) Surveys of nomadic "communal game" species and of cheetah, jackal and caracal.

(e) Various ornithological projects, including counts, bird atlas, monitoring of threatened species, effect of powerlines, effect of supplementary feeding on vultures, *etc.*

(f) Education of farmers and school-children concerning the use of poisons.

(g) Caprivi Management Plan: review in progress to initiate a management plan linking conservation to economic development of the area.

(h) Wetlands monitoring: a biologist has been appointed to be responsible for wetlands.

(i) Dehorning of rhinos as a poaching deterrent.

See also 3 (a) below.

3. Multi-agency Projects

(a) Auxiliary Game Guard Network: integrated and operationally managed by local populations in co-operation with the Directorate of Nature Conservation: has been instrumental in reversing trends in elephant and rhino poaching in Damaraland and Kaokoland (Government/EWT/WWF/WSSA).

4. EEC Projects

(a) Radio-tracking of elephants in the Caprivi Strip.

5. EWT Projects

(a) Environmental education programme and equipment, Damaraland and Kaokoland.

(b) Monitoring of dehorned rhinos (see 2(i) above).

6. WSSA Projects

(a) Support for Save the Rhino Trust Fund.

7. WWF Projects

(a) Huab Catchment Area wildlife conservation and utilisation: promotes sustainable use of natural resources by Damara farmers and re-introduction and management of indigenous species of large mammals, including protection of elephant and rhino populations.

(b) Provision of emergency support for anti-poaching units: provision of short-term support for Etosha and Damaraland anti-poaching units.

(c) Conservation of desert elephants.

8. Integrated Rural Development and Conservation **(Namibia)**

(a) Purros Project: influencing the ways two semi-

nomadic herder groups view and use wildlife; control and levying of tourists, craft marketing, casual conservation employment etc.

Suggested Conservation Activities

1. The Caprivi Game Reserve has benefitted from the rehabilitation efforts since the area was demilitarised and continues to be in need of improved management and protection, particularly with regard to threatened antelope species. It should be managed as one unit with the Mahango Reserve.

2. Strict control of the use of poisons by farmers against predators is urgently needed to protect not only the predators but also scavengers.

3. Marine habitats and coastal sites need increased protection from over-fishing, for the benefit of seabird populations as well as fish species (see *Critical Species* 5 above).

4. Wetland assessment and monitoring is also needed as a priority, and staff are in post to deal with this (see *Current Conservation Measures 2* (h))

5. A survey is needed of incidental catches of dolphin and porpoise in coastal fisheries, with subsequent appropriate conservation action if necessary.

6. Vigorous anti-poaching measures are needed, particularly in relation to elephant and black rhino in the Etosha National Park and in unprotected areas of Damaraland and Kaokoland. *Critical Species* 3 above specifies populations and locations.

7. The effects of protective fencing in Etosha National Park on migratory wildlife need to be monitored: the blue wildebeest and Burchell's zebra are in need of specific conservation action in this respect

8. A management plan for the Diamond Areas 1 and 2 needs to be worked out in order that the necessary resources can be planned for its effective conservation management.

9. Action is needed to preserve the arid habitats in the Skeleton Coast Park and also further to the east, where extension of the protected area to double its current width may be considered appropriate. Of particular importance are the adapted desert lions in the Skeleton Coast Park.

10. Persecution of the cheetah and the wild dog by farmers should be stopped.

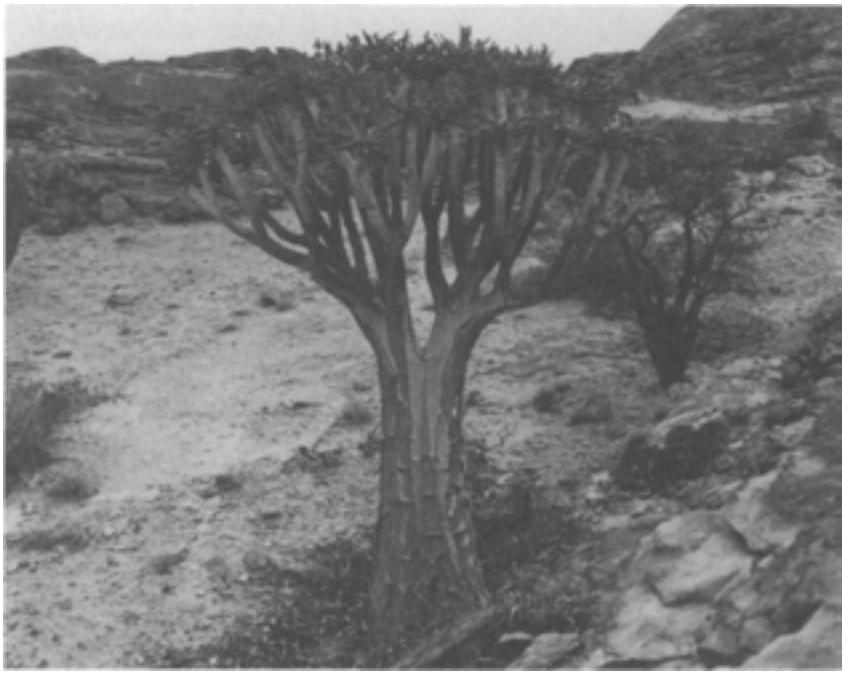
11. Specific conservation action should be taken for those species of birds whose world populations are principally restricted to the country. *Critical Species* 5 above gives details.

12. A survey of the status and conservation requirements of Berger's tortoise should be undertaken.

13. Surveys are needed to assess the status and conservation requirements of marine turtles.

14. The status and conservation needs of the Angolan python should be surveyed.

15. Conservation measures need to be introduced for each of the threatened freshwater fish species.



A view of Namib Desert Park (Photo: WWF/F. Vollmar).

Chapter 36: Niger

Introduction

Area: 1,267,000 km^2. Cultivated: 3%. Pasture: 7%. Forest/woodland: 2%.

Population (1989 data): 7,448,000. Urban: 16%. Labour force in agriculture (1980): 91%. Density: 6/km^2. Annual growth rate: 2.9%, increasing. Doubling time: 24 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 280. GNP annual growth rate: 2.2%.

Biogeographic affinities: Saharan in the north, Sahel Regional Transition Zone in the centre, and Sudanian in the far south. There a few Mediterranean and Afromontane elements in the northern mountains.

Vegetation: Desert and semi-desert in northern half of the country; *Acacia* wooded grassland in the Sahel zone, and Sudanian woodlands in the south. There is some Saharamontane vegetation in the highest peaks of Air.

Stone-age quern (grinding stone) lies abandoned in what is now total desert (Photo: WWF/John Newby).

Critical Sites

1. Niger is one of several Sahelian countries that has suffered very severe degradation of its natural resources as a consequence of droughts and overgrazing by livestock. Many species and habitats within the country are now seriously threatened. The best preserved area of savanna woodland (which once dominated the south of the country) is found in the south-west in "W" National Park and Tamou Nature Reserve. "W" National Park is one of the key areas for conservation of savanna in West Africa, due to its size and proximity to other protected areas. This area is contiguous with protected areas in Benin and Burkina Faso. Adjacent to the Tamou Nature Reserve are some wildlife populations in the Sirba River area and further to the north along the Niger River are some other important habitats for wildlife that are under severe threat. It is here that the last hippos in the country are to be found.

2. Further to the north, the Sahel zone is also severely degraded. The most important area remaining is the Gadabedji Faunal Reserve, which is mainly a grassland area. The reserve is currently too small to support viable populations of the antelopes which are be re-established in the area, and is also subject to heavy illegal use by nomadic pastoralists.

3. Niger has some important desert areas with remnant wildlife populations. The enormous Air and Tenere National Nature Reserve includes both sand deserts and arid mountains. Another important area is the Termit Massif and surrounding desert. Wildlife populations need to be allowed to recover in these regions.

4. Important wetlands exist in the southeast around Lake Chad, but these are not currently the subject of any conservation initiatives. There are numerous seasonal wetlands or "mares" with ponded water, which are often wooded, across the Sahel zone. These are extremely important for wildlife, particularly birds, and need to be evaluated.

Critical Species

1. Plants. 1,178 species occur, but only two are "dubiously" endemic. The Air and Tenere National Nature Reserve is the most interesting part of the country from a botanical point of view, but "W" National Park still harbours a full array of savanna habitat plants and communities that have largely disappeared elsewhere in Niger. The gallery forests are important, as are two orchid species and a sundew species whose Niger occurrences are limited to this area.

2. Antelopes. 16 species occur, with one recent extinction, that of the Sitatunga. All but two of the extant species are threatened to some extent, but nine of them have viable populations in "W" National Park and Tamou Nature Reserve,

providing the protection of this area can be maintained and improved. The korrigum is reduced to a remnant population of about 50 animals in "W" and Tamou. The scimitar-horned oryx used to occur widely in the Sahel zone, but is now believed to be extinct in the country. There is now a proposal to reintroduce the species, and this should be pursued. The addax occurs further to the north, but in extremely small numbers (200 estimated for the whole country in late 1989) around the Termit Massif and in the Air and Tenere Reserve. Plans to reintroduce the species to Air and Tenere are a welcome conservation measure. Four species of gazelle occur, and all have declined. The slender-horned gazelle is very rare, with probably less than 1000 animals still surviving in the Air and Tenere and possibly elsewhere in Niger's deserts. The dama gazelle is also extremely rare, with small numbers in Air and Tenere (estimated at around 350 in late 1989), and several hundred around the Termit Massif. The red-fronted gazelle occurs widely in the south of the country, but in greatly reduced numbers. The total population is about 3-5,000 animals, including a few in the Gadabedji Faunal Reserve. The dorcas gazelle still survives in good numbers, with 6-10,000 animals in the Air and Tenere. Niger has the opportunity to pioneer the re-establishment of desert and sahelian antelopes in Africa.

3. Other Mammals. About 3-400 elephants survive, the great majority in the "W" National Park and Tamou Nature Reserve and about 100 in the Babanrafi Forest south of Maradi. "W" constitutes part of a priority baseline population for West Africa, which includes the reserves of northern Benin and southeastern Burkina Faso. Niger has around 3,500 Barbary sheep, of which 70% are in the Air and Tenere Reserve, where there is also a remnant population of cheetah, believed to number only around 20. The last hippos occur in the Niger Valley near the Mali border, and the last giraffes in an area east-northeast of Niamey; they are in urgent need of protection. Wild dogs are now believed to be extinct in the country, and striped hyaenas are under severe threat from poisoning by nomads protecting their livestock.

4. Birds. One threatened species occurs, the river prinia, in wetlands around Lake Chad. Lake Chad and the Niger River are important areas for wintering palearctic waterbirds. Lake Chad is also on an important migratory route, with 70 species moving through the area each year. The last viable population of the West African race of the ostrich, around 1,000 birds, is found in Air and Tenere Reserve. The Nubian bustard is widespread but nowhere common, and is probably subject to poaching outside the Air and Tenere Reserve.

5. Reptiles. Small numbers of Nile crocodiles occur in the Niger River, where they are seriously at risk. They are also present in Mekrou and Tapoa Rivers in "W" National Park. The African spurred tortoise probably occurs widely in the south, but its status and conservation requirements are unknown.

Pumping water from a well to fill a temporary waterhole for wildlife (Photo: WWF/John Newby).

Threats

1. Niger's ecosystems are severely degraded through prolonged droughts, agriculture and overgrazing by livestock. As a result, several species have been, or are in the process of being, lost.

2. Protected area management in the country has been inadequate, with illegal hunting of many species taking place.

3. Several species, notably giraffe, hippopotamus, addax, scimitar-horned oryx, slender-horned gazelle, striped hyaena and cheetah, have been reduced to such small populations that their long-term survival seems unlikely.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Water Resources and the Environment, in particular the Department of Water and Forests, which has sections on environment, wildlife, fisheries, and forests. The Wildlife Service is responsible for the management of protected areas, and for research.

2. Multi-agency Projects

(a) General assistance to the forest service (Netherlands Govemment/UNSO).

(b) Conservation and development of Air and Tenere (IUCN/ DDA/WWF): various aspects of operating this huge area, including setting up infrastructure, conservation and rehabilitation of natural resources and rural development.

(c) Schools education project in the Air and Tenere (IUCN/ISF).

(d) Wildlife survey with a view to assessing sustainable utilisation prospects (IUCN/ISF).

3. CARE Projects

(a) Conservation of elephants in Babanrafi Forest

4. DDA Projects

(a) Management programme for natural resources.

(b) Support for forest management in Dallol Maouri.

5. Netherlands Government Projects

(a) Reforestation projects at Tera and Dakora.

Suggested Conservation Activities

1. The development of the "W National Park-Tamou Nature Reserve complex should be linked to the establishment of a multiple use reserve to the north along the Niger River, including a core protected area for the country's last populations of hippo.

2. Increased co-operation between Burkina Faso, Benin and Niger is needed in the "W" National Park in terms of management and law enforcement.

3. The Gadabcdji Faunal Reserve should be enlarged, particularly with a view to re-establishment of antelope populations (see *Critical Species* 2 above).

4. Protective measures are needed in the Air and Tenere Nature Reserve and the Termit Massif to allow wildlife populations to recover, most notably antelopes. Re-introduction proposals for a number of species should be implemented as outlined in *Critical Species 2* above.

5. A major emphasis in all conservation projects should be on the sustainable use of wildlife resources, particularly bushmeat.

6. Anti-poaching measures need urgent improvement to protect large mammals, especially elephants, in the "W" National Park and Tamou Nature Reserve, and Nile crocodiles in the Niger River.

7. A study is needed to assess the prospects for protecting the country's last giraffe population to the east-northeast of Niamey.

8. The wetlands around Lake Chad should be investigated and proposals for protected areas prepared, with particular reference to bird species (see *Critical Species* 4 above).

9. A survey of the status and conservation requirements of the African spurred tortoise is needed.

Principal biomes and conservation areas of Niger. *Conservation areas* — 1: W National Park (2200 sq km). 2: Tamou Faunal Reserve (777 sq km). 3: Gadabedji Faunal Reserve (760 sq km). 4: Air and Tenere National Nature Reserve (77 360 sq km, including a 12 806 sq km Strict Nature Reserve for addax). *Other geographical features* — 5: Niger River. 6: Sirba River. 7: Termit Massif. 8: Lake Chad. 9: Niamey. 10: Agadez.

Chapter 37: Nigeria

Introduction

Area: 923,850 km^2. Cultivated: 34%. Pasture: 23%. Forest/woodland: 16%.

Population (1989 data): 115,316,000. Urban: 28%. Labour force in agriculture (1980): 68%. Density: 125/km^2. Annual growth rate: 2.9%, increasing. Doubling time: 24 years.

Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: US$ 370. GNP annual growth rate: 0.1%.

Biogeographic affinities: Predominantly Guinea-Congolian in the south and Sudanian in the north with a broad transition zone across the centre of the country. There are Afromontane elements in the east, and Sahel Regional Transition Zone in the extreme northeast.

Vegetation: Lowland rainforests in the south (now considerably fragmented for agriculture and plantations) and Sudanian woodland in the north, with a mosaic of forest patches, woodland and secondary grassland in the transition zone. In the mountains there are important areas of montane forest and grassland, and in the extreme northeast there is a small area of sub-sahelian wooded grassland. There are very extensive mangrove areas along the coast (especially in the Niger Delta and in the southeast), and some important wetlands along the northern rivers, and around Lake Chad.

Major natural vegetation zones of Nigeria. The derived savanna zone was formerly moist lowland forest. 1: Lake Kainji. 2: Lake Chad. 3: Jos Plateau. 4: Niger River. 5: Benue River. 6: Cross River. 7: Lagos. 8: Atlantic Ocean.

Critical Sites

1. Nigeria has by far the largest human population of any country in Africa (over 115 million people) and consequently the demands on its natural resources are very severe. The protected areas system within the country remains very incomplete, and many areas need to be gazetted as a matter of urgency before it is too late. Those protected areas that exist are often not adequately managed. There is a particularly serious shortage of protected areas in the country's lowland forest zone. Those currently in existence are the Omo Biosphere Reserve, Udo Game Reserve, Okomu Wildlife Sanctuary, Gilli-Gilli Game Reserve and Sapoba Forest Reserve west of the Niger River, and the Udi-Ndukka Game Reserve and Upkon Forest Reserve east of the Niger. With the exception of Omo Biosphere Reserve, all of these need rehabilitation or strengthened management There are important differences in species composition between the western and eastern forests. Several new game reserves are needed as a matter of urgent priority. Those west of the Niger are Ologbo and Ohosu. East of the Niger, the proposed Game Reserves A and B are the top priority, and will be in part covered by the Oban National Park development. There is a need to improve the management of Nigeria's forest reserves in general, to ensure that they serve the needs of conservation as well as of timber production. There are some additional very important forests that might be considered for upgrading to game reserve status. These include Gambari in the west (important for the Ibadan malimbe), and Afi River (increasingly degraded and hunted) and Boshi-Okwangwo in the southeast, the latter two being important for gorillas (although their populations are isolated from each other), and for drills. The Boshi-Okwango complex is likely to be incorporated in the Cross River National Park, possibly with extensions in the Mbe Mountains. There are also some important forest patches north of the main forest zone. Some of these are conserved in the Upper Ogun, Anambra and Akpaka Game Reserves, and the proposed Iri-Ada-Obi, Orle River, and Ologbolo-Emu-Urho Game Reserves. However,

Conservation areas of Nigeria. 1: Kainji Lake National Park (5340 sq km). 2: Sambisa Game Reserve (517 sq km). 3: Chingurme-Duguma Game Reserve (proposed) (354 sq km). 4: Okomu Forest Reserve (1082 sq km, including 70 sq km Okomu Wildlife Sanctuary). 5: Gilli-Gilli Game Reserve (363 sq km). 6: Sapoba Forest Reserve (492 sq km). 7: Lake Chad Game Reserve (705 sq km). 8: Orle River Game Reserve (352 sq km). 9: Lame-Burra Game Reserve (proposed) (2008 sq km). 10: Ologholo-Emu-Urho Forest Reserve. 11: Anambra Forest Reserve (354 sq km). 12: Udi Nsukka Forest Reserve (56 sq km). 13: Akpaka Forest Reserve (296 sq km). 14: Okwangwo Forest Reserve-Boshi Forest Reserve-Boshi Extension Forest Reserve (580 sq km) (site of new Boshi-Okwangwo National Park). 15: Oban Hills (A and B) Forest Reserves (3900 sq km) (site of new Oban National Park). 16: Stubbs Creek Forest Reserve (100 sq km). 17: Okpara Game Reserve (2486 sq km). 18: Old Oyo National Park (formerly Upper Ogun/Old Oyo Game Reserve) (2512 sq km). 19: Dagida Game Reserve (294 sq km). 20: Ebba Kampe Forest Reserve (1217 sq km). 21: Nasawara Game Reserve (proposed) (1813 sq km). 22: Dampar Sanctuary (proposed). 23: Pandam Wildlife Park (362 sq km). 24: Yankari Game Reserve (2240 sq km). 25: Pai River Game Reserve (2214 sq km). 26: Wase Game Sanctuary (1865 sq km). 27: Gashaka-Gumti Forest Reserves (6630 sq km). 28: Kwiambana Game Reserve (2613 sq km). 29: Kamaku Game Reserve (proposed) (1130 sq km). 30: Alawa Game Reserve (296 sq km). 31: Falgore (Kogin Kano) Game Reserve (920 sq km).

there are also some important outliers of lowland forest near Kagoro, much further to the north, on the slopes of the Jos Plateau. In particular, the Sanga River, Kagoro and Amere Forest Reserves need greatly improved protection. The Niger delta forests, especially at Taylor Creek, also include important sites for which protection should be considered.

2. Nigeria also has some important areas of montane forest along its border with Cameroon. The two main sites are the proposed Cross River National Park, an area of montane grassland with forest patches and important transition forests on its southern slopes, and the Gashaka-Gumti National Park, a mountainous area with montane grasslands, and forest patches in the valleys. The Cross River National Park needs to be established as soon as possible (particularly with a view to developing more conservation-oriented practices in the Obudu Cattle Ranch), and the management plan for Gashaka-Gumti needs to be implemented.

3. Nigeria has a very wide array of different savanna habitat types, ranging from moist woodland to sahel. Most of the country's existing protected areas are in these habitats though, again, more need to be established to provide a good representation of each habitat in the reserve network. Those currently in existence are Kainji Lake National Park, Pandam Wildlife Park and the following Game Reserves: Falgore (or Kogin Kano), Hadejia-Nguru Wetlands (now approved for National Park status), Kwiambana, Sambisa, Upper Ogun, Yankari, Chingurmi-Duguma, Gashaka-Gumti (now re-gazetted as a National Park), Lake Chad, Okpara, Lame-Bura, Yankari, Anambra and Akpaka. Management plans await implementation for Kainji Lake and Yankari. There are proposals for a number of important game reserves: Kamuku, Alawa, Dagida, Wase Sanctuary, Ankwe River, Pai River, Wase Rock, Ebbazikamper, Nasarawa, Damper, Iri-Ada-Obi, Orle River, and Ologbolo-Emu-Urho. Probably the most important areas for wildlife at present are Kainji Lake National Park and the Game Reserves of Yankari and Lame-Bura.

4. Nigeria has many important wetland sites, particularly in the north. The most important, particularly for palearctic waterfowl, are probably Lake Chad and the Hadejia-Nguru Wetlands, though there are others in many areas, including around Kano. Current problems which need addressing include sustainable use of wetland resources by local people and the ecological implications of irrigation schemes (in the north of the country).

5. There are large mangrove areas, particularly in the Niger Delta, and in the southeast. There is one proposed game reserve at Stubbs' Creek, which is relatively intact and would be a uniquely valuable sanctuary for birds, amphibians, reptiles and primates. However, others are needed. Coastal areas are vulnerable to damage from oil exploration activities.

Critical Species

1. Plants. 4,614 species occur, with 39 endemics in the north, 38 in the west and centre, and 128 in the east (concentrated on the Oban Hills).

2. Primates. 20-24 species occur, nine of which are of conservation concern. The red-capped mangabey is widely distributed in the forests. The olive colobus is restricted to parts of the Niger Delta, Benne State and possibly in or near Omo in the west The drill occurs in Boshi-Okwangwo, Afi River and Oban, and the chimpanzee in Oban, Obudu and the

Gashaka-Gumti Game Reserve. The gorilla and the red-eared guenon occurs in Afi River and Boshi-Okwangwo and the latter probably also in Oban. Preuss's guenon may be present in Boshi-Okwangwo. The white-throated guenon is largely endemic to Nigeria, with small populations in Benin and Togo. It occurs only in the forests west of the Niger, in particular Okomu and Omo. Sclater's guenon is endemic to Nigeria and is restricted to a small area between on the Niger flood plain west of Oguta, Imo State. It is important to identify an appropriate forest area in which this very rare species can be conserved.

3. Antelopes. 23 species occur, with two, the giant eland and scimitar-horned oryx, recently extinct. All but two of the surviving species are considered to be threatened to some degree, as a result of over-hunting, and poorly managed reserves. Of particular importance is the isolated population of mountain reedbuck in the Gashaka-Gumti Game Reserve and the klipspringer population on and around the Jos Plateau and in the Lame-Bura reserve. The most important areas for antelope conservation in Nigeria are Kainji Lake National Park, Gashaka-Gumti Game Reserve, and the proposed Lame-Bura Game Reserve.

4. Fruit Bats. 13 species occur, including one of conservation concern: *Epomops buettikoferi* (endemic to the West African forests of Nigeria, Ghana, Guinea, Ivory Coast, Liberia and Sierra Leone).

5. Other Mammals. About 3,000 elephants survive in Nigeria. Populations are declining through poaching and are very fragmented. The largest numbers occur in Yankari and Sambisa Reserves. Hippos survive in Kainji and a distinct subspecies of pygmy hippo *(Choeropsis liberiensis heslopi)* may still occur in the Niger delta. Manatees occur in some of the larger rivers, though are heavily exploited. The conservation needs of these species need to be investigated. The wild dog has been reduced almost to extinction in Nigeria. The giant forest hog occurs in Gashaka-Gumti Game Reserve, in Gongola State and possibly in rainforests in Cross River State, but is vulnerable or endangered. Two rodent species of conservation concern occur, including a species of African fat mouse *Steatomys jacksoni,* which is known only from southwestern Nigeria and from Ghana. The extent of dolphin and porpoise deaths in coastal fisheries is unknown, nor is it clear whether this presents a conservation problem.

6. Birds. Six threatened species occur, one of which, the Fernando Po Swift, has been recorded from the Obudu Plateau, where it is probably a wanderer. Three other species occur in the montane forests near the Cameroon border, the green-breasted bush-shrike, white-throated mountain-babbler, and Bannerman's weaver. All are recorded from the Obudu Plateau, and the last also from the Mambila Plateau within the Gashaka-Gumti Game Reserve. The Ibadan malimbe is a very rare species, endemic to Nigeria, where it occurs on the forest-savanna interface in the southwest of the country around Ibadan, including the Gambari Forest Reserve. It is severely threatened by habitat destruction. The Anambra waxbill is a little known species, also endemic to Nigeria, occurring in non-forest habitats in the Niger delta area, and in the southwest. The Lake Chad area, and other northern wetlands and woodlands are important wintering sites for critical species. The conservation of these habitats through appropriate rural development schemes is a high priority. Important waterbird breeding colonies exist around Lake Chad, and there is a large white pelican colony on Wase Rock proposed game reserve. The ostrich still occurs in Sambisa Game Reserve and in other parts of Borno State, but is absent in other parts of the north.

7. Reptiles. All three species of crocodile survive in reduced numbers. They remain quite widespread. Nile crocodiles occur in Lake Chad, and the African dwarf crocodile is most common in the southeast. The African spurred tortoise occurs in the north but its status and conservation requirements are not known. Almost nothing is known of the status or conservation needs of marine turtles.

8. Amphibians. 19 species of conservation concern occur, 18 of which are shared with Cameroon and are restricted to the southeast of the country. Many are montane species occurring on the Obudu Plateau. The status of the hairy frog needs to be assessed. There is one endemic toad *Bufo perneti,* only known from the Idanre Hills in Ondo State.

Threats

1. Nigeria has suffered from excessive clearance of woodland, lowland forest, and montane forest habitats, and drainage of wetlands, and as a result, many species are now very rare, if not already extinct. Many of the savanna habitats are also suffering from overgrazing by livestock.

2. The protected area system is totally inadequate in terms of forest conservation, and those reserves that do exist in forests are generally too small for viable populations of many species. Many important reserves in the savanna zones are not yet gazetted. Mangrove and marine elements are also missing from the protected area system.

3. Over much of the country, but especially in the forest zone, there is severe over-hunting of wildlife, resulting in population declines and local extinctions. This, coupled with forest fragmentation, bodes ill for the future of Nigeria's tropical forest ecosystems.

4. Dam construction is having serious impacts on wetlands, floodplain forests and species dependent upon these habitats.

Current Conservation Measures

1. Government Administration of Conservation

(a) In Nigeria, most aspects of environmental management are devolved upon the State Governments. The role of the Federal Government is to provide advice and coordination for State Government activities, to enforce export controls, to undertake research, and to fund and implement certain projects. Under the Federal Ministry of Works and Housing, there is the Federal Environmental Protection Agency responsible for air and water pollution control. This Agency sets the basic standards, but its implementation work is largely carried out the State Government Departments. There is also a National Ecological Problems Committee which receives 1-1.5 % of the Federal budget which it uses on remedying desertification, soil erosion and pollution. A further 1.5 % of Federal funds are allocated to the southern states to address environmental problems resulting from oil development.

(b) The Federal Ministry of Agriculture and Natural Resources provides coordination between the Federal and State Governments in the fisheries and forestry sectors, respectively through the Federal Department of Fisheries and the Federal Department of Forestry and Agricultural Land Resources. Forestry and inland fisheries management devolves entirely on the State Governments. Marine fisheries are controlled by the Federal Government through the Federal Department of Fisheries, and the Nigerian Institute of Oceanography and Marine Research. Wildlife conservation comes under the Federal Department of Forestry and Agricultural Land Resources, but devolves mainly on the State Governments. National Parks come under the Federal Department of Forestry and Agricultural Land Resources.

(c) There is a Federal Natural Resources Conservation Council (NRCC), chaired by the President, with representatives from the Ministries of Agriculture and Natural Resources, External Affairs, Works and Housing, and Health, and from the Nigerian Conservation Foundation. The Council provides coordination and develops policies in natural resources conservation, and can take direct measures to secure the status of species and sites, as well as providing funds for conservation and research work. Much of the Council's work is carried out through State Government agencies. The NRCC is charged with promoting the National Conservation Strategy.

(d) Advice on conservation policy is also provided by the National Council of Agriculture, which is itself guided by the National Forestry Development Committee (NFDC). There is a National Wildlife Conservation Committee under the NFDC.

(e) Among the projects being conducted by the Federal Government are: the formulation of Conservation Action Plan for Nigeria; drawing up proposals for mangrove conservation; and a pilot captive breeding programme for selected species.

(f) Most land comes under the control of the State Governments, except the National Parks. Within States, wildlife and forest conservation is usually the responsibility of a Commissioner for Agriculture, under whom is a Director of Forestry. Although the State Governments have very wide powers, in practice they are strongly influenced by the Federal Government, partly because the latter sometimes provides funding, and also because all the State Directors of Forestry sit on the National Forestry Development Committee.

2. Multi-agency Projects

(a) Oban Division, Cross River National Park: Integrated Rainforest Conservation Programme (NCF/WWF/EEC/ODA): establishment of protection of most of the remaining moist forest in Nigeria, including management plan for Oban National Park and sustainable use of natural resources in and around the National Park.

(b) Boshi-Okwango Division, Cross River National Park (NCF/WWF/EEC): preparation of a development plan for the area to the north of the Oban National Park.

(c) Hadejia-Nguru wetlands conservation (Government/NCF/AWF/ICBP/IUCN/RSPB/FINNIDA): conservation of part of the Hadejia-Nguru wetlands, some oases in Borno State and Chingurme-Duguma Game Reserve, by managing the area on a sustainable basis and carrying out education programmes.

(d) National Wildlife Survey (Government/IBRD/IUCN): provision of baseline data on species distribution and abundance.

(e) Okomu Wildlife Sanctuary (ODA/NCF/WWF): protection of a viable portion of rainforest by alleviation of land-use pressures.

(f) Rainforest Belt Conservation Education Programme (NCF/WWF): establishing or upgrading resource centres at universities and elsewhere, training teachers and establishing Nature Clubs in schools.

(g) Protection of Kagoro-Nindam forest (NCF/ICBP).

(h) Protection of Gashaki-Gumti National Park (Government/NCF).

(i) Wildlife study (Government/IUCN): overview of the current status of wildlife resources, assessment of species conservation priorities, and design of a long-term monitoring programme.

3. FFPS Projects

(a) Printing advisory leaflet for hunters in Cross River State.

4. NCF Projects

(a) Support for Yankari Game Reserve.

(b) Survey of Anambra, Imo and Rivers States to locate remnant population of Sclater's guenon.

(c) Protection of Taylor Creek Reserve, Rivers State.

5. ODA Projects

(a) Cross River State forestry reform: provision of technical support to the State Forestry Department to enable sustainable use of forests.

(b) Bendel State Forestry Sector reform: provision of technical support to the State Forestry Department to enable sustainable use of forests.

6. WCI Projects

(a) Survey of the distribution of the drill.

Suggested Conservation Activities

1. Nearly all the priority activities involve a combination of improved protection, establishment of new protected areas, integrated development and sustained use of natural resources, most notably bushmeat.

2. There should be an expansion of the workforce in the environmental sector to deal with increased conservation activities.

3. Additional facilities need to be procured for the Federal School of Wildlife Management, Marine and Freshwater Fisheries Schools and Schools of Forestry, in order to increase output of relevant technical personnel.

4. The curriculum of the National Water Resources Institute should be revised to accommodate recent ideas on water resources conservation and its linkage with the sustainable management of other living resources.

5. Conservation awareness programmes should be intensified at both formal and informal levels.

6. In the lowland forest zone, the following activities are necessary:

(i) Improved management of Forest Reserves and other protected areas, particularly to prevent unnecessary settlements and uncontrolled clearance, is necessary to balance timber production needs against conservation.

(ii) Some Forest Reserves need upgrading to Game Reserves: Gambari (important for the Ibadan malimbe, see *Critical Species* 6 above), Afi River (also in urgent need of rehabilitation) and Boshi-Okwangwo (important for gorillas). Boshi-Okwangwo could usefully be managed as one unit with Obudu Cattle Ranch.

(iii) The Sanga River, Kagoro and Amere Forest Reserves need greatly improved protection.

(iv) New Game Reserves urgently need establishing at Ologbo and Ohosu (both west of the Niger) and proposed Game Reserves A and B east of the Niger. Also a reserve in the Taylor Creek vicinity (an elephant stronghold) of the Niger Delta is urgently required.

7. Montane forest areas need additional conservation action as follows:

(i) The management plan for the Gashaka-Gumti National Park should be implemented, and an effective means found of integrating the needs of farming and stock-raising communities with conservation before the wildlife resource is depleted beyond rescue.

(ii) The Cross River National Park should be established as soon as possible.

8. In savanna habitats, action is needed as follows.

(i) Management plans for Kainji Lake (important for antelopes) and Gashaka-Gumti (important for antelopes and primates) should be implemented.

(ii) For Yankari Game Reserve, the proposed extension needs to be either gazetted or abandoned and the legal basis of the reserve needs to be strengthened.

(iii) Proposed Game Reserves at a number of sites (see *Critical Sites* 3 above) should be gazetted.

9. Wetland areas need rational conservation, specific action being proposed as follows:

(i) Ensure that ecological implications of irrigation schemes (in the north) are evaluated before implementation.

(ii) Develop guidelines on environmental usage of coastal wetlands in partnership with the oil industry.

10. Mangrove areas require increased protection, by gazetting of the proposed Game Reserve at Stubbs Creek and identification of further sites for protected areas.

11. Means of developing sustainable-yield hunting of bushmeat in all parts of the country should be explored.

12. Protection for primates should be improved as indicated above and in *Critical Species* 2, and a protected area should be established for the very rare Sclater's guenon.

13. Protection for antelopes needs to be improved by better protected area management and increased control of hunting, most importantly in Lake Kainji National Park, Gashaka-Gumti Game Reserve and the proposed Lame-Bura Game Reserve.

14. Rigorous anti-poaching measures need implementing to conserve elephants, particularly in the Lake Kainji National Park.

15. The conservation needs of hippos (Kainji Lake), pygmy hippos (Niger Delta) and manatees (larger rivers) need urgent assessment.

16. A survey of dolphin and porpoise deaths in coastal fisheries is needed to assess their extent and propose conservation action if necessary.

17. Rural development programmes need to be established in the northern woodlands and wetlands, including Lake Chad, to conserve breeding, wintering and migratory areas for birds.

18. A survey is needed to assess the status and conservation requirements of the African spurred tortoise and the hairy frog.

Chapter 38: Réunion

Note: Réunion is an overseas Department of France.

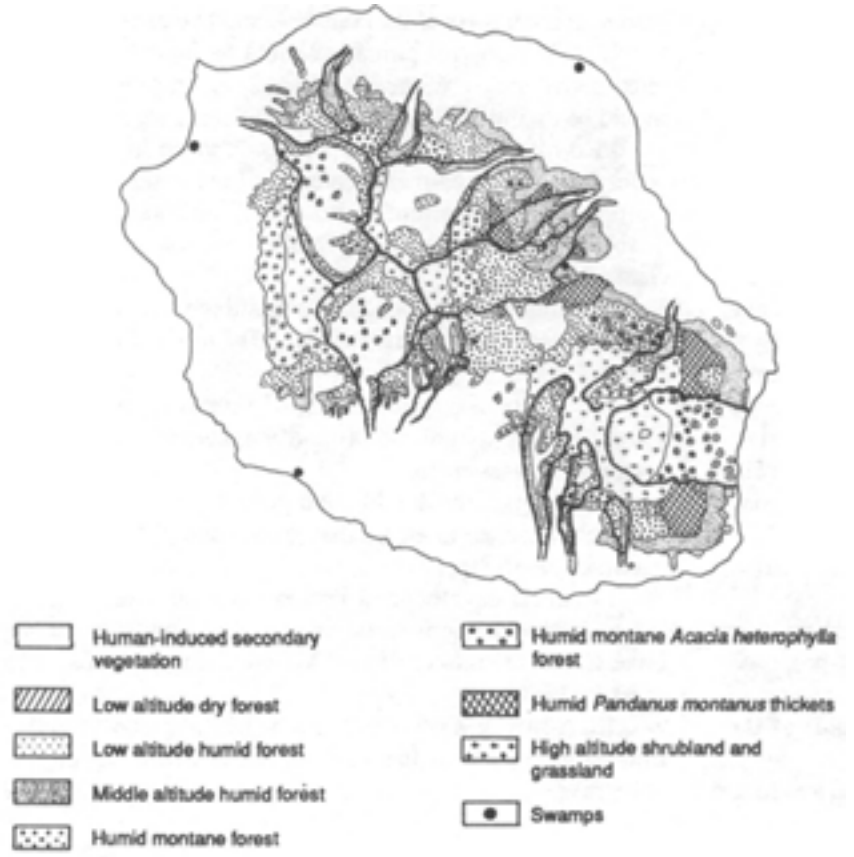
Introduction

Area: 2,515 km^2. Cultivated: 22%. Pasture: 4%. Forest/woodland: 35%.

Population (1989 data): 585,000. Urban: 98%. Labour force in agriculture (1980): 18%. Density: 233/km^2. Annual growth rate: 1.7%, decreasing. Doubling time: 41 years.

Economy (1987 data): World Bank index: no data. GNP/capita: no data. GNP annual growth rate: no data.

Biogeographic affinities: Mascarene, with some Malagasy links on the main island of Réunion, with Indo-Pacific Oceanic affinities on the small islands.



Map of Réunion.

Vegetation: Formerly evergreen rainforest on the main island (except on lava flows and cinder fields that are characterised by sparse, herbaceous vegetation); now severely degraded in most places, though there are a few patches of less damaged vegetation in some of the reserves. Native heathland occurs above 2,000 m. Réunion has much less damaged vegetation than the other Mascarene islands (Mauritius, Rodrigues). The more remote oceanic islands are vegetated with characteristic Indo-Pacific scrub.

Critical Sites

1. The Department of Réunion consists of the island of Réunion. There are, in addition, a number of tiny, far-flung islands in the Indian Ocean: Tromelin, Iles Glorieuses, Juan do Nova, Europa and Bassas da India whose legal status is unclear, as they do not formally form a part of the Department but are administered from the Préfect of Réunion. Réunion island was once almost completely forested, but much of this has long since been destroyed. Most of its terrestrial critical sites for biological diversity include remnant patches of forest. Important biological reserves have been established at Hauts de Saint Philippe, Mazerin, Hauts du Bois de Nèfles, and Mares at le Sommet de l'Enclos. Other biological reserves are proposed for Bebour, Ilot de Patience, Rempart de Cilaos, Plaine des Chicots, Bord de Bon Acceuil and Notre Dame de la Paix. Nature reserves are proposed for Etang du Gol, Etand de Saint Paul, Ravine de la Grande Chaloupe and Colorado. The establishment of all these reserves is essential if the remaining biological diversity on the island is to be saved.

2. Réunion's marine resources need protection, particularly the coral reefs in view of their relative smallness and the variety of factors threatening them. A rotating fishing reserve has been declared on the west coast (covering most of the reef area) but has not yet been formally gazetted, and in any case proposals for a different approach to conservation, based

on continuous fishing using only traditional methods, is now proposed. Suitable sites for other marine reserves have been identified but not yet formally gazetted on Tromelin, Iles Glorieuses, Juan do Nova, Europa and Bassas de India, some of which have regionally important breeding populations of seabirds and marine turtles.

Critical Species

1. Plants. About 500 indigenous seed plants occur (including 120 orchids), of which 30% are endemic. There are about 220 species of pteridophytes, of which 12% are endemic. Examples of threatened plants include a small tree, *Badula crassa* (known from only three individuals), and another tree, *Drypetes caustica* (known from 12 individuals on Réunion and two on Mauritius).

2. Mammals. Three of the five naturally occurring mammal species are now extinct. The two survivors are both bats that occur widely within Africa.

3. Birds. 19 of the 33 indigenous species are extinct. Two threatened species occur, the extremely rare Mascarene black petrel, which if it survives at all, probably breeds near Entre-Deux and Grand Bassin (the species is already extinct at its only other locality, Rodrigues), and the Réunion cuckoo-shrike (which survives only in the north of the island at Plaine d'Affouches and Plaine des Chicots). Other interesting species on the island include Barau's petrel (believed to be endemic), the Réunion harrier (numbering 130-200 pairs, increasing since legal protection commenced and also occurring on the Comoros and Madagascar), an endemic subspecies of stonechat (still fairly abundant) and the Mascarene swiftlet (still widespread on Réunion and Mauritius, but declining). There are major seabird colonies on the Iles Glorieuses, consisting mainly of sooty terns and brown noddys.

4. Marine Turtles. Major populations of green turtles nest on Europa, and Tromelin, with smaller numbers on Iles Glorieuses, Juan do Nova and Bassas da India. These sites are protected by virtue of their inaccessibility but need monitoring to determine whether more specific measures will become necessary. Hawksbills nest in small numbers on the Iles Glorieuses, and possibly elsewhere. Loggerheads are occasionally reported from Réunion waters. A ranching operation for the green turtle has been operating for several years on the main island of Réunion.

5. Other Reptiles. Three of the five indigenous species are extinct on Réunion, but two geckos, *Phelsuma borbonica* and *P. ornata inexpectata*, survive. An endemic gecko occurs on Juan de Nova, but its status is unknown.

6. Invertebrates. The papillon la pature *Papilio phorbanta* is endemic to Réunion. It occurs in the forests of the island, and, although protected, is believed to be under threat.

Threats

1. The devastating rate of species extinction on Réunion is being driven by three factors: loss of natural habitat, hunting (including for sport) and introduction of alien species. Invasive plant species are themselves one of the agents of habitat modification. The reserve system has not been adequate to ensure the conservation of sizeable areas of natural habitat.

2. The surviving populations of many of the endemic species (especially of plants and birds) are so low there their chances of recovery are very slim.

3. Many marine species and ecosystems around the main island of Réunion are not currently included in the protected area system and are at risk.

4. There are also disturbances on some of the outlying islands: operation of a lighthouse on Tromelin; and some persecution of sea turtles and collecting of bird eggs on Iles Glorieuse.

Current Conservation Measures

1. Government Administration of Conservation

(a) Terrestrial environmental matters come under the National Office of Forests in the Ministry of the Environment in France. The management of reserves and forests is delegated to the National Office of Forests's Regional Department for Réunion. Fishing Reserves are managed by the Administration of Maritime Affairs, while classified sites are administered by the Regional Department of Architecture.

Suggested Conservation Activities

1. The new reserves specified in *Critical Sites* 1 above should be established as soon as possible.

2. Recommendations for improved management and protection of marine and coastal ecosystems (particularly reefs) have been drawn up and should be implemented as soon as possible.

3. The introduction of alien species of animals and plants should be stopped and efforts made to prevent the invasion of protected areas by existing introduced species.

4. The proposals for increasing marine protected areas should be implemented as soon as possible.

Chapter 39: Rwanda

Introduction

Area: 26,330 km^2. Cultivated: 38%. Pasture: 16%. Forest/woodland: 19%.

Population (1989 data): 6,989,000. Urban: 6%. Labour force in agriculture (1980): 93%. Density: 265/km^2. Annual growth rate: 3.4%, increasing. Doubling time: 20 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 310. GNP annual growth rate: 4.9%.

Biogeographic affinities: Predominately Afromontane in the highlands and Lake Victoria Regional Mosaic in the lowlands.

Vegetation: Montane vegetation in the west, including montane forest and grassland (and Afroalpine communities in the Virunga Volcanoes), and evergreen bushland and secondary *Acacia* wooded grassland in the east. There are large areas of wetlands, especially in the east, but also smaller swamps in the mountains in the west.

Conservation areas of Rwanda. 1: Akagera National Park (2500 sq km). 2: Volcanoes National Park (150 sq km). 3: Mutara Hunting Reserve (300 sq km). 4: Gishwati Forest Reserve (100 sq km). 5: Nyungwe Forest Reserve (970 sq km). 6: Lake Kivu. 7: Kigali.

Critical Sites

1. Rwanda is a small country with a high human population density, and yet it contains a remarkable variety of different habitats and species. The largest area of natural habitat in the country is the Akagera National Park and the contiguous Mutara Hunting Reserve. This area includes several types of savanna woodland, large swamps, and lakes, and is the most important area for large mammals in the country.

2. The country has several areas of lakes and swamps (including high altitude swamps in the mountains, and papyrus swamps at lower altitudes). Important sites are Lake Kivu, Lake Luhondo, Lake Bulera, and the Akagera, Akanyaru, Nyabarongo, Rugezi and Mulindo Swamps. These wetlands are under severe threat, and are in need of appropriate protection, including new protected areas and sustainable-use rural development programmes. A few swamps are protected in the Volcanoes National Park and the Nyungwe Forest Reserve, but the Kamiranzovu Swamp (in Nyungwe) is threatened by mining.

3. The Volcanoes National Park is a spectacular and remarkable area including the Rwanda sector of the Virunga Volcanoes. It is contiguous with the Virunga National park in Zaïre, and is noted for its population of mountain gorillas. It includes montane forest, afro-alpine vegetation, and high altitude grasslands. Both poaching and excision of forest areas have been a threat to this area in the past but are currently under control.

4. The Nyungwe Forest Reserve includes some of the most extensive areas of montane forest in Africa and part of it has fortunately been upgraded to National Park status; the whole of the Reserve needs improved protection. A number of rare species occur there. Another interesting area is the Gishwati Forest Reserve, which is similar to Nyungwe, but has been damaged in recent years and needs much stricter protection if it is to survive.

Critical Species

1. Plants. 2,150 species occur. The level of endemism is not known, but it is unlikely that it is very high.

A view of the Volcanoes National Park (Photo: WWF/Michel Terrettaz).

2. Primates. 14-16 species occur, including l'Hoest's guenon (in Nyungwe), chimpanzee (in Nyungwe and a very few in Gishwati), and mountain gorilla (in the Volcanoes). The golden guenon *Cercopithecus mitis kandti* is endemic to a restricted altitudinal area in the Virungas.

3. Antelopes. 15 species occur, most of them in Akagera National Park, though there are several species of duiker in the Nyungwe Forest Reserve. The yellow-backed duiker is nearing extinction in Rwanda from over-hunting and the endemic Lestrade's duiker *Cephalophus weynsi lestradei* is known only from the Nyungwe Forest.

4. Elephants and Rhinos. About 70 elephants occur in Akagera National Park, and represent a reiniroduction, following extinction in the country earlier this century. Approximately 100 elephants cross into the Virunga Volcanoes area seasonally from Zaïre. A small population of black rhinos survives in Akagera. Both species are under severe threat from continued poaching.

5. Rodents. Nine species of conservation concern occur, including Delany's mouse *Delanymys brooksi* (which occurs in high altitude swamps in Rwanda, nearby Uganda and Zaïre), a species of creek rat *Pelomys hopkinsi* (which lives on the edge of papyrus swamps in northern Rwanda and southern Uganda), a large rodent *Thamnomys venustus* (which is confined to montane forest and bamboo in Rwanda and nearby Uganda and Zaïre), and a species of harsh-furred rat *Laphoromys medicaudatus* (which occurs in montane forest in Rwanda and eastern Zaïre). The survival of all these species probably depends on habitat conservation.

6. Fruit Bats: Seven species occur, including one of conservation concern: *Rousettus lanosus* (which occurs in scattered populations in montane areas in Rwanda, Ethiopia, Kenya, Sudan, Tanzania, Uganda, and Zaïre, where its status is very poorly known).

7. Birds. Five threatened species occur. The shoebill breeds in Akagera National Park, with non-breeding visitors to the

Akanyaru and Nyabarongo Swamps. The Albertine owlet occurs in Nyungwe Forest Reserve (as well as nearby Zaïre and Uganda). Grauer's swamp warbler occurs in swamps in the Volcanoes National Park, and the Nyungwe Forest Reserve (especially the Kamiranzovu Swamp), and also in the Rugezi Swamp. The papyrus yellow warbler occurs around Lakes Luhondo and Bulera, and in the Rugezi, Mulindi and Akanyaru Swamps. The Kungwe apalis occurs in a few hundred hectares at the northern edge of the Nyungwe Forest Reserve, and in a few other small patches of drier montane forest.

8. Amphibians. 11 species of conservation concern occur, almost all in the montane forest area. There are no endemics.

9. Fishes. There are important populations of endemic fish, particularly in Lake Kivu.

10. Invertebrates. The cream-banded swallowtail butterfly occurs in the Gishwati and Nyungwe Forest Reserves (as well as nearby Burundi, Uganda and Zaïre).

Threats

1. Owing to the high human population density in the country, much of the natural habitat in Rwanda has already been destroyed, and that which survives is often small and fragmented. As such, there is a considerable risk of extinctions of certain species where the remaining habitats are not large enough to support viable populations.

2. Wetlands outside the main reserves are poorly protected and managed in Rwanda, and the important biological resources in these ecosystems could easily be lost through clearance and over-use. The important Kamiranzovu Swamp is threatened by mining.

3. Some protected areas are suffering from poaching of large mammals, in particular Akagera National Park and the Nyungwe Forest Reserve.

4. Montane forest clearance has been serious in some areas, and the most importance sites have not been given adequate conservation status.

5. There is a potential threat to populations of endemic fish from the introduction of alien fish species, as well as from over-fishing and pollution.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Agriculture, Livestock and Forests, in particular its Division of Forest Management. Conservation of wildlife and the management of protected areas are delegated to the Rwandan Office of Tourism and National Parks, which is also responsible for promoting tourism, and research.

2. Multi-agency projects

(a) Nyungwe Forest conservation (Government/WCI/USAID): research, training, education and tourism development to improve conservation and management of the reserve.

(b) Gituza forestry project (CARE/Netherlands Government): development of village-level forestry.

(c) International Gorilla Conservation Programme (Government/AWF/FFPS/WWF/WCI): development of conservation programme for the Volcanoes National Park, with emphasis on gorillas, local education, and appropriate tourism as an economic support to conservation.

(d) Assistance in development of National Tourism Plan (Government/UNDP/WTO).

Guard at Volcanoes National Park (Photo: WWF/Michel Terrettaz).

3. FFPS Projects

(a) Study of Muzanze cave system to assess the potential impact of tourism and to recommend conservation management measures.

4. GTZ Projects

(a) Control of soil erosion and agricultural improvements in the Karogo, Giciye, Satinsyi and Kibilira areas.

(b) Assistance to the Rwandan Institute of Agricultural Sciences to test ecologically appropriate agricultural systems.

(c) Introduction of ecologically appropriate village-level agriculture in the N'shili and Kivu areas.

5. Netherlands Government Projects

(a) "Economie Bois de Feu", a project aimed at improving energy use from wood.

6. WCI Projects

(a) Research on animal seed-dispersers in Nyungwe Forest, and their implications in conserving the area.

7. WWF Projects

(a) Conservation and management of Akagera National Park: strengthening protection in Akagera National Park by various measures.

Suggested Conservation Activities

1. New protected areas, combined with sustainable use programmes for wildlife resources, are urgently needed for wetland areas before further erosion occurs and are crucial for the survival of some species. Key areas are listed in *Critical Sites 2* above; see also *Critical Species* 7.

2. The Nyungwe Forest Reserve should be upgraded to a higher category of protection; in addition to its habitat importance, several rare species are present: see *Critical Species* 2, 3, 5, 7, 8 and 10 above.

3. The southern section of the Gishwati Forest Reserve needs much improved protection.

4. Anti-poaching measures need strengthening considerably, particularly in Akagera National Park, Volcanoes National Park, and Nyungwe Forest Reserve.

5. Controlled use of wildlife resources should be a prominent feature of conservation projects; particular action is needed to protect some species from over-hunting, notably the yellow-backed duiker.

Chapter 40: São Tomé and Príncipe

Introduction

Area: 964 km^2.

Population (1989 data): 121,000. Urban: 38%. Labour force in agriculture (1980): no data. Density: 126/km^2. Annual growth rate: 2.8%, increasing. Doubling time: 25 years.

Economy (1987 data): World Bank index: no data. GNP/capita: US$ 280. GNP annual growth rate: no data.

Biogeographic affinities: Gulf of Guinea Islands.

Vegetation: Lowland and montane rainforest, much of the former now replaced with plantations. Dry forest in the east and north of each island.

Critical Sites

1. No protected areas have been established in São Tomé and Príncipe to protect the country's unique biological resources. The remaining areas of lowland and montane forest are of critical importance on both São Tomé and Príncipe, since they have some of the highest levels of species endemism in the world. The montane forests are also essential water catchments for the country. Appropriate protection, including buffer zones, for forest areas in southwest and central São Tomé and in southern Príncipe should be established.

2. Important turtle nesting beaches occur on São Tomé and Príncipe, and some of these almost certainly require protection.

Critical Species

1. Plants. 601 species are known from São Tomé, of which 108 are endemic. 314 species are known from Príncipe, of which 35 are endemic. In particular, there is very high endemism and diversity for ferns. In addition to suffering habitat clearance, there is the possibility that some of these species are subject to international trade, for instance the porcelain rose *Renealmia grandiflora.*

2. Mammals. Five species bat occur (three of the fruit bats), of which the São Tomé little collared fruit bat *Myonycteris brachycephala* is endemic and is only known from two records. Two of the other species of bat occur as endemic subspecies. An endemic shrew, *Crocidura thomensis,* occurs

Map of São Tomé Island (shading indicates remaining forest cover).

Map of Príncipe Island (shading indicates remaining forest cover).

on São Tomé, and an endemic subspecies of the widespread *Crocidura poensis* on Príncipe. A survey is needed of incidental catches of dolphins and porpoises by the coastal fisheries, including an assessment of whether a conservation problem exists. A number of introduced mammals occur, including monkeys, cats, pigs, rats, mice, civets and weasels. It is not known to what extent these pose a conservation problem, and an investigation is recommended.

3. Birds. 49 species of land bird breed on São Tomé and Príncipe, including 14 species endemic to São Tomé, 6 endemic to Príncipe and 5 endemic to both. Some of these species have no close relatives anywhere in the world (there being four endemic genera on São Tomé and one on Príncipe). Several of these species are of serious conservation conern, including the dwarf olive ibis (probably very rare), maroon pigeon (under hunting pressure), São Tomé scops owl, S2o Tomé fiscal shrike (very rare), São Tomé thrush, São Tomé short-tail (probably very rare), São Tomé paradise flycatcher, São Tomé white-eye, Príncipe speirops, giant sunbird, São Tomé grosbeak (possibly extinct), and Príncipe drongo. In addition, there are 14 endemic subspecies, at least one of which is probably extinct.

4. Reptiles. 12 terrestrial species occur on São Tomé and 11 on Príncipe. One legless skink and a burrowing snake are endemic to Príncipe, and five species (two geckos, one skink and two burrowing snakes) are endemic to both islands. Both hawksbill and green turtles nest on São Tomé and Príncipe, but are subject to heavy persecution, with some trade to Angola where turtle-shell products are made.

5. Amphibians. Four endemic species occur on São Tomé (two tree frogs and two caecilians) and two endemic species occur on Príncipe (one tree frog and one frog). One species of caecilian is endemic to both São Tomé and Príncipe.

6. Invertebrates. The dragonfly *Trithemis nigra* is endemic to Príncipe.

Threats

1. Although pressure on São Tomé and Príncipe's natural resources, in particular on the rainforests with their many endemic species, is not yet very severe, the country lacks a protected area system, and therefore cannot easily react to threats as they become apparent

2. It is possible that some species have become extinct as a result of earlier habitat clearance, or as victims of introduced species, or because their populations had become too small for long-term viability. These last two might still be threats.

Current Conservation Measures

1. Government Administration of Conservation

(a) Governmental environmental responsibilities are are not yet clearly defined, but at least three ministries are involved: Industry, Transport, Fisheries and Tourism; Agriculture and Animal Husbandry; and Cooperation. At present there is no legislation for protected areas in the country.

2. Multi-agency Projects.

(a) Promotion of forest conservation (Government/ IUCN/EEC): development of an action plan for forest conservation by: planning a protected areas system to include rainforest habitats; development of sustainable use programmes in the forest zone; assessing conservation needs of forest wildlife; and dissemination of results of research.

(b) São Tomé artisanal fisheries (Government/FAO/ UNDP): general support provided for the development of artisanal fisheries in São Tomé.

3. ICBP Projects

(a) Survey of endemic birds and their habitats, leading to a major conservation project involving sustainable forest management

Suggested Conservation Activities

1. Two major protected areas for forests should be established as soon as possible, one in southwest and central São Tomé and the other in southern Príncipe. They should be surrounded by buffer zones of exotic fast-growing timber species to provide fuel and construction material.

2. Marine turtles need protection, in terms of both nesting-site protection and controlled hunting to ensure that populations are not seriously depleted.

3. Endemic plant species should be fully protected from excessive international trade and exploited at sustainable levels only.

4. Investigation into the impact of introduced mammal species is needed, with appropriate control procedures being implemented if necessary.

5. A coastal fishery survey is needed to determine the extent of incidental dolphin and porpoise deaths: conservation action should be taken if necessary.

6. Surveys are needed to establish the status and conservation requirements of a number of endemic bird species, as detailed in *Critical Species* 3 above.

7. Urgent action is needed to prohibit the hunting of the maroon pigeon, and the export of grey parrots and red-headed lovebirds.

Chapter 41: Senegal

Introduction

Area: 196,722 km^2. Cultivated: 27%. Pasture: 29%. Forest/woodland: 30%.

Population (1989 data): 7,171,000. Urban: 36%. Labour force in agriculture (1980): 81%. Density: 36/km^2. Annual growth rate: 2.6%, increasing. Doubling time: 27 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 510. GNP annual growth rate: 2.2%.

Biogeographic affinities: Predominantly Sudanian, with Guinea-Congolian/Sudanian Regional Transition Zone in the south and west, and Sahel Regional Transition Zone in the north.

Vegetation: Predominately Sudanian woodland, with small areas of evergreen forest and secondary grassland in the south and west, dry *Acacia* wooded grassland and deciduous bushland in the north, and mangroves on the coast.

Critical Sites

1. Some of Senegal's most important sites for the conservation of biodiversity are in wetland and mangrove areas along and near the coast. The Senegal River Delta in the north of the country is a diverse area including large floodplains, saline and intertidal flats, dykes and sand dunes. There are several small reserves in the area, including the Djoudj National Park, Langue de Barbarie National Park, Ndiael Bird Reserve and the Geumbeul Faunal Reserve. The delta as a whole needs to be managed in cooperation with neighbouring Mauritania and with a view to reconciling human and conservation interests. Further inland along the Senegal River is a currently unprotected area of Nile acacia forest on the Ile à Morfil, which is being rapidly degraded by a range of mainly human causes. Further to the south, the Delta du Saloum National Park includes very important and extensive areas of mangroves and conservation of this area should involve close collaboration with neighbouring Gambia. There are further areas of mangrove in the far south of the country near the border with Guinea-Bissau, including within the Basse-Casamance National Park.

2. Most of Senegal is savanna country, with increasing aridity to the north. The most important savanna woodland area in the country is the Niokolo-Koba National Park, which has by far the largest populations of large mammals. Poaching poses a serious problem, especially for elephants and leopards, and might be combatted more easily in cooperation with the authorities in neighbouring Guinea. The possibility of establishing a new reserve southeast of Niokolo-Koba in the Kedougou-Dendo Felo area for chimpanzees needs to be considered. The Ferlo North and Ferlo South Faunal Reserves are in the drier grassy and bush-savanna zone and have lost much of their biological value in recent years because of overgrazing by livestock. Hence conservation plans which reconcile human and habitat/wildlife needs are needed.

3. Senegal has some important sites in the coastal zone, including the Iles de la Madeleine National Park, Delta du Saloum National Park, Langue du Barbarie National Park, and Kalissaye Bird Reserve. Seabirds and marine turtles nest at some of these sites.

4. There are some outlying patches of lowland tropical rainforest in Senegal, the northwestern most limit of this biome in Africa. The most important site in this aspect is the Basse-Casamance National Park, though there is also an interesting 765 ha outlier further to the north in the Samba Dia Classified Forest, dominated by the palm *Borassus aethiopium.*

Critical Species

1. Plants. 2,100 species occur, of which 26 are believed to be endemic.

2. Primates. Between 9 and 11 species occur, including: the Guinea baboon, which is quite widely distributed; Temminck's red colobus, which occurs quite widely in the south, including Niokolo-Koba National Park (where it is severely threatened), Basse-Casamance National Park, Delta du Saloum National Park, and elsewhere; and the chimpanzee, which is restricted to Mount Assirik in Niokolo-Kola National Park, and to the Kedoujou-Dendo Felo region to the southeast. Fewer than 300 chimpanzees are believed to survive.

3. Antelopes. 16 species occur, two of which, the dorcas and dama gazelles, have been reintroduced after having become extinct. In addition the scimitar-horned oryx and the korrigum are both extinct. The population of 700 giant eland in

Major natural vegetation zones of Senegal, and protected areas. 1: Niokolo-Koba National Park (9130 sq km). 2: Basse Casamance National Park (50 sq km). 3: Delta du Saloum National Park and Biosphere Reserve (1800 sq km; terrestrial component about 1000 sq km). 4: Djoudj National Park (160 sq km). 5: Gueumbeul Faunal Reserve (7.5 sq km). 6: Ferlo North Faunal Reserve (4870 sq km). 7: Ferlo South Faunal Reserve (6337 sq km). 8: Sambia Dia Classified Forest Biosphere Reserve (7.5 sq km). 9: Senegal River. 10: Faleme River. 11: Lake de Guiers. 12: Ferlo River. 13: Saloum River. 14: Gambia River. 15: Casamance River. 16: Rao. 17: Fete Ole. 18: Tambacounda. 19: Kedougou. 20: Dakar. 21: Atlantic Ocean. 22: Koida.

the Niokolo-Koba National Park is the only secure population of the western race of this species anywhere in the world. About 1,000 animals occur in Senegal as a whole. The red-fronted gazelle is greatly reduced in numbers through hunting, overgrazing and droughts. It survives in the Ferlo North and Ferlo South Faunal Reserves, the Guembeul Reserve and in the Djoudj National Park, but is in need of further active conservation measures. The dorcas gazelle has been reintroduced into the Djoudj National Park, and the dama gazelle to the Geumbeul Faunal Reserve. Wider reintroductions of both species are needed, and one is planned for the dama gazelle in Ferlo, where it is hoped that it can be managed sustainably as a resource by the local people.

4. Other Mammals. Elephants have been very seriously reduced, and only about 50 survive, all in the Niokolo-Koba National Park. Niokolo-Koba also possesses important populations of buffalo (2,500), hippo (about 1,000, one of the largest protected populations of the species in West Africa), wild dog, spotted hyaena, lion, and leopard, all of which have been seriously reduced elsewhere through the West African wooded savannas. One rodent species of conservation concern occurs, a gundi *Felovia vac,* in eastern Senegal, as well as in southern Mauritania and western Mali. It prefers rocky areas near dry forest. In the mangrove areas, manatees still survive, though stricter conservation measures are needed. The extent of dolphin and porpoise captures in coastal fisheries is not known, nor whether is constitutes a conservation problem.

5. Birds. Only one threatened species, the yellow-throated olive greenbul, has been recorded, from the Casamance region. However, there have been no records during this century, and it is not known whether it survives in Senegal. Important populations of seabirds and waterbirds nest, especially in the Senegal River Delta, the Delta du Saloum National Park, and the Iles de la Madeleine National Park. Species include greater flamingo, lesser flamingo, white pelican, pink-backed pelican, cormorant, reed cormorant, red-billed tropicbird, slender-billed gull, grey-headed gull, Caspian tern, royal tern, gull-billed tern, common tern and little tern. The populations of slender-billed gull and royal tern are of international importance. There many sites of importance to palacarctic migrants, especially waders, along the coast.

6. Crocodiles. All three species occur, but are severely depleted, though good populations of the Nile crocodile and dwarf crocodile survive in Niokolo-Koba National Park.

7. Marine Turtles. All five species occur in Senegalese waters, though the olive ridley and hawksbill have not been proved to nest (though both are expected to do so). The loggerhead has been recorded as nesting on the Iles de la Madeleine, and the green turtle and leatherback have been found nesting more widely. However, very little is known of any of these turtle populations or of their conservation requirements.

8. Tortoises. The African spurred tortoise occurs in Senegal, but its conservation requirements are not currently known.

Threats

1. The integrity of some of Senegal's protected areas has been threatened by illegal hunting of certain species, in particular elephants.
2. In the north and east, both habitats and wildlife have suffered severely from over-grazing by livestock.
3. The populations of certain species, especially those confined to small forest patches, might be too small to be viable.
4. Senegal is the world's largest exporter of birds. The trade includes parrots. The impact of this trade on wild populations is not yet clear, but it could be very serious.

Current Conservation Measures

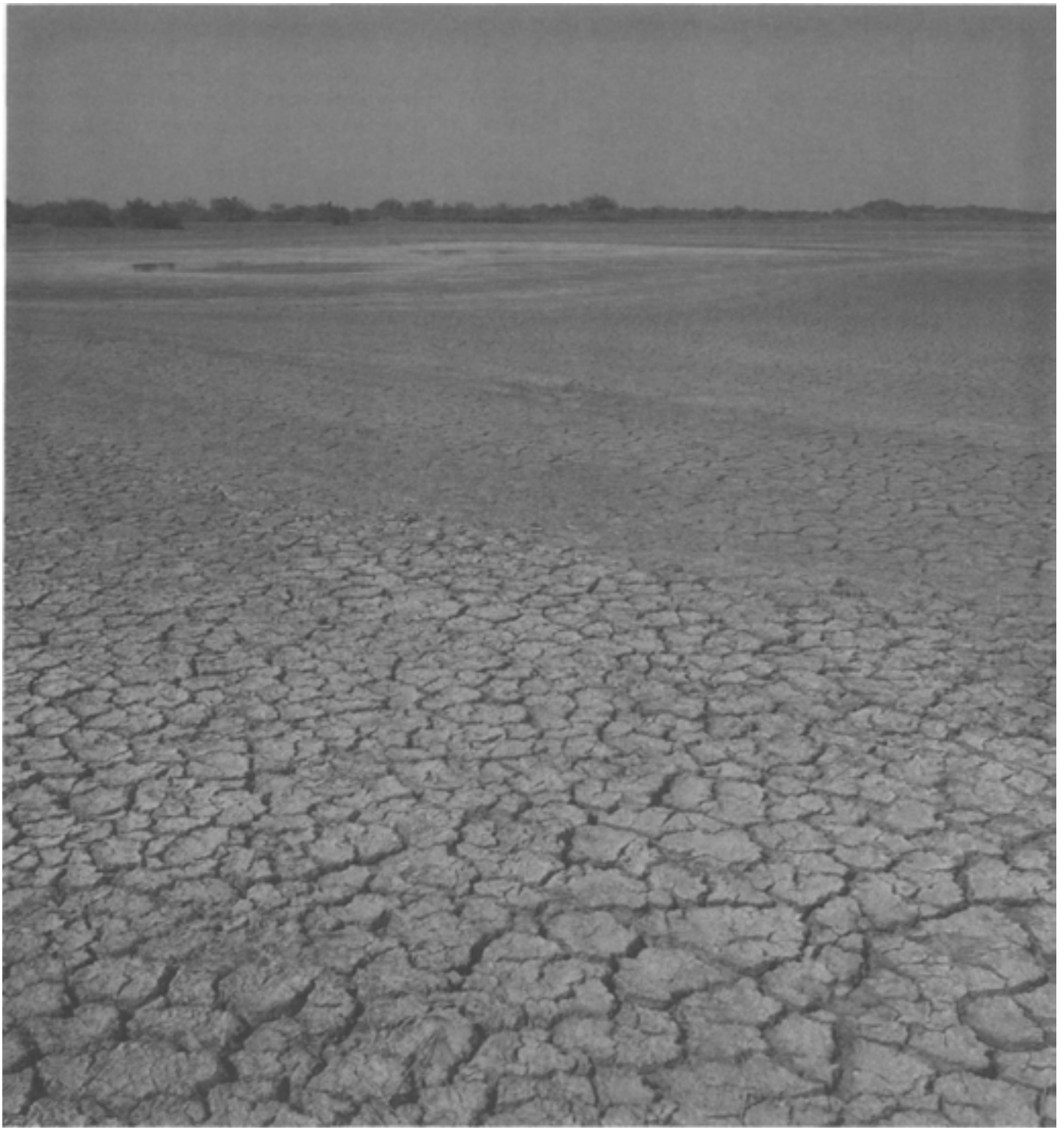
1. Government Administration of Conservation

(a) The Ministry of Nature Protection is responsible for the management of forests, hunting, and National Parks, and the conservation of soil.

(b) The Ministry of Animal Resources is responsible for the management and conservation of fisheries.

2. Multi-agency Projects

(a) Assistance with the management of Popenguine Sanctuary (ICPB/IUCN).



Drought in Djoudj National Park (Photo: WWF/Michel Terrettaz).

(b) Village-level forestry in the Senegal River basin (FAO/Netherlands Government).

(c) Support for forest services in the development and implementation of village-level forestry programmes (FAO/Netherlands Government).

(d) Support of forestry school for middle-level staff (FAO/Netherlands Government).

(e) Development of national strategy for village-based forestry (FAO/Netherlands Government/UNDP).

(f) River basin management in Casamance region (IUCN/Netherlands Government/ISF).

(g) Oyster conservation, management and utilisation in the Casamance region (IUCN/CIDA/ORSTOM).

(h) Study of possible impact of proposed new road through Niokolo-Koba National Park (Government/IBRD/IUCN).

(i) Community re-forestation in the groundnut project (FAO/FINNIDA): a wide variety of community-based forestry activities, including energy-efficient wood-burning stoves, and rehabilitation of forests.

(j) Reforestation and dune stabilisation project (Government/UNDP): contribution to the anti-desertification programme.

(k) Formation of an Ecological Monitoring Centre to provide information on natural resources and their utilisation (Government/UNDP).

(1) Development of a plan to rehabilitate, protect and manage the Baies de Dakar (Government/UNDP).

(m) Management of Dabo Classified Forest (Government/FAO/UNDP).

3. DDA Projects

(a) Training in appropriate forms of agriculture and forestry.

4. GTZ Projects

(a) Carrying out experiments in agriculture, forestry, and livestock management with a view to finding ways to combat desertification in northern Senegal.

5. Netherlands Government Projects

(a) Environmental profile of the Senegal River basin.

(b) Support for the Tropical Forestry Action Plan process in Senegal.

6. WWF Projects

(a) Management plan for the Djoudj National Park: includes sustainable use of natural resources, tourism development, water-management procedures, education and awareness, research and general/technical management

(b) Conservation and management of Geumbeul Faunal Reserve: addresses water management problems to enable effective waterbird conservation and improve salt extraction facilities for local people.

(c) "Simplified Tropical Ecology" Manual for Rural Schools: developing and field testing materials for conservation education.

(d) Impact of pesticides on Palearctic migratory birds (completed): investigated the short and long term impact of agricultural chemicals in the Senegal Delta.

Suggested Conservation Activities

1. The Senegal River Delta complex needs overall management, in co-operation with Mauritanian authorities, to integrate protection, notably of birds, both within and around protected areas. Integrated rural development approaches will be necessary (see *Critical Sites* 1 above).

2. Co-operation with Gambia should be increased in relation to managing the Delta du Saloum National Park.

3. Lowland forests should be protected against further erosion *(Critical Sites* 4 and *Critical Species 2* and 5 above).

4. Integrated rural development programmes, possibly involving the re-introduction of dama gazelles, are urgently needed in Ferlo North and Ferlo South Faunal Reserves to prevent further habitat degradation.

5. A major emphasis in all conservation projects should be the sustainable use of wildlife resources, particularly bushmeat.

6. Stricter anti-poaching measures are needed, preferably in co-operation with Guinea. Elephant and leopard populations are particularly in need of increased protection in this respect.

7. A new reserve should be considered for chimpanzees southeast of Niokola-Koba in the Kedoujou-Dendo Felo area (see *Critical Species 2* above).

8. Active conservation measures for antelopes, including reintroductions and sustainable-yield hunting, are needed for a number of species in a variety of locations (see *Critical Species* 3 above).

9. Stricter protection of manatees in mangrove areas is needed.

10. The export trade in birds needs to be studied as a matter of urgency to determine whether it is sustainable or not. If necessary, quotas should be assessed and enforced.

11. A survey of coastal fisheries to determine the extent of incidental dolphin and porpoise deaths is needed, with subsequent appropriate conservation action.

12. Surveys of marine turtle populations and nesting sites are needed to determine their conservation requirements.

13. A survey of the African spurred tortoise is needed to assess its conservation requirements.

Chapter 42: Seychelles

Introduction

Area: 453 km^2. Cultivated: 25%. Pasture: 0%. Forest/woodland: 18%.

Population (1989 data): 68,000. Urban: 52%. Labour force in agriculture (1980): no data. Density: 168/km^2. Annual growth rate: 1.8%, decreasing. Doubling time: 39 years.

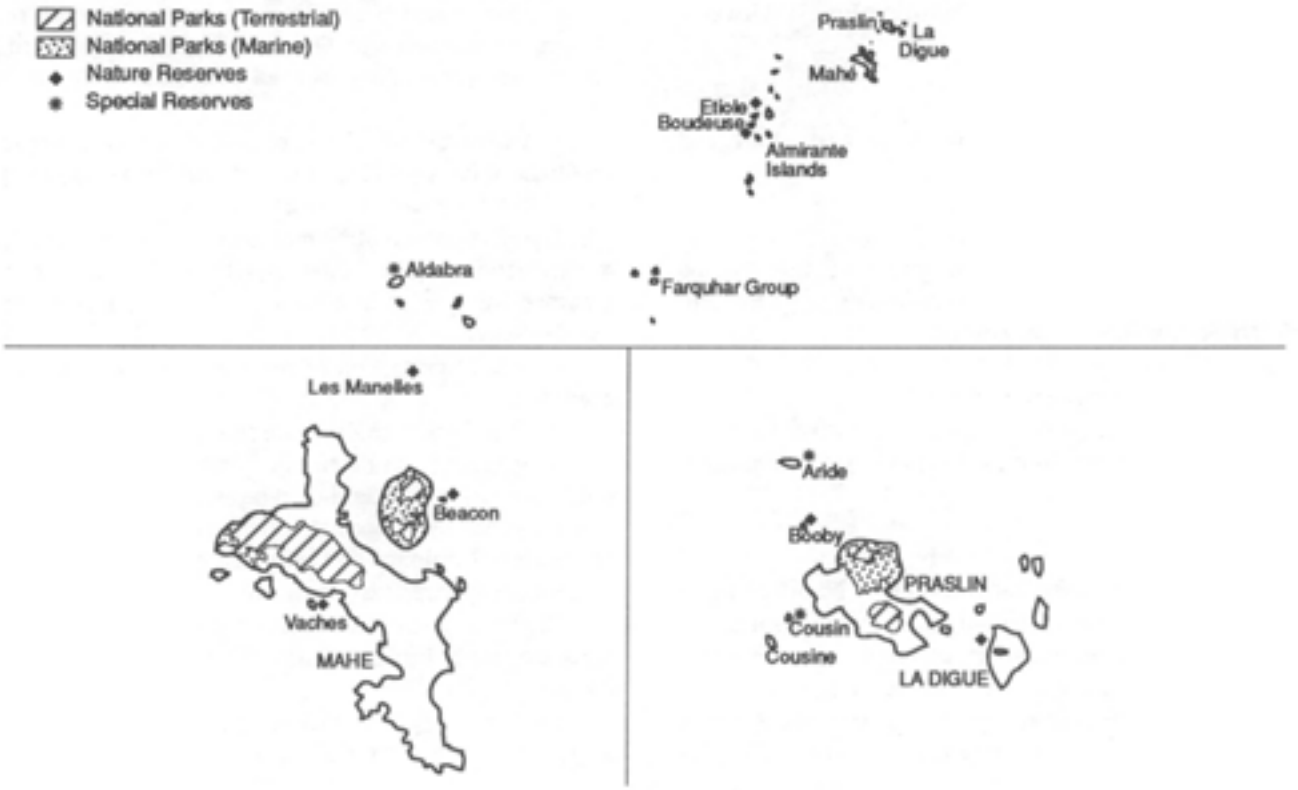
Economy (1987 data): World Bank index: no data. GNP/capita: US$ 3180. GNP annual growth rate: no data.

Biogeographic affinities: Seychelles, with Malagasy, African and minor Indian links on the granitic islands; Indo-Pacific Oceanic on the coralline islands.

Vegetation: On the granitic islands, rainforests, palm-dominated in the drier areas (though much of the natural vegetation now replaced by plantations); on the coralline islands, scrub and scrub-forest.

Critical Sites

1. The Seychelles covers a very diverse group of islands in the western Indian Ocean. They can be divided into the granitic and coralline islands, the former concentrated in the main Seychelles group, and the latter are widely scattered throughout the territory, especially towards the southwest. The granitic islands are rugged and often larger. Mahé is by far the largest granitic island in the Seychelles and includes the very important Morne Seychellois National Park. Many endemic species occur in this area of diverse topography, although the natural vegetation is being invaded by exotic plant species. Other important protected sites among the granitic islands are Curieuse Island (within the Curieuse Marine National Park), the Praslin National Park including the Vallée de Mai Nature Reserve (on Praslin Island), the Aride Island Special Reserve, the Cousin Island Special Reserve, the La Digue Veuve Reserve (on La Digue Island) (still to be formerly designated in law), the Booby Island Nature Reserve, six islands within the St. Anne Marine



Map of the Seychelles.

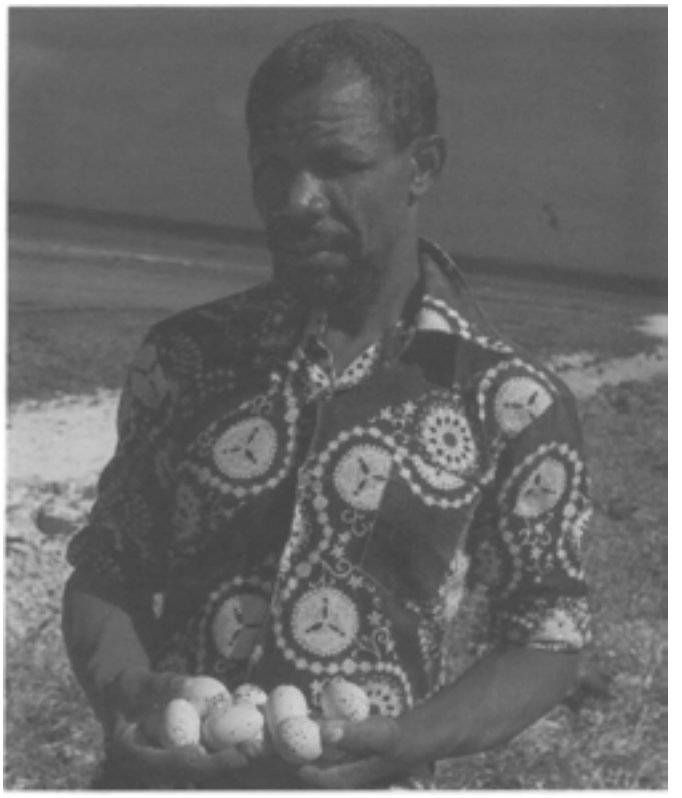
National Park (St Anne, Round, Long, Moyenne, Cerf and Le Cachée), and the nature reserves of King Ross, Beacon, Ile aux Vaches Marine and Mamelles on small islands off Mahé, There are several granitic islands that are important for endemic species and require stronger forms of protection: Silhouette, Frégate, Cousine, Félicité and Bird (actually a coral cay, but situated among the granitic islands).

2. Among the coralline islands, the Aldabra World Heritage Site is by far the most famous, with several very unusual species and a landscape and vegetation dominated by tortoises. The group of four main islands constitutes the largest coral atoll in the world. The successful conservation of Aldabra is an international triumph for species conservation. The other coralline islands are less well known, especially among the Amirantes, Farquhar and Providence islands groups. There are two nature reserves on the Amirantes: Etiole and Boudeuse. Important seabird colonies occur on some of these islands, but the conservation priorities of this area are not well enough known. Most of the coralline islands are uninhabited by people.

3. Important marine biological resources exist throughout Seychellois waters, including the following marine national parks: Baie Ternary (Mahé); Port Launay (Mahé); Curieuse (Curieuse and the north coast of Praslin); Silhouette; and St Anne (St Anne, Round, Long, Moyenne, Cerf and Le Cachée islands). Important coral reefs occur in these sites, and there are a number of marine turtle nesting beaches. There are recommendations for ten new marine reserves by the UNEP Regional Seas Programme. Important coral reefs are also included within the reserves on Aldabra, Aride and Cousin.

Critical Species

1. Plants. Although 1,139 species of seed plant have been recorded in 669 genera, most of these are introduced. Only about 250 indigenous species are known. Counts of angiosperm species for individual islands are as follows: Mahé 173 indigenous species, of which 59 are endemic to the Seychelles; Praslin 92 and 30; Silhouette 138 and 51; La Digue 79 and 11; Curieuse 83 and 17; Aldabra island group 185 (including subspecies) and 43 (with 17 endemic to Aldabra itself, one to Assumption and one to Cosmoledo); Amirantes Islands 72 and zero; Farquhar Island 46 and zero; and Coetivy 49 and zero. The Aldabra island group is unusual among coralline islands in its greater elevation, reaching 8 m altitude. As a result the flora includes endemics, and species of African, Madagascan and Seychelles (granitic islands) origin, and not just pantropical and Indo-Pacific species that are characteristic of coral atolls. Several plant species in the Seychelles are severely threatened, including: the famous double coconut *Lodoicea maldivica* (with largest seeds of any plant) on Praslin (in the Vallée de Mai Nature Reserve and at Mont Ferdinand) and on Curieuse; the small shrub *Medusagyne oppositifolia* (a unique species, the one member of its family) known from about 50 individuals in the Morne Seychellois National Park; *Peponium sublitorale* known from less than 1,000 individuals on the coastline of Aldabra; an undescribed species of *Peponium* recently found on Aride; a liana *Toxocarpus schimperianus* known from Curieuse and possibly still surviving on Mahé; and the large tree *Valeria seychellarum* known only from Morne Seychellois National Park.



Egg collecting, Farquhar Island, Seychelles. Such harvest needs to be assessed to ascertain whether or not it is carried out at a sustainable level (Photo: WWF/Jeanne Mortimer).

2. Mammals. Two endemic species occur. The Seychelles sheath-tailed bat is severely threatened, occurring in the Morne Seychellois National Park and in Praslin National Park. The Seychelles fruit bat survives in larger numbers (although it is still hunted for use in tourist restaurants), though the subspecies on Aldabra is considered to be at risk.

3. Birds. Several of the endemic bird species to the Seychelles are now extinct, but a good number survive. Ten threatened species occur, of which nine are endemic. The Seychelles kestrel occurs in reasonably good numbers on Mahé, and in small numbers on Silhouette and Praslin; the Seychelles scops owl is endemic to Mahé; the Seychelles swiftlet occurs on Mahé, Praslin and La Digue, and is at risk from disturbance of its nesting sites; the Seychelles magpie-

robin now survives only on Frégate, where less than 30 individuals remain; the Seychelles warbler occurs on Cousin (where the population has now increased to 250-300 birds) and 29 birds were released on Aride in September 1988 where the population had increased to 88 birds by April 1990; the Aldabra warbler, is endemic to Aldabra, where it is nearly extinct (if not already); the Seychelles black paradise flycatcher occurs on La Digue and in very small numbers on Praslin and possibly Félicité; the Seychelles white-eye occurs only on Mahé, where it has declined almost to extinction for unknown reasons; the Seychelles fody occurs on Cousin, Cousine and Frégate; and the roseate tern (which is not endemic) breeds on Aride (its status in the Amirantcs and Providence now being unclear). Another species that is not threatened but is very restricted in range is the Aldabra drongo, of which 1,500 birds survive on Aldabra. There are several threatened subspecies, including the Aldabra sacred ibis, the Aldabra kestrel, the Aldabra white-throated rail, the Seychelles black parrot (only on Praslin), and the Seychelles turtle dove (which is disappearing through hybridisation with the introduced Madagascar turtle dove). As well as their endemics, the Seychelles are also known for their vast breeding colonies of seabirds. 18 species nest in the country as a whole, of which 12 breed on Aldabra, 5 on Providence, 10 on the Amirantes and 10 on the main granitic islands (principally on Aride, Cousin and Bird). The species concerned are

Aldabra giant tortoise (Photo: WWF/Christian Zuber).

the wedge-tailed shearwater, Audubon's shearwater, red-tailed tropicbird, white-tailed tropicbird, blue-faced booby, red-faced booby, brown booby, greater frigatebird, lesser frigatebird, Caspian tern, roseate tern, black-naped tern, bridled tem, sooty tern, greater crested tem, brown noddy, lesser noddy and fairy tern. Tem eggs are cropped in the Amirantes, primarily on Desnarefs, and these are taken to Mahé for distribution and sale. It is not clear whether or not this cropping scheme represents sustainable utilisation.

4. Marine Turtles. Green turtles nest in scattered populations throughout the islands. Of the estimated 3,000-5,000 green turtles that nest annually in the country, more than 90% nest in the southern islands of Aldabra, Cosmoledo, Asomption, Astove and Farquhar. More than half of them nest at Aldabra. The green turtle population has declined severely, primarily as a result of over-harvesting of breeding adults which are taken for their meat, either while laying eggs on the nesting beach or by harpoon in nearshore waters The hawksbill is also severely persecuted. Between 1,200 and 1,800 nest annually, in widely scattered sites, though with a concentration on the granitic islands (including 30-40 nesting annually on Cousin). Most of the nesting population are harvested each year for their shell. The loggerhead and leatherback are known from Seychellois waters but do not nest.

5. Tortoises and Freshwater Turtles. The Aldabran giant tortoise survives in very large numbers on Aldabra, where it is well protected. Elsewhere in the Seychelles giant tortoises had become extinct, but have now been reintroduced from Aldabra to several of the islands: they wander freely on Curieuse, Cousin, Fregate and Moyenne but have been penned on other islands after proving to be serious garden pests. The introduced tortoises breed successfully but suffer from poaching, especially on Curieuse. The endemic Seychelles mud turtle is very poorly known, though there were indications that it survives in the granitic islands as recently as 1986. It is probably threatened by the draining of freshwater swamps and marshes. Its status and conservation requirements need assessment, concentrating on Mahé

6. Other Reptiles. The status of the endemic tiger chameleon *Chamaeleo tigris* is not presently known. There are also endemic *Mabuya* lizards and *Phelsuma* geckos.

7. Amphibians. 12 species occur, of which 11 are endemic, including one tree frog, 3 typical frogs, and, remarkably, 7 caecilians. 9 endemics occur on Mahé (including 5 caecilians), 8 on Silhouette, 7 on Praslin, and 4 on La Digue. One caccilian, *Grandisonia diminutiva*, is endemic to Praslin.

8. Invertebrates. Many endemic species are believed to occur. An example is the very large Frégatc Island giant tenebrionid beetle *Polposipus herculeanus.* The dragonfly subspecies *Teinobasis alluaudi alluaudi* is endemic to the Seychelles, but may now be extinct. There are over 30 endemic land snail species, which are under threat from habitat destruction and the introduced carnivorous snail *Euglandina rosea.*

Threats

1. The devastating rate of species extinction in the Seychelles is being driven by two factors, loss of natural habitat and introduction of alien species. Invasive plant species are themselves one of the agents of habitat modification. Another serious concern is the the introduced Indian house crow, which is an increasing threat to endemic bird species.

2. The surviving populations of many of the endemic species (especially of plants and birds) are so low that their their chances of recovery are very slim.

3. Some species are directly exploited, notably marine turtles, the eggs of sooty and noddy terns, and giant tortoises. In the case of marine turtles, the situation is very serious and licenses for export of shells should no longer be issued by the Seychelles Fishing Authority.

4. The threat to convert Aldabra into a military base has hopefully now passed, but feral goats are destroying many endemic plants and competing for food with the tortoises, while destroying their common food source.

5. The coral reefs of the Seychelles are threatened by landfill, dredging and pollution.

6. There is a danger of encroachment or degradation of protected areas by other activities, such as construction projects. This has already occurred to some extent in the St Anne Marine Park.

7. It is possible that hunting is having a negative impact on populations of the Seychelles fruit bat, and this needs to be assessed.

8. The hotel and tourist industries on Mahé are having a major impact impact on the coastal environment, and this needs to be carefully managed and controlled.

Current Conservation Measures

1. Government Administration of Conservation

(a) All conservation matters come under the President. Much of this is devolved to the Ministry of the Environment which is responsible for the national parks in particular, and the protection of nature in general.

(b) The management of fisheries and forests comes under the Ministry for Community Development

2. Multi-agency Projects

(a) Conservation and management of Aldabra (SIF/WWF): this includes the general conservation and research work on Aldabra, as well as the goat eradication programme.

3. ICBP Projects

(a) Conservation education programme: production of educational materials for use in schools.

(b) Cousin Island reserve management: restoration of vegetation, and protection of threatened species and seabird populations.

(c) Management programme for Seychelles magpie-robin with the aim of securing a long-term population recovery.

4. RSNC Projects

(a) Conservation and management of Aride Island.

5. SIF Projects

(a) Conservation programme for Curieuse Island.

(b) Conservation of the Vallée de Mai on Praslin.

Suggested Conservation Activities

1. Continued rigorous protection of existing conservation areas is necessary. Methods of controlling incursions of alien species (plants and animals) should be researched and applied.

2. Additional protected areas on granitic islands should be established: *Critical Sites* 1 above gives locations and *Critical Species* 1, 2, 3, 4, 5, 7 and 8 indicate some important species.

3. Assessment of the conservation requirements of the less well-known coralline islands is needed, notably on the Amirantes and in relation to seabirds: *Critical Species* 3 gives details.

4. The UNEP Regional Seas Programme recommendations for 10 new marine reserves should be implemented.

5. Endemic bird species should have their conservation requirements assessed and, where appropriate, specific protective measures should be introduced. *Critical Species* 3 indicates the most urgent priorities.

6. A review is needed of the tern egg-cropping scheme on the Amirantes to ensure that it is managed on a sustainable basis.

7. Exploitation of marine turtles should be stooped and their nesting sites accorded adequate protection. The situation is very serious and licenses for export of shells should no longer be issued by the Seychelles Fishing Authority.

8. Strict anti-poaching measures are needed to protect tortoises, notably on Curieuse.

9. A survey of the status and conservation requirements of the rare Seychelles mud turtle is needed, focussing on Mate.

10. The status and conservation requirements of the tiger chameleon should be assessed.

11. The effects of hunting on the conservation of the Seychelles fruit bat need to be assessed.

12. The operation of the tourist industry in the Seychelles needs to be reviewed to ensure that it does not damage the natural resource base upon which it depends.

13. A study is needed to devise ways of eliminating the Indian house crow before its numbers build up too much.

Chapter 43: Sierra Leone

Introduction

Area: 72,278 km^2. Cultivated: 25%. Pasture: 31%. Forest/woodland: 29%.

Population (1989 data): 4,064,000. Urban: 28%. Labour force in agriculture (1980): 70%. Density: 56/km^2. Annual growth rate: 2.4%, increasing. Doubling time: 29 years.

Major vegetation zones of Sierra Leone, and significant conservation areas. Primary moist lowland forest is now largely confined to forest reserves. 1: Bolilands rice belt (formerly floodplain grassland and swamp). 2: Great Scarcies River. 3: Little Scarcies River. 4: Rokel River. 5: Sewa River. 6: Moa River. 7: Atlantic Ocean. 8: Freetown. *Conservation area — 9: Outamba-Kilimi National Park (980 sq km). 10: Tiwai Island Game Sanctuary (12 sq km). 11: Mamunta-Mayoso Swamp Nature Reserve (proposed) (20 sq km). 12: Western Area Forest Reserve (179 sq km). 13: Kuru Hills Forest Reserve (70 sq km). 14: Loma Mountains Forest Reserve (560 sq km). 15: Tingi Hills Forest Reserve (106 sq km). 16: Tonkoli Forest Reserve (438 sq km). 17: Tama Forest Reserve (162 sq km). 18: Kangari Hills Forest Reserve (130 sq km). 19: Gola North Forest Reserve (448 sq km). 20: Gola West Forest Reserve (62 sq km). 21: Gola East Forest Reserve (228 sq km).**

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 300. GNP annual growth rate: 2.1%. Biogeographic affinities: Guinea-Congolian, with Afromontane elements on higher ground, and Guinea-Congolian/Sudanian Regional Transition Zone in the extreme north.

Vegetation: Lowland forests may have once covered at least half of the country and, though much has been cleared, important patches remain in the south and east. Lower montane forests survive in several of the hilly areas. Most of the country is now a patchwork of secondary forests and agriculture. There are large areas of mangroves along the coast, and some savanna woodland in the far north.

Critical Sites

1. Sierra Leone is at the western extremity of the Upper Guinea lowland rainforests. Most of the country's rainforests have been cleared, but important areas survive in the Gola complex near the border with Liberia, consisting of the Gola North, East and West Forest Reserves. The area is ideal for a multi-use reserve, combining fully-protected areas and sustainable-use hunting and logging areas (the latter would mean than some of the existing potentially destructive concessions should be cancelled). Wildlife populations need a recovery period before regular hunting could be instituted. The development of this multi-use area should be carried out in conjunction with authorities in Liberia, if the latter gazette the proposed Loffa-Mano National Park. It is essential to maintain forest corridors between Sierra Leone and Liberia, because without them there is a danger of severe species loss resulting from habitat fragmentation. There are plans to integrate Tiwai Island Wildlife Sanctuary and the islands below it in the Moa River within the overall management system for Gola West, which will improve coordination of conservation activity in the area.

2. The remaining forest reserves in Sierra Leone are biologically important, and include some interesting hill forests, but all are very poorly protected and are suffering from very heavy poaching and encroachment The Western Area Forest Reserve on the Freetown Peninsula needs upgrading to national park status; this area offers excellent educational and tourism possibilities. The forest reserves of the Kuru Hills, Loma Mountains, Tonkolili, Tama, Tingi Hills (or Sankan Biriwa) and Kangari Hills should all be given full

conservation status, the Loma Mountains being of particular importance.

3. The most important savanna area of the country is the Outamba-Kilimi National Park. Efforts at improving the conservation and management of this area need strengthening, as it is here that the bulk of the large savanna mammals in the country survive. The interesting *Lophira* grasslands near Port Loko and Bo need protection as a Game Reserve.

4. Sierra Leone has some interesting wetland and mangrove areas. The small Mamunta-Mayosi Swamp Nature Reserve, a mosaic of swamp, woodland and forest remnants that is being protected at the local level, needs central government blessing and support. Three important freshwater lakes - Sonfon, Mape and Mabesi - currently lack protection. The wetland and mangrove areas along and near the coast include the estuaries of the Sherbro, Scarcies and Sierra Leone Rivers, the swamps west of Port Loko, the lower River Malen north of Gbundapi, Yelibuya Island, Bumpe, Yawri Bay, Sewa-Waanje, Bonthe, Kpaka and Pujehan. Appropriate conservation strategies for all these areas need to be devised, which will probably include a balance between establishing new protected areas (as has been recommended for the Sherbro River estuary) and appropriate forms of integrated rural development.

Critical Species

1. Plants. At least 2,000 species occur, probably more, of which at least 74 species and one genus are endemic. Centres of plant species diversity and endemism are found in the Gola Forests, and in the hill forests and grasslands of the Loma Mountains and Tingi Hills.

2. Primates. 15 species occur, of which the following are of particular interest: the Guinea baboon which occurs in the north of the country; the Diana monkey, known from the Goias, Tiwai Island, and Western Area Forest Reserve; the bay (or red) colobus which occurs in the Goias and elsewhere, but in very low numbers; the olive colobus which occurs in forests in the south of the country; and the chimpanzee which is widely distributed at low densities.

3. Antelopes. 18 species occur, and another two, the giant eland and western hartebeest, are now extinct Of the extant species, 16 are considered threatened to a greater or lesser degree. In almost all cases, populations are severely depleted through over-hunting and habitat destruction. The highest priorities are improved protection of the Gola Forests, the Western Area Forest Reserve and the Outamba-Kilimi National Park. Two species of particular concern are the zebra duiker, known from the Goias, and Jentink's duiker, known in the Western Area Forest Reserve and probably occurring elsewhere, such as the Goias.

4. Fruit Bats. Nine species occur, including one of conservation concern: *Epomops buettikoferi* (endemic to the West African forests of Sierra Leone, Ghana, Guinea, Ivory Coast, Liberia and Nigeria).

5. Other Mammals. Elephants are now very rare, and have been reduced through poaching to around only 250 animals. They occur in the Goias, and in the Outamba-Kilimi National Park. The pygmy hippopotamus survives in the Goias and in the Moa River islands system, which is a key area for this species. The Warthog and giant forest hog occur only within reserves in the extreme north, and are either vulnerable or endangered. The red river hog has a wider distribution in the north but may still be vulnerable. Two rodent species that are distributed widely but in very small numbers in the African rainforests reach their western extremity in Sierra Leone: a species of palm squirrel *Epixerus ebii* and a species of pygmy scaly-tailed flying squirrel *Idiurus zenkeri.* The rare Leighton's linsang might occur in Sierra Leone, most probably in the Gola Forests. Manatees are hunted in the mangrove areas and the floating rice fields in the estuaries of the Sewa and Waanje rivers. The extent to which dolphins and porpoises are being killed in coastal fisheries is unknown, and may constitute a conservation problems.

6. Birds. Six threatened species occur, all in the rainforest areas. They are: the white-breasted guineafowl, which is very rare, occurring in the Goias and on Tiwai Island; the rufous fishing owl, occurring in the Goias and perhaps the Western Area Forest Reserve; the yellow-throated olive greenbul known from the Goias and from the Nimini Hills; the western wattled cuckoo-shrike occurring in Gola; the white-necked picathartes, known from the Western Area Forest Reserve, Loma Mountains, Tingi Hills, the Goias (a large population of >21 active colonies) and probably also the Kangari Hills, Tama and Tonkolili; and the Gola malimbe known from the Gola Forests. Sierra Leone has some important sites for palaearctic migratory ducks and waders, especially along and near the coast. The most important areas are the estuaries of the Scarcies, Sierra Leone and Sherbro Rivers, the swamps west of Port Loko, the River Malan north of Gbundapi, and Lake Mabesi.

7. Crocodiles. All three species occur, but their populations are severely depleted throughout the country.

8. Marine Turtles. Green turtles are known to nest in small numbers on Turtle Island and perhaps elsewhere along the coast. The loggerhead and hawksbill have both been recorded in Sierra Leone waters, and nesting of the hawksbill has been reported. A full assessment is needed of the true status and conservation requirements of marine turtles in Sierra Leone.

9. Amphibians. Two endemic species occur, *Cardioglossa aureoli* known only from the Western Area Forest Reserve, and a toad *Bufo cristiglans* known only from the Tingi Hills. Four other species of conservation concern occur, all shared with Guinea, and one with Guinea-Bissau as well.

10. Invertebrates. There are two endemic species of dragonfly, neither of which has been recorded for many years, *Argiagrion leoninwn* and *Allorhizucha campioni.* The rare African giant swallowtail butterfly reaches its westernmost extremity in the forests of Sierra Leone.

Threats

1. The greatest threat is the continuing clearance of forests, both in the the lowlands and the hills. This habitat, which once covered most of the country, is now reduced to only 5% of the land area. Protective measures, even within the forest reserves, are generally inadequate. The lack of an effective protected area system remains a fundamental problem.

2. Many of the patches of surviving habitat are too small for viable populations of many species.

3. Wetlands and coastal habitats are generally not included in the protected areas, and are under serious threat

4. Over-hunting is taking place of most species of large mammal, the populations of many species are now seriously depleted.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Ministry of Agriculture, Natural Resources and Forestry is responsible for the environment. Forest Reserves are under the authority of the Forestry Division. The Wildlife Conservation Branch of the Forestry Division is responsible for wildlife conservation and national parks. The management and conservation of fisheries comes under the Fisheries Division in the same Ministry.

(b) The Ministry of Lands, Housing and Environment is responsible for general environmental matters, such as the control of pollution.

2. Multi-agency Projects

(a) Gola Rainforest Conservation Programme (Government/ CSSL/RSPB/ICPB). This project is examining forest resource use by rural communities and timber companies, with a view to recommending practical conservation policies.

3. CSSL Projects

(a) This is the most active locally-based conservation NGO in Sierra Leone and focuses on conservation education in both urban and rural settings.

4. GTZ Projects

(a) Provision of efficient wood-burning stoves for smoking fish at Tombo, thereby reducing deforestation.

5. Peace Corps Projects

(a) Parks programme: volunteers are in place in Loma Mountains, Mamunta-Mayosa swamp and Tiwai.

6. WCI Projects

(a) Tiwai Island Game Sanctuary: includes a visitor centre and research station, conservation education and an artisans co-operative.

7. WWF Projects

(a) Assistance with establishment of the Outamba-Kilimi National Park.

Suggested Conservation Activities

1. Protection of forests needs urgent improvement, in terms of both effectiveness and establishment of new protected areas. The following areas need special attention.

(i) The Gola Forests need to become the subject of an integrated conservation and development programme, in which some areas and species should receive strict protection, and the others should be be under various forms of sustainable use management. This would include sustained-yield logging and controlled hunting to ensure useable levels of bushmeat species. Potentially destructive logging concessions should be cancelled. Bufferzone development should encourage local communities to derive benefits from the living natural resources, without jeopardising the conservation of the species and ecosystems. The strictly protected areas should be at Mogbai (central part of Gola North) and Wemago (northern part of Gola West). Development of the whole area should be carried out in conjunction with the Liberian authorities of the proposed Loffa-Mano National Park, to prevent habitat fragmentation and subsequent loss of species population viability.

(ii) Protection of both habitat and individual species should be improved in Gola West and Gola East (see *Critical Species* 1, 2, 3, 5 and 6 above). Anti-poaching measures are particularly important here.

(iii) The development of the proposed Tiwai Island Wildlife Sanctuary (near Gola West) should be included in the conservation programme for the Goias.

(iv) The considerable importance of the Western Area Forest Reserve render it worthy of consideration for National Park status.

(v) A number of other forest areas are in urgent need of

improved protection, in terms of both clearance prevention and anti-poaching activity (see *Critical Sites* 2 for specific locations).

2. The conservation programme and management of the Outamba-Kilimi National Park should be strengthened, particularly with reference to large mammals (see *Critical Species* 3 and 5 above) and prevention of poaching.

3. Wetland and mangrove areas need increased protection.

(i) Local protection initiatives in the Mamunta-Mayosi Swamp Nature Reserve need government blessing and support.

(ii) Reserves are needed to protect Lakes Sonfon, Mape and Matesi.

(iii) Conservation strategies need to be clarified and programmes established in relation to coastal areas, in the context of integrated development (see *Critical Sites* 4 above).

4. A major emphasis in all conservation projects needs to be the sustainable use of wildlife resources, particularly bushmeat.

5. A survey of coastal fisheries is needed to determine the extent of dolphin and porpoise deaths, and whether conservation action is required.

6. A survey of all three species of crocodile is needed, with subsequent conservation action if necessary.

7. A survey is needed to assess the status and conservation requirements of marine turtles.

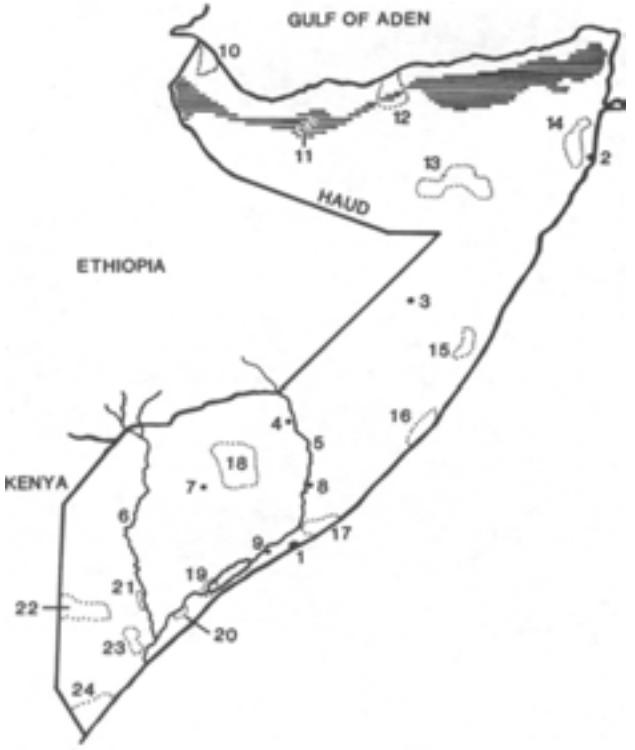
Chapter 44: Somalia

Introduction

Area: 630,000 km^2. Cultivated: 2%. Pasture: 45%. Foresl/woodland: 14%.

Population (1989 data): 8,248,000. Urban: 33%. Labour force in agriculture (1980): 76%. Density: 13/km^2. Annual growth rate: 2.7%, increasing. Doubling time: 26 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 290. GNP annual growth rate: 2.5%.



Somalia, showing some *localities mentioned in the text* (shaded area represents approximate boundary of northern mountainous and hilly strip). 1: Mogadishu. 2: Bender Bella. 3: Galkayu. 4: Belet Weyn. 5: Shebdle River. 6: Juba River. 7: Baidoa. 8: Eji. 9: Awdhegle. *Proposed conservation areas* —10: Zeila. 11: Gaan Libah. 12: Daalo Forest. 13: Las Anod-Taleh-EI Chebet. 14: Ras Hajun-Ras Guba. 15: Hobyo. 16: Haradere-Awale Rugno. 17: Johar-Warshek. 18: Hargan-Dalandoole. 19: Arbowerow. 20: Boja Swamps. 21: Angole-Farblddu. 22: Lake Dere. 23: Far Wamon. 24: Lack Badana National Park (3340 sq km).

Biogeographic affinities: Predominately Somali-Masai, with Afromontane elements in the northern mountains, and Zanzibar-Inhambane Regional Mosaic in the extreme south.

Vegetation: Predominately dry deciduous bushland and thicket, with semi-desert grassland and deciduous shrubland in the north and along much of the coast. There is montane bushland and *Juniperus* forest in the northern mountains, and some coastal semi-evergreen bushland in the south, as well as riverine forest patches on the lower Juba River.

Critical Sites

1. Although Somalia possesses some important and unusual biological resources, with a high proportion of endemic species (particularly plants), the country has been severely ravaged by security problems, droughts and the consequent human disasters in recent years. There is still a lack of a protected area system, and there is neither adequate legislation nor means of enforcement to prevent the overutilisation of its natural resources. There is an urgent need to rectify this situation and to provide the training necessary to develop a national capability in conservation. The country's critical sites are being impoverished rapidly through a combination of droughts, overgrazing and excessive hunting, and there is little time left in which to act.

2. Most of Somalia is dry semi-desert and savanna. A number of important sites have been identified in these habitats, as urgent priorities for protection. The most important are: Zeila; Las Anod-Taleh-EI Chebet (which has been proposed as a national park); Ras Hajun-Ras Gubah; El Hammure; Hobyo; Haradere-Awale; Jowhar-Warshek; Harqan-Dalandoole; Lack Dere (which has been proposed as a national park); Far Wamo; and Lack Badan (also proposed as a national park). In all of these areas, protection has been totally inadequate and poaching of wildlife is generally very severe.

3. There are some areas of wetland, and more moist savanna, especially in the regions of the Shebelle and Juba Rivers. Priority sites for protected areas are Jowhar-Warshek, Har Yiblame, Eji-Oobale, Awdhegle-Gandershe, Arbowerow, Boja Swamps, Angole Farbiddu (which includes riverine forest), and Lake Radidi.

4. The mountains of northern Somalia have some unusual species communities. The two sites of greatest interest are the proposed national parks at Goan Libaax and Daalo Forest

(which includes *Juniperus* forests). The proposed boundaries of the Daalo Forest Park should be extended to include the northern coastline.

5. Somalia has the most extensive and least spoilt coastline in all of Africa. Important coral reefs, seabird colonies and turtle nesting beaches are currently unprotected. There are believed to be very large dugong populations and extensive seagrass beds. Important seabird nesting sites include Mait Island, Zcila Island, and islets off Mogadishu, but more information is needed to identify the critical sites for biodiversity in the coastal zone, and to recommend appropriate conservation action. Priority should be given to the coral reef/island/mangrove systems from Mogadishu south to the border with Kenya

Critical Species

1. Plants. About 3,000 species occur, of which about 518 species are believed to be endemic. In general, the flora, especially the important succulent scrub, is threatened by desertification. Examples of threatened species include: *Euphorbia cameroni,* a bush known only from the northern mountains where it is extremely rare if not extinct; *Whitesloanea crassa,* an unusual succulent also restricted to the northern mountains, where it could now be extinct; *Wissmania carinensis,* the Bankouale palm which occurs in northeastern Somalia in very small numbers (as well as in Djibouti and South Yemen); and *Cordeauxia edulis,* the yaheb nut bush, which survives near Adawilif (and at two sites in Ethiopia). This last species is severely threatened because its highly-prized edible nuts are usually collected, and thus no regeneration is taking place. The government is examining the utility of the species as a crop plant.

2. Antelopes. 22 species occur, and an additional species, Swayne's hartebeest, is now extinct. 14 species are considered to be threatened to a greater or lesser degree. Several species of antelope have their ranges centred on Somalia, and the country's antelope fauna is therefore of international importance. Of particular interest are: the beisa oryx, formerly widespread, but now reduced to a mere 1,000 to 1,200 animals over the country as a whole by poaching; the hirola (otherwise known only from a small part of Kenya) which has decreased severely and now occurs only in the Lack Dcrc region; the bcira (almost endemic to Somalia), which is restricted to the northern mountains and has decreased because of droughts; the dibatag (almost endemic), which occurs in Hobyo and Haradere-Awale Rugno, and has decreased through poaching, drought and overgrazing; Soemmerring's gazelle, which is greatly reduced, although still widespread, occurring in Las Anod-Taleh-El Chebets, Ras Hajun-Ras Guba, Hobyo, Jowhar-Warshek, and south of Haradere-Awale Rugno; Pelzeln's gazelle (almost endemic), which is restricted to the northern coastal zone (including the northern extension of the proposed Daalo Forest National Park), and survives in reasonable numbers; and Speke's gazelle (almost endemic), which is widespread but greatly reduced in numbers, surviving in particular in Hobyo, but also Las Anod-Taleh-El Chebet, Ras Hajun-Ras Guba, Haradere-Awale Rugno, and Jowhar-Warshek. All four species of dikdik occur, including the endemic Piaccntini's dikdik. The red duiker has been recorded from the Juba gallery forests. Somalia's remarkable antelope fauna will only survive if a comprehensive protected area system is established, and protective measures are enforced.

3. Elephants and Rhinos. Elephants still survive in the south and may be a distinct small subspecies *Loxodonta qfricana orleansi,* but poaching is essentially out of control, and the numbers have declined very rapidly to less than 6,000. Important sites are Lack Badana, Arbowerow, and Boja Swamps. The black rhinoceros has been poached almost to extinction, though it might survive in Lack Badana.

4. Other Mammals. The cheetah survives in certain areas, including Las Anod-Taleh-El Chebet. The Somali wild ass still occurs in the same locality and also further to the south. In the south, the giraffe and Grevy's zebra occur in small numbers, as far north as Haqan-Dalandoole. The rare Abyssinian genet might occur in the north, but its status and conservation requirements are not known. The rare golden-rumped elephant-shrew might occur in coastal forest in the extreme south in the Lack Badana area. Three rare species of gerbil occur: *Gerbillus alticola* is known only from northern Somalia; *Microdillus peeli* is endemic to three localities in north and central Somalia; and *Ammodillus imbellis* occurs alongside the previous species, as well as in eastern Ethiopia. Dugongs are believed to survive in good numbers along the coast their conservation requirements are unknown. The impact of the coastal fisheries on dolphin and porpoise populations is not known, nor whether conservation action is needed.

5. Birds. Five threatened species occur, four of which are endemic. The Somali pigeon and Warsangli linnet are restricted to the northern mountains. The *Juniperus* forests of the proposed Daalo Forest National Park are an important locality for the latter species. Ash's lark is restricted to the coastal area north of Modadishu, and might occur at Jowhar-Warshek. The Somali long-clawed lark occurs in the northwest of the country near Hargeisa and Buramo, but despite searches, there have been no reports for many years. The roseate tern breeds in reasonable numbers at various places along the coast. There is evidence that other species of seabird breed widely along the Somali coast, especially the sooty gull, white-cheeked tern, Saunder's little tern, sooty

tern, and others. Both roseate and sooty terns have been found nesting on islets off Mogadishu. On Mait Island the red-billed tropicbird, masked booby, sooty tern, and brown noddy (in large numbers) have been found nesting, and on Zeila Island the brown booby, sooty gull, white-cheeked tern, greater crested tern, lesser crested tern and bridled tern (in large numbers) have all been recorded nesting. Along with Ethiopia, Somalia is the most important country for bustards in the northern hemisphere, with restricted populations of Heuglin's bustard, Hartlaub's bustard, and little brown bustard. Larger species, namely the Arabian bustard and Denham's bustard (a declining species), are heavily hunted.

6. Marine Turtles. Probably several thousand green turtles nest annually along the eastern coast, but the population and its conservation requirements are not known. It is also not known whether loggerheads, hawksbills, olive ridleys and leatherbacks breed, all of them being known from Somali waters but never having been proved to nest.

7. Other Reptiles. It is not known whether the Nile crocodile occurs; there have been no recent records. Similar, unconfirmed reports of the African spurred tortoise require confirmation.

8. Amphibians. One endemic species occurs, the frog *Lanzarana largeni*, known only from the Nogal Valley in the north of the country. One frog and one treefrog are shared only with Kenya, and one toad only with Ethiopia.

Threats

1. Somalia lacks any organised protected area system to conserve its critical sites. As a result, the most important sites for conservation in the country are suffering from chronic over-grazing by livestock, and heavy hunting of large mammals. The country is undergoing serious biological impoverishment.

2. Hunting of most species of large mammal has been extremely severe, leading to catastrophic declines in populations. Protection measures for such species have been inadequate.

3. Several species, in particular of large mammals and of plants, have such small populations remaining that their long-term survival seems unlikely.

Current Conservation Measures

1. Government Administration of Conservation

(a) Terrestrial environmental matters fall primarily under the National Range Agency in the Ministry of Livestock, Forestry and Range. This agency is responsible for the conservation and development of range, forest and wildlife resources. It has Departments of Wildlife and Forestry.

2. Multi-agency Projects

(a) Assistance in wildlife resources management (Government/FAO/UNDP): improving wildlife management, applying benefits of conservation to local communities, developing wildlife legislation, preparing a national park management plan, and starting a crocodile utilisation scheme.

(b) Forestry sector support and training (Government/FAO/UNDP): assistance in forestry and wildlife management, and development of policies and legislation.

(c) Strengthening of Forestry Department (Govemment/FAO/FINNIDA): improvement of forestry, range and wildlife management with extensive training component

(d) Initiating the Tropical Forestry Action Plan in Somalia (Government/FAO).

(e) Improvement of fisheries management through cooperatives and community-based fisheries (Government/FAO).

3. EEC Projects

(a) Development of national elephant action plan for Somalia.

4. GTZ Projects

(a) Reforestation and establishment of green belts around four provincial towns.

5. ODA Projects

(a) Assistance to Forest Range and Wildlife Institute: institutional management, curriculum development and support for training and education.

6. WCI Projects

(a) Somali wild ass research and conservation.

Suggested Conservation Activities

1. A protected area system, backed by appropriate legislation and with an appropriate personnel and training infrastructure, should be established as soon as possible.

2. Protected areas urgently need establishing in Somalia's semi-desert and savanna regions: this is particularly important for plants *(Critical Species* 1 above), the Somali wild ass, and antelope diversity and numbers *(Critical Species 2* above). Priority locations are listed in *Critical Sites 2* above.

3. Poaching needs immediate action on a nationwide basis, particularly in relation to threatened antelope species (see *Critical Species* 2), elephant and black rhino (if this last species survives in the country).

4. Wetland areas are urgently in need of improved protection and management; key locations for new reserves are listed in *Critical Sites* 3 above.

5. The proposed National Parks at Goan Libaax and Daalo Forest (important for birds) should be established, with the boundaries of Daalo Forest National Park extended to include the northern coastline.

6. Surveys of the coastline and islands are needed in order to identify key sites and conservation priorities. Coral reefs, seabird colonies, marine turtles and marine mammals are especially in need of surveys followed by action, particularly in areas where tourism is beginning to increase and may impact marine resources such as corals and shellfish.

7. Mammal surveys are needed as follows:

(i) To assess the status and conservation requirements of the rare Abyssinian genet.

(ii) To assess the impact of coastal fisheries on dolphin and porpoise populations and to propose action if a problem exists.

8. Surveys are needed to establish the status and conservation requirements of the Nile crocodile and the African spurred tortoise.

Chapter 45: South Africa

Introduction

Area: 1,184,827 km^2. Cultivated: 11%. Pasture: 65%. Forest/woodland: 3%.

Population (1989 data): 38,509,000. Urban: 56%. Labour force in agriculture (1980): 17%. Density: 33/km^2. Annual growth rate: 2.6%, decreasing. Doubling time: 27 years.

Economy (1987 data): World Bank index: upper middle-income economy. GNP/capita: US$ 1890. GNP annual growth rate: 1.7%.

Biogeographic affinities: Cape in the south and southwest; Karoo-Namib in the west; Kalahari-Highveld Regional Transition Zone in the centre; Zambezian in the north and east; Afromontane in the Drakensbergs; and Tongaland-Pondoland Regional Mosaic along the eastern coast. Marine biota consisting largely of endemic cold to warm temperate Cape and subtropical Natal elements, plus a major tropical Indo-West Pacific incursion on the east coast (at its strongest in Zululand, where some of the southernmost coral reefs in the world occur). There are also traces of a relict southern ocean element in the Cape.

Vegetation: Very complex mosaic of different vegetation types, with: bushy karoo and fynbos shrubland in the southwest; arid and semi-arid karoo shrubland and grassy shrubland in northern and central Cape Province; highveld grassland in Orange Free State, southern Transvaal and parts of eastern Cape Province; open savanna woodland in northern Transvaal and Natal; montane forest and grasslands in the Drakensbergs; and a mosaic of grassland, savanna and lowland forest on the east coast.

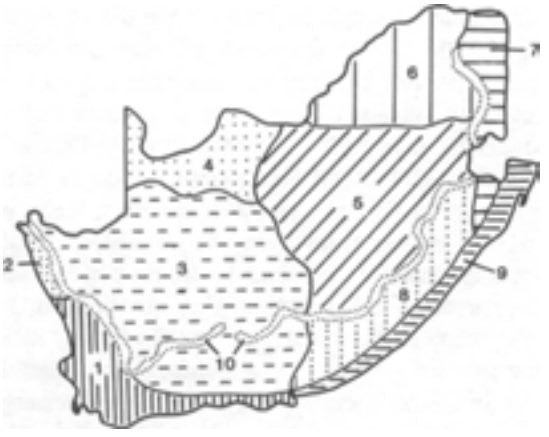
Cape of Good Hope Nature Reserve, Cape Province (Photo: WWF/Olivier Langrand).

Critical Sites

1. Because South Africa is the most economically developed country in the Afrotropical Realm, the country's biological resources have been more severely impacted by man than in most parts of the African continent. In response to this biological impoverishment, South Africa has established numerous protected areas, most of which are very small in size, though there are some notable exceptions. The country is extremely diverse biogeographically, and it is most convenient to consider the critical sites by biogeographical region. It should be noted that it is neither possible, nor helpful, to list every protected area in South Africa here, but mention is made of a representative selection of the higher priority sites.

2. Of particular importance are the habitats in southern and western Cape Province, that are biologically unique. Much of the original lowland fynbos and temperate forest has been destroyed, though important patches remain in the Bontebok and Tsitsikamma National Parks, and the De Hoop, De Mond, and Cape of Good Hope Nature Reserves. More extensive areas of natural vegetation survive in the following Mountain Catchment Areas: Cedarberg; Groot Winterhoek; Matroosberg; Hawequas; Langeberg West; Langeberg East; Hottentots Holland; Riviersonderend; Groot Swartberg/Swartberg East; Outeniqua; Anysberg/Klein Swartberg; Kammanassie; Knysna Indigenous Forests; Kouga/Baviaanskloof; and Tsitsikamma. These sites are of critical importance for the conservation of the many endemic species of the southern and western Cape and need additional protection: the highest priority sites need to be identified.

3. Much of the western, central and eastern parts of Cape Province are covered by dry Karoo vegetation, dominated by dwarf shrubs. Important sites for conservation are the Karoo National Park, the Tankwa-Karoo National Park and the Hester Malan, Karoo and Rolfontein Nature Reserves. There are also some important sites in the intermediate zone between the Karoo and eastern fynbos and grassland in eastern Cape Province. These are Addo Elephant, Mountain Zebra and Zuurberg National Parks, Andries Vosloo Kudu Reserve and Oviston Nature Reserve.



Simplificd outline of the approximate major natural vegetation zones of South Africa. 1: Cape fynbos and temperate forest 2: Coastal desert. 3: Karoo. 4: Kalahari thornveld. 5: Highveld. 6: Bushveld. 7: Lowveld. 8: Eastern midlands. 9: Humid subtropical. 10: Escarpment.

Neighbouring countries and political divisions of the Republic of South Africa. LES: Lesotho. SWAZ: Swaziland. *Provinces* — A: Cape Province. B: Orange Free State. C: Transvaal. D: Natal. *Black Slates* (boundaries shown as dotted outlines) — I: Venda. II: Gazankulu. III: Lebowa. IV: South Ndebele. V: Swazi. VI: KwaZulu. VII: Bophuthatswana. VIII: Qwaqwa. IX: Transkei. X: Ciskei. *Other areas* — 1: Orange River. 2: Vaal River. 3: Limpopo River. 4: Cape of Good Hope. 5: Cape Town. *6:* Pretoria.

4. The winter rainfall karoo, known as the succulent karoo, has a remarkably important flora which is very poorly represented in reserves. Areas of succulent karoo scrub of highest importance for nature reserve establishment are: the Gariep or Richtersveld "centre" in the north-western Cape near the Namibian border, the Knersvlakte "centre" between Vanrhynsdorp and Bitterfontein; the Little Karoo "centre" between Robertson and Uniondale; and the Eastern Cape "centre" from Uitenhage to East London in low-lying valleys.

5. In the dry Kalahari thornveld of northern Cape Province, the most important site is the large Kalahari Gcmsbok National Park, contiguous with the Gemsbok National Park in Botswana. Other important sites in this region are the Augrabies Falls and Vaalbos National Parks and the Molopo Nature Reserve. The Gaap plateau and Witsands area are important potential conservation areas.

6. In *the higher-lying* areas, centred on the Drakensberg Mountains and associated high altitude grasslands especially in the Orange Free State, the following sites are of greatest importance: Golden Gate Highlands National Park; the Giant's Castle and Royal Natal Nature Reserves with the contiguous Drakensberg State Forests (the largest protected area in the highveld); the Willem Pretorius Game Reserve; the Suikerbosrand and Blyderivierspoort Nature Reserves; and the Tussen-die-Riviere Game Farm. There is now a system of 10 contiguous protected areas in this region, covering a total of 244,000 ha. Potential conservation areas include this Memel Vlei System and the Panne area of the Orange Free State.

7. Bushveld covers most of northern and western Transvaal. The largest and most important site is the Pilanesberg National Park. Other interesting sites are Loskop Dam, Langjan, Nylsvley, Percy Fyfe and Doorndraai Nature Reserves. Large areas of the Waterberg and Blouberg are high conservation priorities.

8. The lowveld of the eastern Transvaal and part of northern Natal includes some of the best habitat for large mammals in South Africa. The Kruger National Park together with the contiguous Manyeleti, Timbavati, Klaserie and Sabi Sand Private Nature Reserves comprises by far the largest protected area in South Africa. The Itala Game Reserve and the Hans Merensky and Pongola Nature Reserves are other sites of great importance.

9. In Natal, Transkei and eastern Cape Province, there are important sites at: Itala Game Reserve, and Mkambati, Coleford, Kamberg and Mount Currie Nature Reserves. Most of these reserves are too small and require expansion to make them more viable.

10. The humid subtropical eastern coast, mainly in Natal and Transkei, possesses some important areas, in particular the Umfolozi-Corridor-Hluhluwe Game Reserve Complex, the Mkuzi, Ndumu, Kosi Bay, and St. Lucia Game Reserves and the Sodwana State Forest. Some of the areas of evergreen forest remaining along the eastern coast are in urgent need of protection. The highest priorities are the Ngoye and Duku Duku Forests in Natal and the extensive forests in the civinity of Port St. Johns in Transkei. Grasslands are also threatened, and the Pondoland floral region has the highest number of plant endemics outside the western Cape.

11. South Africa possesses some important marine living resources. Several localities are of importance as breeding grounds for seabirds and for Cape fur seals. Important offshore sites include Bird Island in Lambert's Bay, Dassen Island, Robben Island, Seal Island in False Bay, Dyer Island, Geyser Island, and the islands in Algoa Bay (St. Croix, Jahleel, Brenton Rock, Seal, Stag, and Bird). There are also some mainland sites which are important for the Damara tern. These include the north-western Cape coast, especially near the mouth of the Orange River, and several sites along the south coast between Cape Town and Algoa Bay including the De Hoop Nature Reserve, Tsitsikama Coastal National Park and West Coast National Park ;which includes Langelsaan Lagoon. The most important mainland sites for breeding seabirds need to be identified and their protection secured. On the Tongaland coast of Natal are important marine turtle nesting beaches that have been receiving excellent protection for over 25 years. Certain inshore areas along the south coast, especially San Sebastian Bay, De Hoop and Walker Bay, are important nursery or breeding areas for the southern right whale; most of the area off De Hoop is now included in a marine reserve. For the fur seal, the following sites are important for breeding: Seal Island in Mossel Bay, Quoin Rock, Seal Island in Hout Bay, Robbesteen, Jacob's Reef, Paternoster Rocks and Elephant Rock. The mainland breeding site is Kleinsee while a mainland non-breeding site is Buchu Twins. St Lucia Marine Reserve provides effective protection for all the important coral communities off South Africa and also includes mangroves. A number of other important marine reserves have been established.

The proteas are characteristic of the remarkable fynbos vegetation in southwest Cape Province, South Africa (Photo: WWF/Olivier Langrand).

12. In terms of freshwater and estuarine sites, the west coast Olifants River system has eight threatened endemic species and warrants special attention. Other vital river systems are listed under *Critical Species* 11 below.

Critical Species

1. Plants. Because of the great diversity of different biogeographical regions within the country, South Africa has the richest flora in all of Africa, with 20,300 species occurring. Of particular interest is the Cape Floristic Region in southwestern Cape Province, from where 8,579 species of vascular plant have been recorded, of which 68% are endemic. Different floristic species composition can be found in the northeast (Zambesian), the east (Tongaland-Pondoland), the centre (Kalahari-Highveld), in the west (Karoo-Namib), and in the Drakensbergs (Afromontane). In the southwestern Cape, the fynbos shrubland is of particular importance, and is now reduced, in lowland areas, to small fragments owing to agriculture, development and increasing numbers of introduced invasive plant species. As a result, there are at least 200-300 globally threatened species in this small area requiring urgent conservation attention. The montane fynbos, however, is extensive and well preserved. Many species are severely threatened in the southwest. The following are some examples: *Chondopetalum acocksii* and *Restio acocksii* among the Restionaceae; *Diastella buekii, Leucadendron verticallum, Orothamnus zeyheri, Serruria ciliata,* and *Serruria roxburghii* among the Proteaceae; *Erica chrysocodon* and *Erica jasminiflora* among the Ericaceae; and *Gladiolus aureus* and *Moraea loubseri* among the Iridaceae. After the southwestern Cape fynbos, the next most critical habitat for plant conservation is the succulent karoo (see *Critical Sites* 4 above). In these habitats, about 4,000 of the world's 10,000 succulent species occur, especially in the family Mesenbryanthemaceae which is almost entirely endemic. An example of a threatened species away from the south-western Cape and the succulent karoo is the palm *Jubaeopsis caffra,* known only from Mkambali Nature Reserve, and *Warburgia salutaris.* The situation of all species of cycads in South Africa is one of increasing threat, principally from illegal collection and trade. The most threatened species are *Encephalartos inopinus, E. eugene-maraisii* and *E. cupidus.*

2. Antelopes. 28 species occur, and one other, the endemic bluebuck from southwestern Cape Province, is extinct. Antelopes for which South Africa has international responsibility are: the black wildebeest (of which there are now more than 8,000 in reserves and on farms in Cape Province, Orange Free State, Transvaal and Natal); the bontebok (now numbering more than 1,500 in Bontebok National Park, De Hoop Nature Reserve, and other reserves and farms in Cape Province); the blesbok (now increased to several hundred thousand animals, mainly on farms in Transvaal and Orange Free State, with smaller numbers in reserves in Cape Province, Transvaal, Orange Free State and Natal); the Cape grysbok (which survives in good numbers in most of the protected areas and elsewhere in the southern and southwestern Cape); and the grey rhebok (which remains widespread in Cape Province (except the north), eastern Orange Free State, the Natal Drakensberg and southern Transvaal, occurring in many reserves). All these species are now stable in numbers, or increasing, thanks to effective conservation measures. The conservation of South Africa's antelopes depends upon the effective management of the full range of the country's protected areas, in particular those listed earlier in this section. For many species, major populations also exist on private farms and wildlife conservancies (groups of farms which pool resources for game conservation) in Cape Province, Natal, Orange Free State, and Transvaal, and the role of the private landowner is significant

Major conservation areas in the Cape Province. *National Parks* — 1: Kalahari Gemsbok (9591 sq km). 2: Augrables Falls (94 sq km). 3: Vaalbos (210 sq km). 4: Karoo (270 sq km). 5: Bontebok (28 sq km). 6: Tsitsikamma Coastal (28 sq km) and Forest (5 sq km). 7: Mountain Zebra (65 sq km). 8: Zuurberg (210 sq km). 9: Addo Elephant (86 sq km). *Provincial nature reserves* — 10: Hester Malan (66 sq km). 11: Rolfontein (69 sq km). 12: Doornkloof (88 sq km). 13: Oviston (130 sq km). 14: Karoo (145 sq km). 15: Commando Drift (60 sq km). 16: Andries Vosloo (65 sq km). 17: Thomas Baines (10 sq km). 18: Gamkapoort (80 sq km). 19: Gamka Mountain Reserve (94 sq km). 20: Goukamma (23 sq km). 21: Keurbooms River (8 sq km). 22: Salmonsdam (8 sq km). 23: Vrolljkheid Nature Conservation Station (18 sq km). 24: De Hoop (178 sq km). There are an additional 20 Cape Provincial Nature Reserves. *Local authority nature reserves* — 25: Spitskop (11 sq km). 26: Kuruman (9 sq km). 27: Leon Taljaardt (9 sq km). 28: Akkerendam (23 sq km). 29: Table Mountain (29 sq km). 30: Cape of Good Hope (77 sq km). 31: Fernkloof (14 sq km). 32: Noukloof (28 sq km). 33: Bosberg (35 sq km). There are an additional 64 (mostly smaller) Local Authority Nature Reserves. *Other areas* — 34: Cederberg Wilderness Area (710 sq km). 35: Hottentot-Hollands Nature Reserve (246 sq km). 36: Boosmansbos Wilderness Area (142 sq km). 37: Groendal Wilderness Area (250 sq km). 38: Tsolwana Game Park (Ciskei) (76 sq km). 39: Dwesa Nature Reserve (Transkei) (39 sq km).

3. Elephants and Rhinos. Some 8,200 elephants occur in South Africa, of which 7,500 occur in Kruger National Park, and another 250 in the adjacent Timbavati, Klaserie and Sabi Sand Private Nature Reserves. Other elephant populations in the country are small. Elephant populations are maintained at specific levels in South Africa through intensive management. Over 4,000 white rhinos occur in South Africa, this representing about 90% of the world population. The most important populations are in the Umfolozi/Hluhluwe Game Park (2,000 animals), Kruger National Park (1,200), and Pilanesberg National Park (220). There are numerous other scattered populations, including up to 800 on private land (mainly in Transvaal). The black rhino population is about 630, of which 220 are in the Umfolozi/Hluhluwe Game Park, 160 in Kruger National Park, 70 in Mkuzi Game Reserve, 45 in Itala Game Reserve, 40 in Ndumu Game Reserve and 34 in Pilanesberg National Park. Only small numbers occur elsewhere. As a result of strict conservation measures, rhino numbers are increasing in South Africa.

4. Other Mammals. South Africa possesses sizeable populations of several large mammal species, including the cheetah and the wild dog (which has a stronghold in Kruger National Park). Kruger National Park has major populations of giraffe (about 5,000), hippo (>3,000) and buffalo (25,000). The endemic Cape mountain zebra occurs in at least 5 reserves in the southern and southwestern Cape, in particular Mountain Zebra National Park, Karoo National Park and De Hoop Nature Reserve. It currently numbers about 600 animals and is increasing through strict protection and reintroductions. Four species of rodent of conservation concern occur: Woosnam's desert rat *Zelotomys woosnami,* which occurs in the semi-arid surrounds of the Kalahari in northern Cape Province (as well as in Botswana and Namibia); a species of woodland mouse *Grammomys cometes,* which occurs in coastal forest in Natal (as well as in Mozambique and Tanzania); the white-tailed mouse *Mystromys albicandatus* which occurs widely but is regarded as vulnerable due to habitat destruction for agriculture; and the Namaqua dune molerat *Bathyergus janetta,* which occurs in sand dunes in northwestern Cape Province and southwestern Namibia and is threatened in South Africa by development. The endemic, endangered riverine rabbit *Bunolagus monticularis* occurs in some riverine habitats in a small part of the Karoo and is seriously threatened by habitat destruction for agriculture. The giant golden mole *Chrysospalax trevelyard* is endemic to a few remaining forest patches in the southeast and is threatened. The Cape fox, while not currently threatened, is subject to persecution and its status will require monitoring from time to time. The bulk of the world population of the Cape fur seal occurs around the southern African coast (about 40% in South African waters), where it is generally well protected and increasing in numbers. The entire world population of Heaviside's dolphin occurs along the west coast of south Africa and Namibia; the species is vulnerable to entanglement in gill nets but the scale of the problem is not known. Large numbers of bottle-nose dolphins and Indo-Pacific humpback dolphins are being killed in anti-shark nets off southern Natal. An assessment of this problem and proposals for a solution are presently being researched.

5. Birds. Ten threatened species occur. The bulk of the world population of jackass penguins breeds around the coast of Cape Province. The species is decreasing because of oil pollution and the reduction of its food supply through overfishing by commercial fleets off the South African coast. Particularly large colonies occur on Malgas, Marcus and Jutten Islands in Saldanha Bay, Dassen Island, Dyer Island (the largest colony) and St. Croix Island in Algoa Bay. The southern bald ibis occurs in Natal, Transvaal and Orange Free State, and breeds on cliffs in the vicinity of short grassland. More colonies need to be included in protected areas as their grassland foraging habitat is increasingly threatened by afforestation, mining, urbanisation and crop farming. In Natal, there are protected colonies in the Umfolozi-Corridor-Hluhluwe Game Reserve, in Itala Game Reserve and in Highmoor Forest Reserve; in the Transvaal, at Blyde Nature Reserve and, in the Orange Free State, on the Vaalbank Military Area. Most of the world's Cape vulture population breeds in South Africa, where it is declining seriously. Only small numbers survive in Cape Province, and it is much reduced in Natal and in Orange Free State. Six large colonies should receive priority for protection: Colleywobbles in Transkei (300 pairs); and in Transvaal, Blouberg (350 pairs), Kransberg (700 pairs), Manutsa (100 pairs) and on the Magaliesberg at Roberts' Farm (100 pairs) and Skeerpoort (250 pairs). The major threat to this species is from poisons used in predator control. The wattled crane survives in small numbers (the main populations being in Zambia and Botswana). In South Africa there are two concentrations: in Natal along the eastern foothills of the Drakensbergs in the Umzimkulu, Mooi River and Umgeni River catchments; and in the southeastern highveld of Transvaal in the Steenkampsberg Mountains and in the Usutu River and Vaal River catchments. There are scattered records of the white-winged flufftail in Transvaal, Natal and Cape Province, but this species is so nomadic and scarce that its conservation requirements remain obscure (as is the case in its other countries of occurrence). About 200 pairs of Damara terns breed, mainly in the northwestern Cape near the mouth of the Orange River, and in little colonies along the south coast between Cape Town and Algoa Bay (including the De Mond Nature Reserve). More information is needed regarding its distribution and there is a need for more protection of small colonies. The roseate tern continues to decrease markedly and only 70-80 pairs now survive on St. Croix Island in Algoa Bay. The South African long-clawed lark (Rudd's) is endemic, occurring in high altitude grasslands in the eastern and northeast-

ern Orange Free State and Lesotho to Dullstroom in the Transvaal. Botha's lark is endemic to South Africa and is restricted to a small area of high altitude grasslands in northern Orange Free State and southeastern Transvaal. Both of these species depend on very short grassland, as does the yellow-breasted pipit which is also threatened by habitat destruction. The spotted ground-thrush occurs in coastal forests from St Lucia south to East London, including the Ngoye Forest in Natal (which is the only locality in South Africa for a distinctive subspecies of the green barbet). The bulk of the South African population of the spotted ground-thrush breeds in forests in the Port St. Johns region of Transkei and this habitat is in urgent need of protection. There are several other species of conservation concern. These include the near-endemic blue crane (the National Bird) which has recently suffered a dramatic decline in numbers as a result of changes in land-use practices and misuse of poison. Formerly widespread, it is now common only in the southern Cape. The blue swallow was always restricted in distribution because of its dependence on temperate, high-rainfall grasslands. This habitat is now almost completely lost to commercial timber and the blue swallow is thus almost extinct in South Africa, although populations also occur in Malawi and Tanzania. South Africa is the most important country in the southern hemisphere for bustards, holding the endemic blue korhaan (shared only with Lesotho) and important populations of Ludwig's bustard and karoo korhaan. Two declining species in Europe, the lesser kestrel and the corncrake both winter in the Karoo where they are threatened by locust-spraying and grassland degradation respectively. Fourteen species of seabirds breed in South Africa: jackass penguin, white pelican, Cape gannet, white-breasted cormorant, Cape cormorant, bank cormorant, crowned cormorant, kelp gull, grey-headed gull, Hartlaub's gull, Caspian tern, greater crested tern, roseate tern and Damara tern. For the Cape gannet and crowned cormorant, over half the world population breeds in South Africa.

The Cape pangolin *Manis temminckii* (Photo: WWK/J.H. Blower/J. Allan Cash).

6. Crocodiles. Good populations of the Nile crocodile occur in Kruger National Park, the Umfolozi-Corridor-Hluhluwe Game Reserve Complex, and the Ndumu and St. Lucia Game Reserves. At least 27 crocodile farms are in operation, none of which take from the wild (in accordance with CITES Appendix 1 listing for the species in South Africa) except where purchases are made from other countries which are permitted to trade under a CITES Appendix 2 listing. Outside of reserves and farms, the range of crocodiles has diminished greatly within the country.

7. Marine Turtles. Over 400 loggerheads and 70 leatherbacks nest annually along the Tongaland coast of Natal, especially between Cape Vidal and Kosi Bay. Numbers of both species are increasing under protection. The green turtle, hawksbill and olive ridley all occur in South Africa waters, but they do not breed.

8. Tortoises. The status and conservation requirements of tortoises (of which there are nine species and 15 recognisable subspecies) in the country are not well-known: nine of the 15 taxa present are endemics. The Natal hinge-back tortoise in Natal is of particular concern. The endemic geometric tortoise occurs only in macchia vegetation in southwestern Cape Province, and its survival depends on good management of appropriate reserves. In addition, there are five species of freshwater turtle, none of which is currently of conservation concern.

9. Other Reptiles. 301 species of reptile occur in South Africa (including crocodiles, tortoises and turtles). There are 103 species of snake (21 of which are endemic, or nearly so) and 165 species of lizard (86 of which are endemic, or nearly so). There are seven globally threatened species of snake: Namaqua dwarf adder *Bitis schneideri* (coastal western Cape Province and neighbouring Namibia); Fisk's house snake *Lamprophis fiskii* (a few widely scattered localities in Cape Province); yellow-bellied house snake *Lamprophis fuscus* (widely scattered localities in the south and east of the country); Swazi rock snake *Lamprophis swazicus* (eastern Transvaal and neighbouring Swaziland); striped harlequin snake *Homoroselaps dorsalis* (widely scattered locations in eastern half of country, and Swaziland); Transvaal quillsnout snake *Xenocalamus transvaalensis* (northern Transvaal, KwaZulu, and neighbouring Mozambique); and plain mountain adder *Bitis inornata* (two widely scattered populations on Compassberg and Cederberg, Cape Province). There are 27 globally threatened lizard species, of which the following

are of particular concern: Eastwood's long-tailed seps *Tetradactylus eastwoodae* (known only from the Wolkberg area of Transvaal, where probably now extinct); Smith's dwarf chameleon *Bradypodion taeniabronchum* (restricted to the Van Stadensberg near Port Elizabeth); Methuen's dwarf gecko *Lygodactylus methueni* (vicinity of Woodbush Forest Reserve, Transvaal); giant girdled lizard *Cordylus giganteus* (northeastern Orange Free State, and adjacent regions of Transvaal and Natal); and armadillo girdled lizard *C. cataphractus* (western Cape Province). There are also seven amphisbacnid species, one of which is both threatened and endemic, Lang's pink round-headed worm-lizard *Chirindia langi*, from northern Natal. The most important sites for threatened reptiles in South Africa are: Maputaland in northem KwaZulu; southwest Cape Province; the Soutpansberg area of northern Transvaal; Little Namaqualand and the Richtersveld of northwest Cape Province; the Woodbush Forest of eastern Transvaal; the Natal Drakensbergs; and the Elandsberg area in the eastern Cape. Some of the taxa of conservation concern have very restricted ranges, many have highly specialised environmental requirements that are vulnerable to human impact.

10. Amphibians. 95 species occur, of which 49 are endemic or nearly so. 14 species are considered globally threatened, of which the following give cause for particular concern: Cape platanna *Xenopus gilli* (southwestern Cape Province); micro frog *Microbatrachella capensis* (southwestern Cape Province); Hewitt's ghost frog *Heleophryne hewitti* (Elandsberg Mountains, eastern Cape); Table Mountain ghost frog *H. rosei* (Table Mountain, Cape Peninsula); Cape rain frog *Breviceps gibbosus* (southwestern Cape Province); and Pickersgill's reed frog *Hyperolius pickersgilli* (Natal and KwaZulu coastal lowlands). Of the 14 globally threatened species, six are restricted to the south-western Cape, three in the eastern Cape, three centred on Natal, one in the Drakensberg High Plateau, and one in the western Cape near the Namibian border. The priorities are the protection of important breeding habitats, especially by promoting public concern for overall environmental protection, and ensuring that adequate inter-population corridors (e.g. the "Zululand Funnel") are maintained and protected.

11. Freshwater Fishes. 220 species occur, of which 20 are considered to be globally threatened. Among the most critically endangered are: the Berg River redfin *Barbus burgi* (southwestern Cape); fiery redfin *B. plegathon* (Olifants River system, western Cape); Cape whitefish *B. andrewi* (southwestern Cape); Twee River redfin *B. erubescens* (Olifants River system, western Cape); Treur River barb *B. treurensis* (Upper Blyde River, northeastern Transvaal); sawfin *B. serra* (Olifants River system, western Cape); border barb *B. trevelyani* (Buffalo and Keiskamma Rivers, Ciskei and eastern Cape); Barnard's catfish *Austroglanis barnardi* (Olifants River system, western Cape); rock catfish *A. sclateri* (Vaal-Orange River system, much reduced in distribution); Incomati rock catlet *Chiloglanis bifurcus* (Incomati River system, eastern Transvaal); and Eastern Province rocky *Sandelia bainsii* (four river systems in the eastern Cape and Ciskei). Of the 20 globally threatened species, eight occur only in the Olifants River system in the western Cape, making this a critically important area; three are restricted to the southwestern Cape; three in the Incomati River system in eastern Transvaal; two in the Orange River system; two in the eastern Cape and Ciskei; one in northeastern Transvaal; and one in the Gourits and Keurbooms river systems in the southern Cape. The chief threats are habitat degradation, changes in water management, invasive exotic vegetation, pollution and the introduction of alien predators and competitors for food. Conservation priorities are effective habitat protection in reserves and the promotion of wise catchment management.

Major conservation areas in Natal. *Game reserves* — 1: Hluhluwe (231 sq km). 2: Umfolozi (478 sq km) (Hluhluwe and Umfolozi Game Reserves and the Corridor which separates them form a single complex of 960 sq km, within which movement of wildlife is unrestricted). 3: Itala (259 sq km). 4: Mkuzi (251 sq km). 5: St. Lucia (368 sq km; comprises the water area of Lake St Lucia and islands within the lake). 6: Ndumu (101 sq km). 7: Tembe Elephant Reserve (KwaZulu) (290 sq km). 8: Giant's Castle (346 sq km). *Nature reserves* — 9: Royal Natal National Park and Rugged Glen Nature Reserve (89 sq km). 10: Loteni (40 sq km). 11: Kamberg (22 sq km). 12: Vergelegen (12 sq km). 13: Mzimkulwana (23 sq km). 14: Coleford (13 sq km). 15: Mount Currie (16 sq km). 16: Weenen (43 sq km). 17: False Bay Park (22 sq km). 18: Eastern Shores (139 sq km). 19: Umlalazi (9 sq km). 20: Vernon Crookes (22 sq km). 21: Oribi Gorge (18 sq km). 22: Umtamvuna (31 sq km). There are several other Natal Parks Board Nature Reserves. *Other areas* — 23: Mlambonja Wilderness Area. 24: Mdedelelo Wilderness Area. 25: Mkhomazi Wilderness Area (540 sq km). 26: Mzimkulu Wilderness Area (283 sq km).

12. Estuarine Fishes. There are eight globally threatened species of estuarine fish in South Africa: Knysna seahorse *Hippocampus capensis* (Knysna, Keurbooms, Kleinbrak and Swartvlei estuaries); river pipefish *Syngnathus watermayeri* (mouths of Bushmans, Kasouga and Kariega rivers, eastern Cape); bearded eel-goby *Taenioides jacksoni* (a few sites along the Natal coast, including the St Lucia, Mgeni and Mkomazi estuaries); borrowing goby *Croilia mossambica* (Natal coast, possibly also Mozambique); golden sleeper *Hypseleotris dayi* (Natal coast, possibly also Mozambique); freshwater mullet *Myxus capensis* (southwest Cape to Natal, possibly also Mozambique); checked goby *Redigobius dewaali* (Natal and Mozambique, isolated population at Knysna); and Sibayi goby *Silhouetta sibayi* (northern Natal coast at Lake Sibayi and the Kosi system, possibly also Mozambique). The main threat to these species comes from habitat damage resulting from recreational developments and industry.

13. Butterflies. 630 species occur, of which two are extinct *(Deloneura immaculata* from Fort Bowker on the Bashee River, eastern Cape, and *Lepidochrysops hypopolia* from Blue Bank near Ladysmith in Natal and Potchfstroom in Transvaal). 78 species are considered to be globally threatened, three of these being shared with Lesotho, the rest being endemic. The most serious threatened species are: *Chrysoritis cottrelli* (occurring inland from Knysna, seriously endangered by expanding pine plantations, perhaps already extinct); *Alaena margaritacea* (occurring near Henertsburg, northeastern Transvaal); *Lepidochrysops lotana* (Rietvlei, southwest of Pietersburg, Transvaal); *Orachrysops niobe* (Knysna, threatened by housing development); and *0. dicksoni* (near Melkbosch Strand and Witsand near the Breede River mouth, southwestern Cape). There is a concentration of threatened species in the southwestern Cape, but there is also a wide scatter of such species through the rest of the country.

14. Other Invertebrates. The insect fauna of South Africa is rich (80,000 described species). There are high levels of endemism in many taxa and many are threatened (see for example the butterflies above). Two dragonflies endemic to the southwestern Cape have not been seen for many years and may be extinct: *Ecchlorolestes nylephtha* and *E. peringueyi.* Equally rare dragonflies are the western Cape endemics *Enallagma polychromaticum* (not seen since 1936) and *Metacnemis angusta.* The dragonfly genus *Syncordulia* is known from two populations, one in the Drakensberg Mountains in Natal (perhaps an undescribed species), and one on mountain slopes in the western Cape. Among the other invertebrates, Plant's gulella snail is restricted to a small area around Durban, where it is threatened by bush clearance. The endemic South African acanthodriline earthworms are threatened by deforestation, and many species are probably already extinct. The genera of concern are *Diplotrema* (16 species), *Chilota* (13), *Microscolex* (9), and *Udeina* (67). Most of these species are concentrated in the southwestern Cape. The South African giant earthworms include two genera, *Microchaetus* (occurring in western and eastern Cape Province, Natal and Transvaal), and *Tritogenia* (occurring in Natal). They are threatened by a lowering of the water table and overgrazing. The largest species of all, *Microchaetus microchaetus,* is restricted to a small area near King William's Town in eastern Cape Province. The tiny pulmonate limpet *Siphonaria compressa* is endemic to Langebaan Lagoon, where it lives on the eelgrass *Zostera:* although recently declared a Marine Conservation Area, the threat of pollution from Saldanha Bay remains. Eight species of endemic Cape cowries are threatened through commercial exploitation for the hobby-fish trade. Increasing industrial pollution along the Natal and Zululand coastline threatens both intertidal and offshore reef fauna. South Africa has two endemic genera (*Peripatopsis* and *Opisthopatus)* of onychophorans, all of which are protected.

Threats

1. Although South Africa's biological resources have been severely depleted in the last few hundred years, the conservation measures now in place are in general sufficient to safeguard much that remains. A number of biomes are particularly at risk from agricultural expansion (and in some cases over-grazing) since they are very poorly represented in the protected area system: lowland fynbos, succulent karoo, eastern lowland forest, wetlands and highveld grassland.

2. The vegetation in the southwestern Cape is generally at risk from invasive plant species, which threaten to disrupt the natural floral communities.

3. A general problem is that many of the country's reserves are too small to hold viable populations of certain species.

4. Overgrazing constitutes a serious threat, particularly in subsistence fanning areas.

5. Over-fishing has resulted in the decline of seabird populations, as well as depleting the marine fish resource.

6. Small cetaceans are being killed in anti-shark nets off Natal.

7. A number of bird species are threatened by habitat destruction, in particular forestation of montane grassland with conifers, and by poisoning.

8. Diamond mining around the mouth of the Orange River is devastating natural vegetation, including succulent karoo.

9. Many freshwater fish species are threatened by habitat degradation, changes in water management, invasive exotic vegetation, pollution and the introduction of alien predators and competitors for food.

Current Conservation Measures

1. Government Administration of Conservation

(a) No thorough review is attempted here, since administration of environmental matters is complex, with much authority being vested with provincial governments. Conservation areas are variously managed by the National Parks Board, the Natal Parks Board, the Directorate of Forestry,

Major conservation areas in the Orange Free State. 1: Golden Gate Highlands National Park (62 sq km). *Orange Free State provincial reserves* — 2: Willent Pretorius Game Reserve (120 sq km). 3: Erfenis Dam Nature Reserve (38 sq km). 4: Tusscn-die-Riviere Game Farm (175 sq km). 5: Verwoerd Dam Nature Reserve (275 sq km). 6: Soetdoring Nature Reserve (62 sq km). 7: Sandveld Nature Reserve (377 sq km). 8: Koppies Dam Nature Reserve (43 sq km).

Nature Conservation Divisions of provincial administrations, and appropriate ministries in Transkei, Bophuthatswana, Venda and Ciskei (i.e. the Department of Agriculture and Forestry in Transkei).

2. Multi-agency Projects

(a) Black Rhino Project 2000 (Natal Parks Board/Total SA/EWT): evaluation of needs of Umfolozi-Hluhluwe population.

(b) The "Conservation Plan for the Black Rhinoceros in South Africa, the TBVC States and Namibia" co-ordinates the activities of conservation agencies with respect to this species.

3. Government/Provincial Projects

(a) All offshore islands save 2 are now provincial nature reserves.

(b) Creation of Wildlife Conservancies (Natal Parks Board): development of conservation on all farms, not just game farms. Fanners form cooperative groups to employ game guards and manage wildlife: 1,200+ farmers involved.

4. EWT Projects

(a) Karoo bustard project

(b) Production of endangered species booklet for general public.

(c) Landrover sponsorship: renovation of Landrovers for various projects.

(d) Bottlenose dolphin project

(e) Pangolin research project

(f) Production of booklet "Predators and Farmers", to reduce poison use.

(g) Evaluation of habitat rehabilitation, Sabie-Sand Game Reserve.

(h) Vulture Study Group: working group convened by EWT.

(i) African Raptor Information Centre: working group convened by EWT.

(j) Animals in traditional medicine: seeks sustainable use of products.

(k) Large carnivore research, Kruger National Park.

Major conservation areas in the Transvaal. 1: Kruger National Park (19 485 sq km). *Provincial nature reserves* — 2: Messina (34 sq km). 3: Langjan (48 sq km). 4: Happy Rest (15 sq km). 5: D'Nyala (85 sq km). 6: Hans Strijdom Dam (29 sq km). 7: Percy Fyfe (27 sq km, including a 12 sq km roan camp, 9 sq km sable camp, and 6 sq km tsessebe camp, each fenced separately). 8: Doorndraai Dam (72 sq km). 9: Nylsvley (31 sq km). 10: Hans Merensky (52 sq km). 11: Blyderivierspoort (226 sq km). 12: Ohrigstad Dam (25 sq km). 13: Verloren Vallei (60 sq km). 14: Pongola (69 sq km). 15: Loskop Dam (148 sq km). 16: Rustenberg (43 sq km). 17: Suikerbosrand (133 sq km). 18: Abe Bailey (19 sq km). 19: Boskop Dam (27 sq km). 20: Wolwespruit (23 sq km). 21: Bloemhof Dam (72 sq km). 22: SA. Lombard (37 sq km). There are several additional Transvaal Provincial Nature Reserves. *Local authority nature reserves* — 23: Pietersberg (28 sq km). 24: Gustav Klingbiel. 25: Van Riebeeck (30 sq km). 26: Faan Meintjes (13 sq km). 27: Krugersdorp Game Reserve (14 sq km). *Other areas* — 28: Nwanedi National Park (Venda) (40 sq km). 29: Potlake Nature Reserve (Lebowa) (30 sq km). 30: Pilanesberg National Park (Bophuthatswana) (550 sq km). 31: Klaserie Private Nature Reserve (630 sq km). 32: Timbavati Private Nature Reserve (600 sq km). 33: Sabi Sand Wildtuin Private Nature Reserve (530 sq km).

(l) Support for black rhino census, Pilanesberg National Park.

(m) Research on Gaboon vipers, Richards Bay.

(n) Support for serval research, University of Natal.

(o) Captive breeding of threatened raptors.

(p) Support for environmental impact study of Robberg marina (proposed).

(q) Radio telemetry equipment provision for sable antelope study.

(r) Radio telemetry equipment provision for flufftail study.

4. WSSA Projects

This Society supports a very large number of projects, and only a few key ones are listed below:

(a) Survey of natural forests in Transkei.

(b) Preparation of wetlands awareness brochure.

(c) Save the cycads project.

(d) Ozone awareness project in Natal.

(e) Leopard research and monitoring in the western Cape.

(f) Conservation of the riverine rabbit in the northern Cape.

(g) Raptor conservation in Orange Free State.

(h) Conservation of the geometric tortoise.

(i) Whale research and monitoring project.

(j) Status survey of the cheetah.

Suggested Conservation Activities

1. A general principle of increasing the size of existing reserves, rather than creating additional ones, is needed in order to increase viability of many species populations.

2. New concepts such as conservation on private land, game corridors and so on need to be further explored and developed as alternatives to public reserves, given the pressure on land. Methods for protecting species that cannot be effectively protected in reserves (e.g. the riverine rabbit) need to be developed.

3. The promotion of soil and water conservation is a high priority: this will be considerably aided by implementation of conservative stocking rates for domestic livestock to prevent over-grazing.

4. New reserves are urgently needed to protect remaining areas of lowland fynbos. Surveys should be carried out to identify priority sites for the globally threatened plant species (perhaps 200-300 of them), thereby providing the guidance needed for a coordinated programme of reserve establishment and development.

5. There is a need for more reserves of succulent karoo scrub, and surveys should be carried out to identify suitable sites. This is particularly important for the riverine rabbit (see *Critical Sites* 4).

6. Reserves should be set up as soon as possible in east coast evergreen forest areas (priority sites are listed in *Critical Sites* 10 above), which are particularly important for some threatened bird species *(Critical Species* 5 above).

7. Surveys of marine and coastal sites are needed to identify the principal mainland sites for breeding seabirds and to ensure maximal protection, particularly for those species whose principal world populations breed in South Africa

8. Measures to reduce marine over-fishing should be introduced, not only to conserve sea fish species (see *Critical Species* 12 above) but also to facilitate the consolidation of certain seabird species affected by declining fish populations. The jackass penguin is particularly vulnerable in this context (see *Critical Species* 5 above).

9. Marine turtles need to receive continued protection at their nesting sites in order to consolidate numbers.

10. The status and conservation needs of Heaviside's dolphin need to be surveyed.

11. Solutions to the problem of shark-net deaths of the bottle-nosed dolphin and the Indo-Pacific hump-back dolphin off Natal are urgently needed.

12. Antelope populations need continued active management to ensure their future. Species and areas of prime importance are listed in *Critical Species* 2 above.

13. Guidelines are needed for game-farming enterprises to avoid genetic swamping of rare subspecies (such as bontebok) by related subspecies being farmed in the same area.

14. Many of the estuaries and wetlands in South Africa require protection from development and pollution.

15. The current effective conservation measures for rhinos should continue, as should the policy of moving surplus animals from growing populations to smaller groups.

16. Methods of controlling illegal collection and trade of cycads should be urgently sought, recognising that nursery-rearing may not be sufficient as insect pollinators depend for their survival on the wild plants.

17. A number of rare or threatened bird species need specific conservation action:

(i) More colonies of the southern bald ibis need inclusion in protected areas in Natal, Transvaal and the Orange Free State.

(ii) Six large breeding colonies of the Cape vulture should receive urgent protection: sites are listed in *Critical Species* 5 above.

(iii) The white-winged flufftail needs surveying with a view to specific conservation measures, in Transvaal, Natal and Cape Province. However, in view of its nomadic disposition, specific action may be very difficult to effect.

(iv) Damara terns need more surveys, as well as reserves to protect small colonies (see *Critical Species* 5 above for sites).

(v) The conservation of the roseate tern on Bird Island in Algoa Bay is an urgent priority.

(vi) The conservation requirements of the South African long-clawed lark and Botha's lark need assessment with a

view to appropriate action.

(vii) The habitat requirements of the blue crane need to be fully evaluated and appropriate conservation action initiated to prevent further depletions of this species.

(viii) Remaining blue swallow nest sites should be located and protected.

18. The status and conservation needs of the Natal hinge-back tortoise need to be surveyed.

19. Effective reserve management must continue in order to ensure the survival and recovery of the geometric tortoise in southwestern Cape Province.

20. Conservation needs of endemic and threatened snakes and lizards need to be addressed, focussing on (i) identification and protection of restricted populations and migratory corridors and (ii) habitat protection to ensure conservation of invertebrate prey species. Particular attention should be paid to the most threatened species list under *Critical Species* 9 above.

21. Conservation of threatened endemic amphibians is needed in terms of both improved protection for important breeding sites, particularly by promoting public awareness of environmental issues, and maintenance of inter-population corridors. Particular attention should be paid to the most threatened species list under *Critical Species* 10 above.

22. Threatened species of freshwater fish need effective habitat protection in reserves and the promotion of wise catchment management. Reserves need to be established in the key sites for all the most threatened species (see *Critical Species* 11 above).

23. Investigations into the conservation problems of certain invertebrates threatened by lowering of the water table, overgrazing, urban expansion, planting of exotics and invasive plants need to be carried out (see *Critical Species* 13 and 14 above).

Chapter 46: Sudan

Introduction

Area: 2,505,815 km^2. Cultivated: 5%. Pasture: 22%. Forest/woodland: 19%.

Population (1989 data): 24,484,000. Urban: 20%. Labour force in agriculture (1980): 71%. Density: 10/km^2. Annual growth rate: 2.8%, decreasing. Doubling time: 24 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 330. GNP annual growth rate: 2.0%.

Biogeographic affinities: Saharan in the north; Sahel Regional Transition Zone in the centre; Sudanian in the south; Somali-Masia in the southeast; Guinea-Congolian/Sudanian Regional Mosaic in the southwest; and Afromontane in the Imatong Mountains.

Vegetation: Desert and semi-desert in north; Acacia wooded grassland in the Sahel zone; Sudanian woodlands in the south; lowland forest patches along the border with Zaïre; and montane forest in the Imatong Mountains. Around the White Nile are very extensive swamps and floodplains.

Critical Sites

1. Sudan is the largest country in Africa, with some exceptional biological resources. The country has small areas of lowland rainforest in the southwest, and three game reserves protect this habitat: Bangangai, Bire Kpatuos and Mbarizunga. However, the latter two are tiny, and Bangangai Game Reserve is not currently large enough to contain viable populations of important species.

2. The most important montane forests in Sudan are in the Imatong Mountains in the extreme south. The natural forests are under threat from continued expansion of tea and forestry plantations. Other areas of montane forest exist in the south in the Didinga and Dongotona Mountains (although these have been degraded by burning), and in the proposed Boma National Park in the southeast

3. Much of southern Sudan is savanna woodland, and it is here that most of the country's protected areas are situated. However, since the civil war began in 1983 access has been all but impossible and any estimates of the state of affairs there must be extremely tentative. It appears that all game reserves may currently be "on paper" only. The following important reserves have been established: Southern National Park; Nimule National Park; Radom National Park; Kidepo Game Reserve (contiguous with the Kidepo National Park in Uganda); Ashana Game Reserve; and Juba Game Reserve. In addition, several very important reserves have been suggested but remain ungazetted. These are the Boma National park (which will also include montane forests, flood plains and seasonal swamps); Lantoto National Park; Boro Game Reserve and Meshra Game Reserve. The management of all these areas is believed to be at best seriously compromised by the ongoing civil war. In particular, poaching of large mammals appears to be out of control.

4. The Sudd Swamps along and around the White Nile represent some of the most extensive wetlands in Africa. The size of this wetland has varied enormously in the last 40 years and even with the Jonglei Canal working, will still be larger than its pre-1960 area, if Nile discharges stay at their present high levels. Extensive areas of the Sudd and associated floodplains are conserved in the Zeraf, Fanyikang, Shambe, Mongalla and Badingeru Game Reserves. Additional conservation needs are the establishment of a large extension to the Shambe Game Reserve, the creation of the Badingilo Game Reserve (which will include the existing Mongalla and Badingeru Game Reserves), and the gazettment of the Meshra Game Reserve. Improved management of the Sudd Swamps, including programmes to ensure sustainable use of biological resources, is needed. The ecological effects of major development programmes, in particular the construction of the Jonglei Canal and the likely increase in oil exploration, constitute potential problems. At present, however, conservation in this region is severely hampered by the civil war within the country. One problem appears to be the accidental role of the unfinished, empty Jonglei canal acting as a game trap, which will have significant effects on some populations of large mammals.

5. The only protected area outside the south is the Dinder National Park, with the contiguous Rahad Game Reserve, and buffer-zone. This area includes a flood plain and surrounding savanna. The encroachment of the buffer-zone has destroyed much of the rainy season habitat for large mammals. The habitat has generally been degraded by illegal overgrazing, by domestic stock, and several species of large mammal are now extinct in the area. Nearby edaphic grasslands are also in need of protection. The management plan prepared by FAO should be implemented.

6. There are no protected areas in the desert and sahelian zones of Sudan, which make up half the country, nor are

the best sites for such reserves known, in which the species of these arid habitats can be allowed to recover their populations. Such reserves should be established at low altitudes on both the western and eastern sides of the Nile. In addition, protection is needed to conserve the unusual flora and fauna of the Red Sea Hills, and of the massifs of Jebel Marra and Jebel Gurgei.

7. Sudan's marine living resources are partially identified but need further surveying. There are extensive reefs along most of its coastline and these are largely in excellent condition, the Sudanese having little traditional dependence on the sea. The area containing important fringing coral reefs north and south of Port Sudan is under threat from pollution from the expanding port but there is a proposal for their protection in terms of the Port Sudan Marine National Park. There is also a proposal for a marine national park on the Sanganeb Atoll (the only atoll in the Red Sea), which has considerable tourism potential. Numerous islands in the Red Sea are probably of importance but little is known at present. The Suakin Archipelago is known to be important for coral reefs, seabird nesting colonies and marine turtle nesting beaches, and the Mukawar, Taila and Mayetib Islands are important for reefs and seabirds.

Critical Species

1. Plants. 3,200 species occur with about SO endemics. Jebel Marra is of particular interest. The Imatong Mountains possess about half the total number of species recorded from the country. Examples of threatened species are: the Nubian dragon tree *Dracaena ombet,* known in very small numbers in the Red Sea Hills from near the Egyptian border, south through Ethiopia to Djibouti; the Argun palm *Medemia argun,* which is extremely seriously threatened through overexploitation, being known from one location 200 km southeast of Wadi Haifa, and three localities in Egypt; and a small tree related to the olive, *Olea laperrine,* known from Jebel Marra and Jebel Gurgei where it survives in reasonable numbers (as well as in arid mountains in Niger and Algeria).

2. Antelopes. There is an extremely rich fauna of 34 species, with both the kob and hartebeest being represented by two distinct subspecies. However, three species from the northern arid zone, the addax, scimitar-horned oryx and slender-horned gazelle are nearly, if not already extinct Of particular importance are: the bongo which occurs in the Bangangai Game Reserve and other forests of the southwest; the giant eland which occurs widely in the southwest, particularly near the border with the Central African Republic, in one of the two largest populations of this species in Africa; the white-eared kob which occurs in huge numbers east of the Nile in the southeast, especially in the proposed Boma National Park (Sudan having the bulk of the world population of this subspecies); the Uganda kob, which occurs widely in the south, mainly west of the Nile, in Southern and Nimule National Parks, the Ashana, Numatina and Chelkou Game Reserves, the proposed Lantoto National Park, and the proposed Meshra and Boro Game Reserves; the Nile lechwe, which is almost endemic to the Sudd Swamps, occurring in Zeraf, Fanyikang and Shambe Game Reserves; the lelwel

Conservation areas and provinces of Sudan. ***Conservation areas*** **— 1: Dinder National Park (8900 sq km). 2: Boma National Park* (22 800 sq km). 3: Kidepo Game Reserve (1400 sq km). 4: Southern National Park (23 000 sq km). 5: Nimule National Park (410 sq km). 6: Lantoto National Park* (760 sq km). 7: Ashana Game Reserve (900 sq km). 8: Chelkou Game Reserve (5500 sq km). 9: Boro Game Reserve* (1500 sq km). 10: Numatina Game Reserve (2100 sq km). 11: Juba Game Reserve (200 sq km). 12: Zeraf Game Reserve (9700 sq km). 13: Fanyikang Game Reserve (480 sq km). 14: Meshra Game Reserve* (4500 sq km). 15: Shambe Game Reserve (620 sq km). 16: Badingilo Game Reserve* (8400 sq km; includes two existing game reserves, Mongalla and Badingeru). 17: Bangangai Game Reserve (170 sq km). 18: Bire Kpatuos Game Reserve (5 sq km). 19: Mbarizunga Game Reserve (13 sq km).** ***Other areas*** **— 20: Southern National Park survey area (36 000 sq km). 21: Jonglei Canal. 22: Jonglei Canal survey area (68 000 sq km). 23: Jebel Marra. 24: Red Sea Hills. 25: Khartoum. 26: Juba. 27: Wet season range of Boma white-eared kob. 28: Imatong Mountains. 29: Nile River.** ***Provinces*** **— A. Northern. B: Red Sea. C: Nile. D: Northern Darfur. E: Khartoum. F: Kassala. G: Northern Kordofan. H: El Gezira. I: White Nile. J: Southern Darfur. K: Southern Kordofan. L: Blue Nile. M: Upper Nile. N: Bahr d Ghazal. O: El Buheyrat. P: Jonglei. Q: Western Equatoria. R: Eastern Equatoria.**

***Proposed but not yet gazetted.**

hartebeest which occurs widely in most of the protected areas of the south; the tora hartebeest which is seriously threatened along the Ethiopian border, being already extinct in Dinder National Park; the tiang which is still widespread in huge numbers in the southeast, east of the Nile, especially in the proposed Boma National Park, but it is decreasing through excessive poaching; Wcyn's duiker, which occurs in the far southwest; and the mongalla gazelle, of which most of the world population occurs in the southeast, east of the Nile. The gazelles of the arid and semi-arid zones are all severely depleted in numbers. With the exception of Heuglin's gazelle in Dinder National Park, none of them occur in protected areas. The dorcas gazelle occurs on both sides of the Nile; the dama, red-fronted and slender-horned only on the west, and Heuglin's and Socmmerring's only on the east. For these northern species, strict protection in the arid zone is essential. Both the dorcas and Soemmerring's gazelle would benefit from a reserve in the Red Sea Hills. For most of the remaining antelope species, the highest priority is the rehabilitation of the protected areas in the south, once hostilities cease. Emergency measures are probably needed to save the tora hartebeest along the Ethiopian border.

3. Fruit Bats. Ten species occur, including one of conservation concern: *Rousettus lanosus,* which occurs in scattered

Approximate major ecological zones of Sudan.

populations in montane areas in Sudan, Ethiopia, Kenya, Rwanda, Tanzania, Uganda, and Zaïre, where its status is very poorly known.

4. Other Mammals. The elephant was formerly abundant and widespread in the south of the country, but poaching for ivory is essentially out of control, and the total is probably now well under 30,000 animals, though there is a lack of recent information. The black rhinoceros has been poached almost to extinction, though it might still survive in the Badingeru Game Reserve and in the Aweng district, Bahr-el-Ghazal. The white rhinoceros is probably now extinct, also through poaching. Chimpanzees occur in the far southwest of the country. Three interesting species in the Red Sea Hills are the Nubian ibex (which is seriously threatened by poaching), the Nubian wild ass and the barbary sheep (which occurs elsewhere in suitable habitats in the arid zone). The giant forest hog is restricted to the extreme southwest corner of the country and is believed to be vulnerable. Pousargue's mongoose occurs in the southwest and south of the country, as well as in neighbouring Central African Republic, Zaïre and Uganda. Its conservation requirements are not known. Three species of gerbil are endemic to western Sudan: *Gerbillus muriculus, G. nancillus* and *G. rosalinda.*

5. Birds. Four threatened species occur, though one, the northern bald ibis is an extremely rare palaearctic migrant which appears occasionally on the Red Sea coast, and another, the Red Sea cliff swallow, is known only from one bird that was found dead at the lighthouse on Sanganeb atoll. This bird was almost certainly a migrant, and the breeding grounds of the species remain unknown. The shoebill population in the Sudd (around 5,000 birds) is the largest population of the species in Africa. The spotted ground-thrush is known from the Lotti Forest in the Imatong Mountains, where it is seriously threatened by forest clearance. The Arabian bustard and Denham's bustard occur (the northern stronghold of the latter probably being in Sudan) but are heavily hunted. At least nine species of seabird breed on the Sudanese coast, these being the brown booby, sooty gull, white-eyed gull, white-cheeked tern, greater crested tern, lesser crested tern, Saunder's little tern, bridled tern and brown noddy. There are doubtless more nesting sites to be discovered, but the most important so far are the Suakin Archipelago, and the Mukawar, Taila and Mayetib Islands.

6. Marine Turtles. Around 300 hawksbills are believed to nest annually on the Suakin Archipelago, this being a major population of the species. It might well nest elsewhere within Sudanese territory. The green turtle is known from Sudanese waters, and though it is not known to breed, it might well do so.

7. Other Reptiles. The African spurred tortoises is known

widely from Sudan. Its conservation requirements should be assessed, including the possibility of local reintroductions. The Nile crocodile occurs widely in the south, but is severely depleted through over-exploitation.

8. Amphibians. One endemic species occurs, a frog *Ptychadena schillukorum,* in the Nile Valley.

Threats

1. The management of the protected areas in the south of the country has become very difficult to maintain under conditions of civil war, and severe poaching of large mammals is taking place with some extinctions likely if the situation does not improve. Inevitably, encroachment has also occurred in some areas, particularly Juba and Kidepo.

2. Over-grazing by livestock has become a major problem in many areas, leading to severe environmental degradation.

3. The wetlands in the south are threatened by major water developments, such as the Jonglei Canal.

4. Tea and forestry projects in the Imatong Mountains constitute a threat to the largest *Podocarpus* forest in East Africa: they are currently not progressing owing to the civil war and alternative sites should be sought for these developments when hostilities cease.

5. The northern desert and semi-desert areas and marine ecosystems are not included within the protected area system, and consequently there is little in the way of attempts to safeguard the biological resources of these areas.

6. Disease is potentially an increasing threat. Rinderpest is endemic in the south of the country and all susceptible ungulates are at risk. The risk of screw worm infection spreading from Libya is considerable in view of widespread uncontrolled domestic stock movements. If this parasite became established in Sudan, infection of Eastern Africa would surely follow.

Current Conservation Measures

1. Government Administration of Conservation

(a) Responsibility for environmental matters in Sudan is dispersed among a variety of agencies, ultimately coming under the authority of the Ministry of Agriculture and Natural Resources. The management of forests comes under the Central Forests Administration in the ministry. Marine conservation comes under the Sudanese Marine Conservation Committee.

(b) Considerable responsibilities in the Southern Region are delegated to the Regional Ministry of Wildlife Conservation, Fisheries and Tourism, which manages all the protected areas in the south. In the Northern Region, these responsibilities fall to the Administration of Wildlife Conservation Forces.

2. Multi-agency Projects

(a) Fuelwood development for energy, including a forestry management component for national reserves (FAO/Netherlands Government).

(b) Conservation programme for migratory birds (Government/ICBP): assistance to the Department of Wildlife and National Parks in preparing sites and species inventories, managing reserves, and undertaking public awareness campaigns.

(c) Afforestation programme: combatting desertification through community forestry activities.

3. Netherlands Government Projects

(a) Environmental profile of Kassala Province.

4. ODA Projects

(a) Forestry research/irrigation rehabilitation: applied research and demonstration programme in Kelli irrigation scheme.

Suggested Conservation Activities

1. Management of all protected areas is in need of considerable improvement An important feature of conservation strategies in the country will need to be sustainable use of wildlife resources, particularly in terms of controlled grazing and hunting.

2. Poaching of antelopes, elephants and rhinos is urgently in need of control. Crocodiles also need protection from over-hunting. It is very important that measures are introduced rapidly to stop Sudan continuing to be used as a base for poachers operating in neighbouring countries, and that collaboration with those countries is commenced in order to facilitate control of poaching.

3. The Bangangai Game Reserve should be enlarged to permit viability of populations of important species (notably antelopes - see *Critical Species 2* above).

4. Montane forests in the Imatong Mountains in the extreme south are in need of much stricter protection against incursions by tea and forestry plantations. They are particularly important for plants and birds.

5. Additional reserves in savanna woodland habitats are needed, as is improved management of existing reserves. Key current reserves and priority sites for new ones are listed in *Critical Sites* 3 above.

6. The desert and Sahelian areas of the country urgently need protection: surveys are needed to identify priority sites, with conservation action following quickly. Reserves should be at low altitude and on both sides of the Nile. These measures are particularly important for antelopes, some species

of which will require specific action to ensure survival (see *Critical Species 2* above).

7. Reserves should be established in the Red Sea Hills and in the Jebel Marra and Jebel Gurgei Massifs to protect important plant species and the Nubian ibex (see *Critical Species* 1 and 4 above).

8. Additional conservation areas in the Sudd swamps are needed, by considerably extending the Shambe Game Reserve, creating the Badingilo Game Reserve (which will incorporate the existing Mongalla and Badingeru reserves) and gazetting the Meshra Game Reserve. Integrated development programmes will need to be a particular feature of this region, as the important areas for migratory birds are the swamp edges rather than its centre. *Critical Species* 5 above lists birds of particular importance here.

9. The ecological effects of major irrigation projects such as the Jonglei Canal need to be monitored, and the ecological implications of any major developments, such as further irrigation or oil prospecting, should be carefully considered before work commences. The effects of drainage projects on wetlands are of particular importance.

10. The Dinder National Park and its buffer zone need extensive rehabilitation and the park should be extended to include edaphic grasslands. The management plan prepared by FAO should be implemented.

11. Marine wildlife and ecosystems appear to be in excellent condition and urgently need further study with a view to establishing conservation priorities and developing a protection plan as soon as possible. The following action is needed in the short term, in order of priority:

(i) The proposed Sanganareb Atoll Marine National Park should be established and tourism on this site developed carefully

(ii) The proposed Port Sudan Marine National Park should be established and measures undertaken at the nearby port to control pollution.

(iii) Suakin Archipelago National Park or reserve should be established.

(iv) Mukkawar Marine National Park, incorporating Mukkawar Island, Mesharifa and Maytib Islands, the outer reefs such as Arlington and the coastal area around Mersa Inkafail, should be established.

(v) Further study of the conservation requirements of islands in the Red Sea is needed, particularly in relation to coral reefs, seabirds and marine turtles (see *Critical Species* 5 and 6 above).

12. Mammals other than those already mentioned need specific conservation measures: the Nubian ibex is threatened by poaching (Red Sea Hills) and the conservation requirements of Pousargue's mongoose need to be surveyed.

13. A survey of marine turtle nesting sites is needed with a view to conservation action.

14. A survey of the status and conservation requirements of the African spurred tortoise is needed, and the possibility of re-introductions should be explored.

Chapter 47: Swaziland

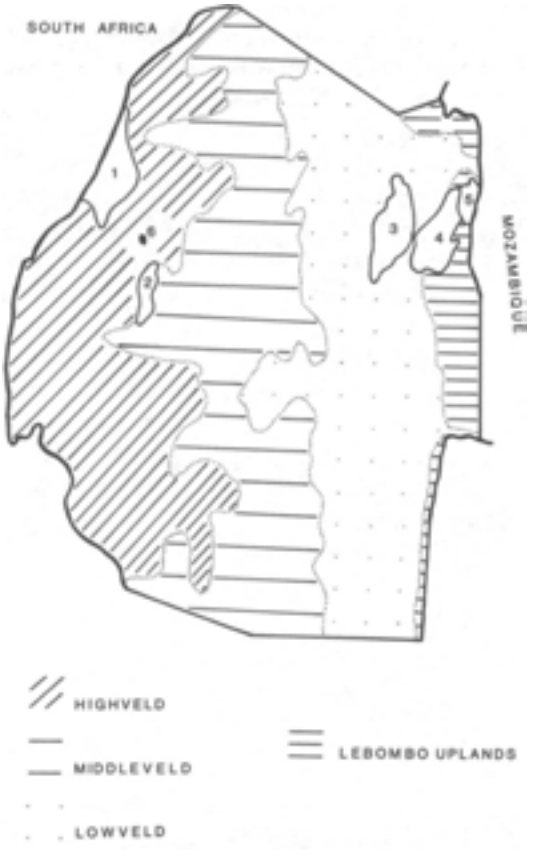
Introduction

Area: 17,366 km^2. Cultivated: 8%. Pasture: 66%. Forest/woodland: 6%.

Population (1989 data): 763,000. Urban: 26%. Labour force in agriculture (1980): 74%. Density: 44/km^2. Annual growth rate: 3.4%, increasing. Doubling time: 21 years.

Economy (1987 data): World Bank index: no data. GNP/capita: US$ 700. GNP annual growth rate: 4.2%.

Biogeographic affinities: Predominantly Tongaland-Pondoland Regional Mosaic, with Kalahari-Highveld Regional Mosaic in the west.



Natural regions and conservation areas of Swaziland. 1: Malolotja Nature Reserve (180 sq km). 2: Mlilwane Wildlife Sanctuary (45 sq km). 3: Hlane Game Reserve (163 sq km). 4: Mlawula Nature Reserve (120 sq km). 5: Ndzindza Nature Reserve (55 sq km). 6: Mbabane.

Vegetation: Predominantly scrub woodland, with montane forest, woodland and grassland in the west.

Critical Sites

1. Swaziland is a small country which has done much in recent years to ensure the conservation of its biological resources. Its nature reserves are generally well managed. The Malalotja Nature Reserve is in hilly highveld country, with scrub forest in the valleys. The Mlilwane Wildlife Sanctuary includes both middle veld and highveld. The Hlane Game Reserve is in the lowveld. The Mlawula Nature Reserve includes both lowveld and part of the Lebombo Mountains, and the contiguous Ndzindza Nature Reserve on the crest of the Lebombo Ridge. Together, these reserves represent a reasonably good coverage of the country's different habitats: other significant areas needing inclusion being the *Androstachys* forest to the north of the Mbuluzi River and the oribi habitat west of Mhlumeni.

2. There is scope for the creation of new protected areas in the following sites of biological importance: in other parts of the Lebombo Mountains to include Cape vulture breeding colonies (such a reserve could form a transfrontier protected area in collaboration with Mozambique); Mahamba Gorge to conserve southern bald ibis breeding grounds; the Makwonjwa Hills (for moist forests); Umkhobolondo Mountain (for Cape vultures), and various sites near Mbabane (for endemic plants).

Critical Species

1. Plants. 2,715 species occur, four of which are endemic. One endemic is the shrub *Eumorphia swaziensis*, known from two populations near Mbabane, both consisting of several hundred individuals. Another is *Knipholia umbrinus*, endemic to just one area north of Mbabane, where it is under threat.

2. Antelopes. Up to 26 species once occurred, though four of these are now extinct: the roan antelope, Lichtenstein's hartebeest, suni and springbok. Nevertheless, 22 surviving species (some of which have had to be reintroduced) is a large number for so small a country. Of particular interest are the black wildebeest and blesbok, both of which died out but have been reintroduced to Malolotja Nature Reserve, and the blesbok

also to Mliwane Wildlife Sanctuary. Both species are recovering well. The grey rhebok occurs in the highveld, but in very small numbers and is seriously threatened.

3. Other Mammals. The elephant is long extinct in Swaziland, as is the black rhino; however, both have been recently re-introduced to a private game reserve. The white rhinoceros has been reintroduced after having died out. It now occurs in Malalotja Nature Reserve, Mliwane Wildlife Sanctuary and Hlane Game Reserve. The total population is 60-100 animals, but they are now under threat from poaching.

4. Birds. Three threatened species occur. The southern bald ibis nests in colonies in the west of the country, including in Malolotja Nature Reserve and the proposed new reserve at Mahamba Gorge. About 50 pairs of the Cape vulture are thought to survive, on Umkhobolondo Mountain and the Lebombo Mountains. The status and conservation needs of both these species are not fully known, but important populations need to be identified and strict protection provided. There is a small breeding population (perhaps the only one in Swaziland) of the near-threatened blue swallow in the Malolotja Nature Reserve.

5. Reptiles. The Nile crocodile occurs in small numbers on the Usutu, Umbeluzi, Nkomati and Ngwavuma Rivers. It is poorly protected and is declining. The Natal hinge-back tortoise occurs in Swaziland but its status and conservation requirements are not known in detail. Two globally threatened snake species occur: the Swazi rock snake *Lamprophis swazicus* (in the west of the country and in neighbouring South Africa); and the striped harlequin snake *Homosorelaps dorsalis* (also in the west and neighbouring South Africa).

Threats

1. Although Swaziland's conservation effort is generally effective, the protected area system does not include certain critical sites, especially for forests and rare plants, which are at risk.

2. Habitat degradation by overgrazing and pollution (from wood-pulping and mining) are serious threats.

3. A general problem is that the country's reserves tend to be too small to hold viable populations of certain species.

4. The white rhinoceros has been threatened as a result of recent poaching incidents.

5. Dogs, often hunting independently of their owners, kill and disturb wildlife in many areas.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Swaziland National Trust Commission is responsible for nature conservation, including the management of protected areas. The management of forests comes under the Forestry Service in the Ministry of Agriculture and Cooperatives.

2. EWT Projects

(a) Provision of radio equipment for anti-poaching work.

3. FINNIDA Projects

(a) Environmental training course for African communicators: course available to nationals of English-speaking SADCC countries.

4. GTZ Projects

(a) Nationwide forest inventory with a view to drafting and national forest conservation and management programme.

Suggested Conservation Activities

1. The Mlawula Nature Reserve should be enlarged to include the *Androstachys* forest to the north of the Mbuluzi River and the oribi habitat west of Mhlumeni.

2. New protected areas are needed for breeding colonies of the Cape vulture, one in the Lebombo Mountains (possibly forming a transfrontier reserve jointly managed with Mozambique) and another on Umkhobolondo Mountain. A survey of the species is needed to identify key populations.

3. A new protected area is needed in the Mahamba Gorge to conserve southern bald ibis breeding grounds. A survey is needed to identify its most important populations.

4. Protection is needed for moist forests in the Makwonja Hills.

5. Protected areas for endemic plants, particularly *Knipholia umbrinus*, are needed for various sites near Mbabane.

6. Specific conservation measures are needed for the grey rhebok.

7. Anti-poaching measures need to be intensified to protect the white rhino.

8. Specific protective measures are necessary for the Nile crocodile.

9. A survey should be carried out to assess the status and conservation requirements of the Natal hinge-back tortoise.

Chapter 48: Tanzania

Introduction

Area: 939,762 km^2. Cultivated: 5%. Pasture: 37%. Forest/woodland: 45%.

Population (1989 data): 26,343,000. Urban: 19%. Labour force in agriculture (1980): 86%. Density: 28/km^2. Annual growth rate: 3.6%, increasing. Doubling time: 19 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 220. GNP annual growth rate: 1.4%.

Biogeographic affinities: Predominantly Zambezian, with a broad band of Zanzibar-Inhambane Regional Mosaic along the coast, Somali-Masai in the north and northeast, extending in a band into the centre of the country, Afromontane in the mountains, the Lake Victoria Regional Mosaic in the northwest, and a small element of Guinea-Congolian in the extreme northwest along the Ugandan border.

Conservation areas of Tanzania and regions censused by Ecosystems Ltd. *National parks* — 1: Serengeti (14 760 sq km). 2: Ruaha (10 200 sq km). 3: Mikumi (3230 sq km). 4: Tarangire (2600 sq km). 5: Katavi (2250 sq km). 6: Kilimanjaro (756 sq km). 7: Lake Manyara (325 sq km). 8: Rubondo Island (240 sq km). 9: Arusha (137 sq km). 10: Gombe Stream (52 sq km). 11: Uzungwa Mountains (proposed; approx. 1200 sq km). 26: Mahari Mountains (1200 sq km). 12: Ngorongoro Conservation Area (8280 sq km). *Major game reserves* — 13: Selous (51 200 sq km). 14: Rungwa-Kizigo (15 400 sq km). 15: Ugalla (4860 sq km). 16: Mkomazi and Umba (3580 sq km). 17: Maswa (2180 sq km). 18: Kilimanjaro (890 sq km). 19: Uwanda (1100 sq km). 20: Biharamulo-Burigi (1170 sq km). 21: Rumanyika Orugundu (800 sq km). 22: Ibanda Arena (200 sq km). 24: Moyowosi (6000 sq km). *Regions censused* — 23: Arusha (82 000 sq km). 25: Tabora (90 000 sq km).

Vegetation: Predominantly miombo woodland, with *Acacia/Commiphora* thicket and grasslands in the drier parts of the north and northeast; montane forest, grassland and Afroalpinc vegetation at higher elevations; patches of lowland forest in the coastal belt and in a few other locations; very extensive wetlands and floodplains (especially in the west); and mangroves along the coast (especially in the Rufiji Delta).

Critical Sites

1. Tanzania is one of the richest and most diverse countries in Africa in terms of both species and habitats. The various types of grassland and open woodland in the north constitute the most famous conservation areas in the country. The best known, and probably most important, is the Serengeti National Park, with the contiguous Ngorongoro Conservation Area, Maswa Game Reserve, and Ikongoro and Loliondo Game Controlled Areas. Together, these areas include what is probably the greatest concentration of large mammals anywhere in the world. Conservation problems in the area include heavy poaching for meat in the west of the Serengeti (including Ikongoro), and reconciling the interests of pastoralists and wildlife conservation in the Ngorongoro Conservation Area. Attempts at reconciling these conflicts are currently the focus of two conservation projects. Another important but less well known and protected wildlife area in the north is the Masai Steppe. The largest concentrations of wildlife are in the northwest of this area, especially in the Tarangire National Park (which is the dry season refuge for much of the game), and the Lolkisale, Simanjiro and Mkungunero Game Controlled Areas. This whole area is in urgent need of measures to reconcile conflicting land-use demands; if this is not done, these important wildlife populations are unlikely to survive in the long-term. In the northeast, the Mkomazi and Umba Game Reserves constitute important southward extensions of Tsavo National Park in Kenya and have now been designated National Projects and pastoralists have been removed. The management improvements of these two areas need to be continued to reduce poaching and to regulate livestock grazing in Umba There are a number of smaller, isolated reserves in the north which contain some grassland and open woodland, in particular Lake Manyara

***Hagenia abyssinica* tree, Empakaai Crater, Ngorongoro Conservation Area (Photo: WWF/George W. Frame).**

National Park, Arusha National Park, and Sadani Game Reserve. The first two of these, together with Serengeti, Ngorongoro and Tarangire, are essential components of the tourism industry in Tanzania.

2. Further to the south and west, the country is dominated largely by woodland, in particular miombo woodland in the wetter areas. The largest and most important protected area is the huge Selous Game Reserve and contiguous Mikumi National Park. This area has suffered badly from elephant and rhino poaching throughout, and from general wildlife poaching in the northeast. Efforts are now being made to bring the situation under control, but these need to be intensified. The wildlife population of the area is still very large, including in many areas outside the reserve to the east, west and south. Another large complex of protected areas includes the Ruaha National Park, and the Rungwa and Kizigo Game Reserves, together with associated Game Controlled Areas. This is another area where poaching is out of control, particularly of elephants. There are some major reserves in the west and northwest with important areas of woodland. These are Katavi National Park, and the Ugalla, Moyowosi, Biharamulo and Burigi Game Reserves. Smaller areas of open woodland habitat are conserved in Gombe and Mahale Mountain National Parks, and Ibanda and Rumanyika-Orugundu Game Reserves. All these areas need improved protection and management. The possibility of establishing a transfrontier reserve in the extreme south in collaboration with Mozambique should also be considered.

3. The unique Itigi Thicket area in the centre of the country is being cleared and requires rapid protection.

4. Tanzania has extensive but poorly known wetland areas. A large part of the huge Malagarasi Swamps are conserved in the Moyowosi Game Reserve. This is one of the most extensive wetlands in Africa. There are important wetlands in the northwest, especially in Burigi Game Reserve, and the Kagera Swamp (bordering the Akagera National Park in Rwanda). The Ugalla Game Reserve includes extensive wetlands around the Ugalla River. The Wembere Swamps included huge nesting colonies of waterbirds. And the wetlands of the Kilombero Valley include some of the largest wildlife populations outside protected areas in the country. Other important wetlands include the Bahi Swamps and the Usangu and Buhoro Flats. For wetland areas outside reserves (e.g. Kagera, Wembere, Kilombero, Usangu, Buhoro, Bahi and part of Malagarasi), conservation will need to focus on sustainable-use approaches to reconcile human and wildlife needs.

5. As well as permanent swamps, Tanzania also has seasonally inundated flood plains, most notably in the Uwanda Game Reserve and elsewhere around Lake Rukwa. Increasing lake levels in recent years have resulted in a decline in the pasture available for grazing animals, and hence some serious populations crashes amongst certain species. Other important floodplains include the Kilombero Valley, the Wembere Steppe (around the swamps), the Usangu and Buhoro Rats, and parts of Katavi National Park (planned for extension to include the northern part of Lake Rukwa) and Ugalla Game Reserve. Again, conservation of some of these areas will need to integrate human and wildlife needs.

6. Tanzania is renowned for its rich variety of lakes. Large parts of all three of the great lakes, Victoria, Tanganyika and Nyasa, occur in Tanzania. These are all important for their large number of endemic fish and invertebrate species (the details of many of which are poorly known) and protection needs to be improved, the most ready means being the extension of national park boundaries to include bands of water stretching at least 1 km out into the lakes; this possibility is now under active consideration by the National Parks authority. Improved conservation is needed for Lake Natron, the flamingo breeding ground of East Africa, for Lake Manyara (which is within the National Park) and the other soda lakes (all of which are important for birds): Lake Eyasi, Lake Balangida and Lake Balangida Lelu. Other smaller, but nevertheless important, lakes include: Lakes Chale and Jipe on the Kenyan border (especially the latter for nesting waterbirds); Lakes Burigi and Kimba in the northwest; Lake Kitangiri at the mouth of the Wembere Swamps; Lake Masimbi in Moyowosi Game Reserve; the Momclla Lakes in Arusha National Park; and Lake Rukwa (partly in the Uwanda Game Reserve).

7. Tanzania possesses a great variety of different forests. Although these are generally in relatively small patches, they are nevertheless of great importance for the conservation of biological diversity. Lowland forest is the most restricted. In the extreme northwest of the country at Minziro, there is an outlier of the central African lowland rainforests. This is probably the richest area biologically in Tanzania, and should be given maximum protection. Other lowland forests occur in the west along Lake Tanganyika, particularly in Gombe and Mahale Mountain National Parks. There are also small forest patches in river valleys in the area between the

Major ecological zones and important localities of Tanzania. 1: Lake Victoria. 2: Ngorongoro Crater. 3: Mount Kilimanjaro. 4: Mount Meru. 5: Zanzibar Island. 6: Pemba Island. 7: Lake Tanganyika. 8: Dar es Salaam. 9: Usambara Mountains. 10: Uluguru Mountains. 11: Uzungwa Mountains. 12: Southern Highlands. 13: Mahari Mountains. 14: Ufipa Mountains. 15: Lake Rukwa. 16: Mafia Island.

Mahale Mountain and Katavi National Parks, though these areas are being cleared rapidly. There were once extensive forests on the southern shores of Lake Victoria, though these have now been completely cleared, except in the important Rubondo National Park on Rubondo Island. The remaining lowland forests in Tanzania are concentrated in the east. The true extent of the coastal forests is still poorly known. There are important sites near Dar es Salaam at Pande, in the Pugu Hills, and Kiono Forest, and further to the south in the Kichi Hills, the Matumbi Hills (Kiwengoma Forest) and Rondo Plateau: all are inadequately protected. Surveys will almost certainly locate additional sites in remote areas that are in need of protection. Lowland forests are also found at several places at the foot of the eastern mountain ranges, often in completely unprotected tiny patches. Several such sites exist in the Usambara and Nguru foothills, at Kimboza and several limestone outcrops in the Uluguru foothills, and perhaps most extensively in the Uzungwa foothills from Mwanihana south to Chita. There are some important outlying patches of lowland forest near the Uzungwas, in particular in Magombera Forest, now included in the extreme northwest of the Selous Game Reserve. On Zanzibar, the most important area is the Jozani Forest, which requires increased protection, along with Mapopwe Forest. Important forest also occurs on Zanzibar at Muungwi Forest, Muyuni Coastal Strip, and Uzi Island. On Pemba the Ngezi Forest is in need of strict protection.

8. Most of the forests in Tanzania are in the mountains. Those of greatest importance in terms of species diversity and cndcmism are in the so-called "Eastern Arc" mountains from the Pares, south to the Southern Highlands. The highest priority areas are the Usambaras, Ulugurus and Uzungwas. In the Usambaras, where there are numerous isolated forest patches and a very high human population density, current efforts to reconcile human and conservation needs should be intensified. This will include extending the current programme in the East Usambaras to the West. In the Ulugurus, protected areas should be created, and further encroachment, especially on the lower eastern slopes, should be prevented. In the Uzungwas, there is a national park recommended for the eastern side and another protected area further south, from Dabaga to Chita should be considered. It is important that protection in the Uzungwas includes the lowland forests in the eastern foothills and areas of montane grassland. Protection is also insufficient for forests on the Pare, Kama, Nguru, Ukaguru and Rubeho Mountains, and for forests in the Uzungwas away from the proposed national parks. In the Southern Highlands, forest conservation measures are needed for Mount Rungwe, and the Poroto, Kipengere, Njombe and Livingstone Mountains, including areas of montane grassland. Interesting outliers of the main "Eastern Arc" system are to be found in the Mahenge and Matengo Highlands. Conservation needs in these areas should be assessed. In western Tanzania, the most important patches of montane forest are to be found in the Mahale Mountain National Park. Other interesting forest patches are in need of conservation on the Ufipa Plateau, in particular the Mbisi Forest and a few other sites. The remaining montane forests in Tanzania are on volcanic soil, and although they are of less importance for rare and endemic species, they perform essential roles as water catchments. Those sites already well protected are the Mount Kilimanjaro National Park (though encroachment in the surrounding forest reserve remains a problem), Mount Meru (in the Arusha National Park and Mount Meru Game Reserve), other forest sites in Arusha National Park (in particular the Ngurdoto Crater), and the Ngorongoro Conservation Area (in particular the southern and eastern parts of the Ngorongoro Crater Highlands and the Empakaai Crater). Other forests on volcanic soils in need of improved conservation are Loliondo, Losiminguri, Gelai, Longido, Burko, Kitumbeine, Monduli, Mbulu, Hanang, and other forests in the Babati and Kondoa areas.

9. The montane grasslands of southern Tanzania represent a poorly protected and rapidly declining habitat, that are well protected in Africa only in Nyika National Park in Malawi. This habitat occurs in the Southern Highlands, Uzungwa Mountains and Ufipa Plateau, and lacks the protection necessary to ensure its survival. Of particular importance is the Kitulu Plateau in the Southern Highlands, with its remarkable flora.

10. The conservation requirements of Tanzania's marine living resources are not fully explored. The seabird island colony of Fungu Kisimkase (Latham Island) is unprotected. There are many coastal coral reefs, whose lagoons are vital to the productivity of offshore ecosystems, and the priorities for marine national parks still need to be assessed. It is known that important reefs exist around Mafia Island, as do sand cays on which turtles nest, and a marine national park for that area is in an advanced stage of planning. Also in the planning process is a marine national park at Zanzibar Town and several other areas in Pemba and Zanzibar are under study for national park development. Coral reefs also occur around many other islands and dynamiting of these reefs has been widespread and very damaging. Maziwi Island used to be the country's most important turtle nesting site but has recently submerged, and further surveys are needed to identify turtle populations. Seagrass beds and dugong populations also lack protection. The conservation needs of other mangrove areas are not fully known. The best protected marine area so far is the coastline of Sadani Game Reserve.

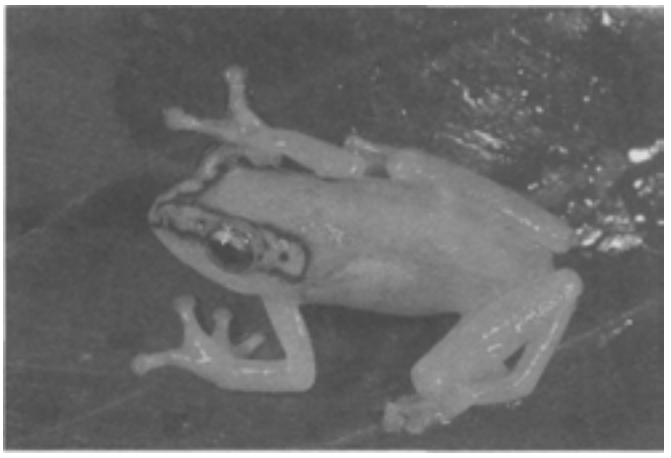
Critical Species

1. Plants. 11,000 species occur. The very large number of species is a reflection of the great variety of different habitats and biogeographic regions in the country (e.g. East African coastal, Somali-Masai in the centre and northeast, Afromontane in the mountains, Zambesian in the centre, south and west, Guinea-Congolian in the extreme northwest, and the Lake Victoria Regional Mosaic). Examples of threatened species include: a succulent herb *Garalluma distincta*, known from the Umba area and two localities in Kenya (it could be seriously threatened by overgrazing in Tanzania); an attractive flowering tree *Gigasiphon macrosiphon*, known from Amani in the East Usambaras, and the Rondo Plateau, as well as two sites in Kenya; and 19 African violet *Saintpaulia* species (out of 22 known in the world), with three species on the coastal plain near Tanga, one on Mount Tongwe southwest of Tanga, seven in the East Usambaras, four in the West Usambaras, two in the Ngurus, one in the Ukagurus, three in the Ulugurus, and one in the Uzungwas. The African violets have become extremely rare because of over-collecting for horticulture. The vulnerable mpapindi palm *Chrysalidocarpus pembanus* is endemic to Pemba and Zanzibar.

2. Primates. 19-20 species occur, including six of conservation concern. The Zanzibar galago occurs in the coastal forests and the montane forests of the "Eastern Arc" mountains. The Sanje mangabey is an isolated subspecies of the crested mangabey, and is only known from Mwanihana Forest, which is part of the proposed Uzungwa National Park. The eastern red colobus occurs in a few forest sites in the west, notably in Biharamulo Game Reserve, Gombe and Mahale Mountain National Parks, and Mbisi Forest on the Ufipa Plateau. The Uhehe red colobus is endemic to Tanzania, restricted to the forests on the southern and eastern escarpments of the Uzungwa Mountains, and to the nearby Magombera Forest Reserve. The Zanzibar red colobus occurs widely on Zanzibar, with concentrations in the Jozani and Muungwi Forests, the Muyuni coastal strip, and Uzi Island. The chimpanzee is restricted to the west, with protected populations in the Gombe, Mahale Mountain and Katavi National Parks, and several populations in isolated forest patches between Mahale Mountain and Katavi. Survival of all these species depends on conservation of their habitats, and in some cases on restrictions on hunting.

3. Antelopes. 34 species occur, of which 29 are in a satisfactory situation as regards conservation. An additional species, the kob, is extinct. Two globally threatened species occur: Ader's duiker, restricted to eastern Zanzibar, which depends on the establishment of the proposed Jozani National Park for its survival; and Abbott's duiker, which occurs in the forests of Kilimanjaro, and the "Eastern Arc" mountain chain from the Usambaras to the Southern Highlands. Tanzania possesses many major populations of more abun-

Wild dogs *Lycaon pictus*, Lake Manyata (Photo: WWF/ Mark Boulton).



An endemic tree-frog *Hyperolius puncticulalus* from the rainforest of the East Usamabara Mountains (Photo: WWF/F. P. Jensen).

dant species, for example populations of international importance of: eland (Serengeti, Selous/Mikumi,Ruaha/Rungwa/ Kizigo, Tarangire/Masai Steppe); Sitatunga (Moyowosi, Burigi, Rubondo); waterbuck(Rukwa, Selous/ Mikumi, Moyowosi, Serengeti); puku (KilomberoValley, Rukwa); roan antelope (Ruaha/Rungwa/Kizigo, Katavi/Rukwa); sable antelope (Selous/Mikumi, Ruaha/Rungwa/Kizigo, Katavi/Rukwa); wildebeest (Serengeti/ Maswa /Ngorongoro (1-1.5 million), Tarangire/ Masai Steppe (24,000+), Selous/ Mikumi (82,000)); Coke's hartebeest (Tarangire, Serengeti, Masai Steppe); Lichtenstein's hartebeest (Ruaha/Rungwa/Kizigo, Moyowosi, Selous/Mikumi, Rukwa); topi (Serengeti, Moyowosi, Rukwa); impala (Serengeti/Maswa/Ngorongoro, Selous/Mikumi, Ruaha/Rugwa/Kizigo, Tarangire/Masai Steppe); Grant's gazelle (Tarangire/Masai Steppe, Serengeti/Maswa/Ngorongoro); and Thomson's gazelle (Tarangire/Masai Steppe, Serengeti/Maswa/Ngorongoro). These enormous antelope populations are a rich natural heritage that can only be maintained through positive conservation action.

4. Elephants and Rhinos. Both species have been severely reduced by poaching. Elephant numbers, although still among the largest on the continent, have been reduced to around 60-70,000 animals, about 30,000 of which are in the Selous/Mikumi area and its surrounds. The other large population is in the Ruaha/Rungwa/Kizigo area. These two populations, and those of the Lake Manyara and Kilimanjaro National Parks are considered to be priority baseline populations for the species. Tanzania is in danger of losing the elephant as a species of significant commercial value, unless the poaching situation can be rectified rapidly. The black rhinoceros has been reduced to less than 300 animals, mainly in Selous and Mikumi. The priority for this species is to establish three well guarded sanctuaries, at Lake Manyara, Ngorongoro Crater, and Rubondo Island.

5. Rodents. Nine species of conservation concern occur: Swynnerton's squirrel *Paraxerus vexlllarius* is endemic to the forests of the West Usambaras; a species of groove-toothed rat *Otomys denti* occurs on mountains in northeastern Tanzania (in addition to Zaïre, Uganda, Rwanda and Malawi); the lesser hamster-rat *Beamys hindei* occurs in coastal forests in the northeast (and also in Kenya); the greater hamster-rat *B. major* occurs in the forests of the Southern Highlands (as well as in Malawi and Zambia); a species of African climbing wood mouse *Hylomyscus denniae* occurs in the highlands (and several surrounding countries); a pygmy species of multimammate mouse *Mastomys pernanus* occurs around Lake Victoria (and also in Kenya and Rwanda); a species of woodland mouse *Grammomys comestes* occurs in the southern coastal forests (as well as in Mozambique and South Africa); the mill rat *Mylomus dybowskii*, which occurs in very small numbers in many countries, reaches its southeastern limits in western Tanzania; and a species of mole rat *Heliophobius spalax* is endemic to Mount Kilimanjaro (just venturing into Kenya).

6. Elephant-Shrews. The black-and-rufous elephant-shrew occurs in the coastal forests and the forests of the "Eastern Arc" mountains. The subspecies *adersi* is endemic to Zanzibar, where it occurs in Muungwi Forest, the Muyuni Coastal Strip, and Uzi Island, but is probably absent from the Jozani Forest, owing to seasonal flooding of the area. The chequered elephant-shrew occurs in the forests of southern and western Tanzania but its status is not known. There is also a slight chance that a rare subspecies of the four-toed elephant-shrew *Petrodromus tetradactylus sangi* occurs on Mount Meru.

7. Fruit Bats. 14 species occur, including four of conservation concern: *Rousettus lanosus*, which occurs in scattered populations in montane areas in Tanzania, Ethiopia, Kenya, Rwanda, Sudan, Uganda, and Zaïre, and its status is very poorly known; *Myonycteris relicta* (known only from lowland forest in the Usambara and Nguru Mountains, as well as one locality in Kenya); the Pemba flying fox *Pteropus voeltzlcowi* (endemic to Pemba, where it has suffered drastic declines in recent years and may be seriously threatened); and *Pteropus seychellensis comorensis* (occurs on Mafia Island, and otherwise only on the Comoros).

8. Other Mammals. Huge populations of Burchell's zebra occur in Tanzania, especially in the Serengeti/Ngorongoro area, and of the buffalo (especially in the Serengeti, but also in Selous/Mikumi, Ruaha/Rungwa/Kizigo, and Rukwa). The Serengeti also harbours the largest giraffe population in Africa, estimated at between 8,000 and 17,000. Other major giraffe populations occur in Tarangire/Masai Steppe and Ruaha/Rungwa/Kizigo. Large hippo populations occur in the Serengeti (>1,000), Rukwa and Selous/Mikumi. Tanzania

has populations of international importance of the wild dog (especially Serengeti/Maswa/Ngorongoro, and Selous/Mikumi), and cheetah (Serengeti/Maswa/Ngorongoro, and the Masai Steppe). The Usambara tree hyrax *Dendrohyrax validus* is known only form the Usambaras and other Eastern Arc mountains where its survival depends on the survival of its forest habitat. It is hunted for food and fur, but the impact of this is not currently known. The presence of the Sokoke bushy-tailed mongoose in the coastal forests is uncertain, and the status of a possibly distinctive subspecies of the servaline genet in the Uzungwas is unknown. There are also some endemic shrews: *Sylvisorex howelli* (Ulugurus); *Crocidura tansaniana* (East Usambaras); *C. telfordi* (Ulugurus); and *C. usambarae* (Usambaras). Dugongs occur along the coast in very small numbers, but the whereabouts of the most important populations and their conservation needs are not known, though there are recent reports from the Rufiji Delta and Mafia Island. Likewise, the extent of dolphin and porpoise catches in coastal fisheries is not known, nor whether a conservation problem exists.

9. Birds. 22 threatened species occur, of which 16 occur in the coastal or "Eastern Arc" forests: Usambara eagle owl (Usambaras); Sokoke pipit (Pugu); Uluguru bush-shrike (Ulugurus); Swynnerton's forest-robin (Uzungwas); east coast akalat (Pugu, Rondo Plateau, probably elsewhere); dappled mountain-robin (East Usambaras, Uzungwas); Usambara ground-robin (West Usambaras); Iringa ground-robin (Ukagurus, Uzungwas, Southern Highlands); spotted ground-thrush (breeds Rondo Plateau, migrates through other coastal sites, such as Pugu, to wintering grounds on the Kenya coast); white-winged apalis (Ulugurus, Uzungwas); long-billed apalis (East Usambaras); Mrs Moreau's warbler (Ulugurus, Ukagurus, Uzungwas); Amani sunbird (East Usambaras); banded green sunbird (Usambaras, Ngurus, Ulugurus, Uzungwas); rufous-winged sunbird (Mwanihana Forest in the Uzungwas only); and Tanzanian mountain weaver (Usambaras, Ulugurus, Uzungwas). Abbott's starling is a rare forest species, occurring on Mount Kilimanjaro and Mount Meru. The shoebill probably nests widely in the swamps of the west and northwest, especially the Kagera Swamps. The wattled crane is known from the Ufipa Plateau, Rukwa Valley, Southern Highlands, Iringa Highlands (Uzungwas), and the Usangu Flats. There is now evidence that it also occurs further to the north in the Ugalla Game Reserve and the Malagarasi Swamps. If this is the case, it could represent one of the largest populations of this species anywhere within its range. This should be investigated further. The Kungwe apalis occurs on Mahale Mountain, and in forest patches further to the east towards Mpanda. The Karamoja apalis occurs on the Wembere Steppe and its surrounds. Its habitat could be threatened by overgrazing by livestock. The roseate tern has been known to breed near Dar es Salaam and on Mafia Island but its status is uncertain. An additional four species of seabird, the masked booby, greater crested tern, sooty tern and brown noddy, breed regularly on Fungu Kisimkase (Latham Island). There are also some important breeding sites for wetland birds, notably the Wembere Swamps and Lake Jipe, though others probably remain to be discovered. Lake Natron is the only regular breeding site for lesser flamingoes in East Africa, where they often occur in vast numbers. A number of species are restricted to montane grassland, such as the blue swallow and Njombe cisticola. These have not been considered threatened in that past, but the continuing destruction of this unusual habitat might require a reassessment of the status of all the species dependent upon these grasslands. The impact of the international livebird trade on bird populations in Tanzania is not known but, at present, Tanzania exports more birds than any other country in Africa except Senegal (yet the country receives almost no funds from this trade for conservation activities). Bird species endemic to Pemba may be threatened but the situation is unknown at present. The eastern European population of the white stork has a major wintering ground on the Serengeti plains.

10. Marine Turtles. Green turtles used to nest annually in reasonable numbers (over 300) on Maziwi Island, but since its submersion they are only known from cays around Mafia Island, and on Ras Dege on the mainland. The hawksbill probably nests quite widely in very small numbers: an estimated 30-50 in the country as a whole. Several olive ridleys probably nest in the vicinity of large river mouths in the south. Leatherbacks are poorly known, though there is an old nesting record from Zanzibar. Loggerheads have been recorded but do not nest, the animals being from the population that nests in South Africa.

11. Crocodiles. The Nile crocodile is widespread but severely depleted except in protected areas such as Serengeti, Ruaha and Selous. The conservation requirements of the slender-snouted crocodile are not known, but it is now very rare, occurring in a few localities along Lake Tanganyika.

12. Tortoises. The pancake tortoise occurs in rocky areas in savanna in northern and eastern Tanzania. Its conservation requirements are not fully known but it is subject to live export trade which is probably excessive, and quotas have not been set on the basis of an assessment of its conservation status. There is also live export trade of Bell's hinged tortoise and of leopard tortoise that needs to be monitored.

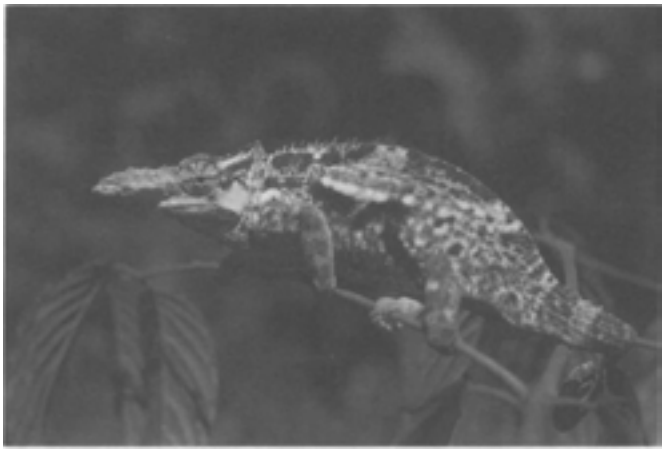
13. Other Reptiles. Many forest species of chameleons and numerous snake species are vulnerable to destruction of forests on isolated mountains.

14. Amphibians. There are 55 species of conservation concern of which 40 are endemic species (11 being known from

single localities only), 12 are species occurring in one country, and three are shared with more than one country. Of these 55, 34 are restricted to the "Eastern Arc" mountains, with 22 in the Usambaras, 21 in the Ulugurus, 11 in the Uzungwas, and 7 in the Southern Highlands.

15. Fishes. There are very large number of endemic fish, especially cichlids, in Lakes Victoria, Tanganyika and Nyasa. A major aspect in the conservation of these species is the prevention of any further fish introductions, such as that of the Nile perch into Lake Victoria. This can have a disastrous effect on highly specialised endemic species. There is a large export trade of freshwater fish that has very high mortality and is not well regulated.

16. Invertebrates. The dragonfly *Amanipodagrion gilliesi* is only known from swamps near Amani in the East Usambara Mountains and another dragonfly, *Aeshna meruensis,* is known only from Mount Meru. The Kilimanjaro swallowtail butterfly is endemic, occurring on Mount Kilimanjaro, Mount Meru, the Ngorongoro Crater Highlands, and the Mbulu Highlands. There are very large numbers of rare and endemic invertebrates in the "Eastern Arc" mountains. For instance, in the Usambaras, there are now known to be many endemic and near-endemic grasshoppers, earwigs, beetles, butterflies, predatory wasps, millipedes and molluscs.



An endemic chameleon *Chameleo fischeri* from the rainforest of the Usambara Mountains, Tanzania (Photo: WWF/F. P. Jensen).

Threats

1. The management of Tanzania's protected areas has not been sufficient to prevent large-scale poaching of mammals, and also encroachment in certain areas.

2. Similarly, the management of wildlife in multi-use zones outside protected areas has not generally been successful, and means of integrating human and conservation interests have not yet been found.

3. The country's system of reserves does not include a large number of important sites and habitats, many of which are under serious threat, notably montane and lowland forests, montane grassland, the Itigi Thicket, much of the area around Lake Rukwa, Fungu Kisimkase (Latham Island), and the whole coastal and marine zone (including mangroves and coral reefs), where reserves have been designated but not implemented.

4. In particular, coral reefs are being rapidly ruined by dynamiting and industrial fishing methods, and forest clearance is very severe in certain areas, especially the Usambaras, and in parts of the coastal zone.

5. The live animal trade is one of the largest in Africa, especially in birds and tortoises, and yet no attempts have been made to determine the effects of such trade on wild populations.

6. Fish introductions can have a major deleterious effect on native fish populations, as has happened in Lake Victoria. Such fish populations are also threatened by over-fishing and pollution.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Ministry of Natural Resources and Tourism. This ministry has a number of sectoral divisions covering fisheries, forestry (which has responsibility for national forest reserves, with authority for local authority forest reserves falling to regional and district governments), tourism, and wildlife. The Wildlife Division is responsible for wildlife outside protected areas, for trade in wildlife, and for six game reserves (Biharamulo, Maswa, Mkomazi, Moyowosi, Rungwa, Selous) that are run as National Projects. The remaining game reserves are managed under regional directorates guided by the Wildlife Division.

(b) National Parks are administered through the semi-autonomous Tanzania National Parks, which reports to the Minister of Natural Resources and Tourism through a board of directors. The Ngorongoro Conservation Area is managed as a multiple use area under a separate parastatal organisation (the Ngrongoro Conservation Area Authority).

(c) Other parastatal organisations in the environmental sector include the Tanzania Wildlife Corporation which runs some of the safari-hunting concessions, and operates some cropping schemes, and the Tanzania Tourist Corporation. Research in protected areas falls under the Serengeti Wildlife Research Institute, which has active field stations in Serengeti, Mikumi, Selous, Gombe Stream, and Mahale Mountains. Other environmental research is coordinated through the Tanzania National Scientific Research Council.

(d) The Government has established a National Environ-

ment Management Council to bring about coordination in environmental policy between the various agencies, and to take the lead in the development of a National Conservation Strategy.

2. Multi-Agency Projects

(a) Implementation of regional conservation strategy for the Serengeti (IUCN/FZS/NORAD/EEC/AWF).

(b) Regional Education Programme (FZS/EEC).

(c) Establishment of Mafia Island Marine Park (TANAPA/FZS/University of Dar es Salaam/Tanzania Petroleum Company/Government Fisheries Division/PTES): resource assessment and boundary fixing for this proposed park.

(d) Marine National Park, Zanzibar Town (Zanzibar Institute of Marine Science/FZS): final planning of this park.

(e) Marine National Park development (Zanzibar Institute of Marine Science/EEC/IUCN): study of several areas in Pemba and Zanzibar with a view to national park development.

(f) Tarangire National Park development: general management assistance plus land-use planning for the Park and surrounding area (AWF/FZS).

(g) Support for College of African Wildlife Management (Governmenl/AWF/DANIDA/WWF/IUCN/NORAD): provision of scholarships, equipment and short-term instructors.

(h) Serengeti monitoring programme (FZS/WWF).

(i) Provision of assistance to Department of Wildlife to upgrade its capability through training programmes and development of wildlife policies that encourage outside investment, thereby contributing to Tanzania's Economic Recovery Plan (AWF/WWF).

(j) Conservation and sustainable development in the East Usambara Mountains (IUCN/EEC/NORAD/FINNIDA): preservation of nature and catchment forests, multiple use of other forests, agricultural improvements.

(k) Conservation and sustainable development in the Ngorongoro Conservation Area (IUCN/NORAD).

(1) Development and implementation of Tropical Forestry Action Plan (TFAP) programme (Government/FINNIDA/FAO).

(m) Wildlife utilisation study, with a view to developing and implementing a new policy (Government/IUCN/ITC/UNDP).

(n) Coastal zone management in Tanga Region (Government/IUCN/NORAD).

(o) Establishment of the Uzungwa Mountains National Park (Government/IUCN/WWF/NORAD): provision of material, management plan and tourist facilities, plus rural development and sustainable use of wildlife resources in the buffer zone.

(p) Development of Tanzania National Parks master plan (Government/IUCN/SIDA).

(q) Preparatory work for a National Conservation Strategy (Government/IUCN/SIDA).

3. AWF Projects

(a) Provision of a mechanic and a mobile workshop for Selous Game Reserve, and providing training in mechanics.

(b) Preparation of guide books for Tanzania National Parks.

(c) Assisting Tanzania National Parks to develop a Community Conservation Service, with a pilot project in Loliondo where there is a trained extension warden and the development of mechanisms to transfer benefits of wildlife conservation to local communities. Next phase will be around Tarangire National Park.

(d) Development of tourism management plan for Gombe Stream National Park.

4. DANIDA Projects

(a) National tree seed project. Strengthening the tree seed sector through the collection, selection and distribution of tree seed to meet a rapidly increasing demand. A national centre is being established in Morogoro with local centres in Iringa and Lushoto.

(b) Soil and water conservation around Iringa, where there has been severe over-grazing and deforestation. Activities include tree-planting and ecological restoration.

5. EAWS Projects

(a) Ecological status and eradication of prickly pear in the Serengeti.

(b) Floristic study of vegetation in Mikumi National Park.

(c) Support to Malihai Clubs of Tanzania.

6. EEC Projects

(a) Monitoring of elephants in National Parks.

7. FINNIDA Projects

(a) Zanzibar Forestry Development Project: combatting slash-and-burn practices and soil erosion with sustainable use of natural forests, and involving local people in agroforestry (also on Pemba).

(b) Zanzibar Integrated Land Use Project: improving living conditions by decreasing environmental stress through improved land management and land-use planning.

(c) Environmental training course for African communicators: course available to nationals of English-speaking SADCC countries.

8. FZS Projects

(a) Wildlife conservation monitoring: resource assessments, surveys and monitoring in all wildlife areas.

(b) Ranger incentive scheme: in all national parks and game reserves.

(c) Aircraft maintenance: provides support for mainte-

Promising effort using elephant grass to combat erosion (Photo: WWF/Marco Erbetta).

nance of National Park and Wildlife Department aircraft.

(d) Pilot training: support for training of aircrew for National Park and Wildlife Department aircraft.

(e) Protected areas management assistance: provision of general management assistance in nine National Parks and Game Reserves.

(0 Airborne anti-poaching unit: assistance with aircraft and with airstrip construction.

(g) Anti-poaching support in Serengeti National Park: support for administration, vehicles, and equipment in anti-poaching services.

(h) Transport in Serengeti National Park: garage rehabilitation, vehicle maintenance and training of personnel to improve transport capability.

(i) Anti-poaching aircraft: operation of 2 aircraft for anti-poaching administration and research in Serengeti National Park.

(j) Staff welfare: renovation of houses for Serengeti National Park staff.

(k) Communication: provision of radio network for Serengeti National Park.

(1) Master plan for Serengeti National Park: support for the development of the overall management plan for the Park.

(m) Study of fire ecology in Serengeti National Park, and its implications for management.

(n) Extermination of exotics in Serengeti National Park.

(o) Cheetah project in Serengeti, including assessment of conservation needs.

(p) Rubondo Island National Park: provision of long-term management assistance.

(q) Maswa Game Reserve: provision of management assistance, various construction projects and equipment.

(r) Ngorongoro Conservation Area: provision and maintenance of various equipment.

9. GTZ Projects

(a) Selous Conservation Programme: technical support of Selous Game Reserve management and development of village activities in the buffer-zone.

(b) Soil erosion control and agroforestry project to promote the participation of local people in the management of forests and watersheds.

10. MBG **Projects**

(a) Botanical survey and conservation of the Eastern Arc forests.

11. ODA Projects

(a) Tropical Forestry Action Plan assistance.

12. WCI Projects

(a) Training and ecological monitoring in Ngorongoro Crater.

(b) Study of jackals and their conservation.

(c) Ecological monitoring in Ruaha, Tarangire and Lake Manyara National Parks.

(d) Support and expansion of Lake Manyara National Park.

(e) Oribi ecology research in the Serengeti.

(0 Study of forest bird species and their conservation in the Uzungwa Mountains.

(g) Control of disease spread between wild and domestic ruminants.

(h) Graduate training in conservation biology.

13. WHF Projects

(a) Purchase of film van and accessories, Serengeti National Park.

14. WWF Projects

(a) Selous Game Reserve, elephant and rhino conservation: management and material support for the Selous Game Reserve.

(b) Conservation of Mount Kilimanjaro: development of an agenda for improvement of protection.

(c) Anti-poaching emergency fund: a flexible funding arrangement to enable the Department of Wildlife to make

rapid responses to emergent problems in poaching control.

(d) Lake Manyara catchment basin: development of an integrated management strategy and anti-poaching support.

(e) Holding actions for elephant conservation: provision of a discretionary fund to enable the Director of Tanzania National Parks to meet short-term requirements for the protection of baseline elephant populations whilst pursuing more substantial funding for long-term work.

(f) Anti-poaching support and management recommendations for Ruaha National Park.

(g) Provision of a radio communications network for the Department of Wildlife.

Suggested Conservation Activities

1. Seven general issues recur throughout the country and need action in relation to most protection strategies: (1) development of management plans for important protected areas; (2) control of poaching and hunting; (3) reconciliation of human and conservation needs; (4) implementation of recent policy on wildlife utilisation; (5) development of tourism plan (including encouragement of private investment); (6) restructuring of the sport-hunting industry so that more benefits are channelled to conservation; and (7) improvement of living and working conditions for field staff in the conservation agencies.

2. In the savanna reserves in the north of the country, the following action is needed:

(i) Improved protection of the Tarangire National Park and the Lolkisale, Simanjiro and Mkungunero Game Controlled Areas by integrated development programmes to reconcile the needs of pastoralists and wildlife.

(ii) The Mkomazi and Umba Game Reserves need improved management in relation to poaching and, in Umba, regulation of livestock grazing.

3. In the savanna woodlands further to the south and west, management and protection need improvement, particularly with regard to poaching of all species but most importantly elephants and rhinos. *Critical Sites* 2 and *Critical Species* 4 above give details of locations and populations in need of specific action.

4. A new reserve of generous size is urgently needed to protect Itigi Thicket in the centre of the country.

5. Increased protection, through integrated rural development programmes, is needed at a number of wetland sites. Kagera Swamp, Wembere (both important sites for waterbird nesting), Kilombero Valley, Usangu, Buhoro, Bahi and part of the Malagarasi Swamps are all in need of this type of action.

6. Improved protection through integrated development programmes is needed in floodplain areas: Kilombero Valley, Wembere Steppe (important for the Karamoja apalis), and the Usangu and Buhoro Flats.

7. The planned extension of Katavi National Park to include the the northern part of Lake Rukwa should be made as soon as possible.

8. Conservation action is needed for a number of lakes:

(i) Rubondo National Park should be should be extended to include a band of Lake Victoria of at least 1 km width.

(ii) A survey is urgently needed of the number and status of endemic species (vertebrate and invertebrate) in Lakes Tanganyika and Nyasa. This should be followed with appropriate conservation action.

(iii) The boundaries of Gombe and Mahale Mountain National Parks should be extended to include bands of Lake Tanganyika of at least 1 km width.

(iv) Improved protection is needed for Lake Natron, with particular reference to flamingo breeding.

(v) Lake Manyara and its associated soda lakes need improved protection, with particular reference to water-birds.

9. Action is urgently needed in a number of lowland forest areas to prevent further clearance:

(i) The patch of central African lowland rainforest at Minziro should be established as a national park.

(ii) River valley forest patches between the Mahale Mountain and Katavi National Parks need rapid protection.

(iii) Surveys should be carried out in the eastern coastal forests to select and establish strictly protected areas.

(iv) A survey is needed in coastal forests to establish the status of the Sokoke bushy-tailed mongoose.

(v) Tiny patches of forest at the foot of the eastern mountains need to be protected.

(vi) On Zanzibar, the Jozani Forest should be upgraded to national park status, with Mapopwe Forest as its buffer zone.

(vii) On Pemba, the Ngezi Forest and other important areas need strict protection.

10. Montane forests need improved protective measures at a variety of locations:

(i) In the Usambara Mountains, the numerous isolated forest patches need increased protection in the context of integrated development programmes: the programmes currently in operation in the East Usambaras should be extended to include the West.

(ii) In the Ulugurus, a national park should be created and further encroachment, particularly on the lower eastern slopes, should be stopped.

(iii) In the Uzungwas, the proposed national park on the eastern side should be gazetted, (important for primates, particularly the Sanje mangabey) and another reserve, from Dabaga to Chita, should be established: these areas should include lowland forests in the eastern foothills and areas of montane grassland.

(iv) A survey is needed in the Uzungwas to locate a possibly distinctive subspecies of the servaline genet.

(v) Strict protection for African violets should be provided in all of the above areas.

(vi) Improved protection is needed for forests in the Pare, Kama, Nguru, Ukaguru and Rubeho Mountains and for forests in the Uzungwas outside the proposed national parks.

(vii) In all of the above areas of the "Eastern Arc" forests the specific conservation requirements of a range of threatened bird species need to be considered and appropriate action taken where necessary. *Critical Species 9* above gives details.

Women cutting trees and thatch in Ngorongoro Conservation Area (Photo: WWF/George W. Frame).

(viii) The status of the Usambara tree hyrax needs to be assessed, particularly with regard to the impact of hunting.

(ix) The Eastern Arc mountains and forests also contain a number of amphibian species of conservation concern, which may need specific protective measures. *Critical Species* 14 above gives details.

(x) Forest chameleon and snake species should be surveyed in order to determine the extent of threat from habitat destruction, and the conservation action needed.

(xi) Large numbers of rare and endemic invertebrates inhabit the Eastern Arc area and their populations should be monitored.

(xii) In the Southern Highlands, conservation for areas of forest and montane grassland is needed on Mount Rungwe and the Uzungwa, Poroto, Kipengere, Njombe and Livingstone Mountains (with the highest priority being the Kitulu Plateau).

(xiii) Conservation needs of forests in the Mahenge and Matengo Highlands should be assessed and reserves established if necessary.

(xiv) Forest patches on the Ufipa Plateau should be protected, particularly the Mbisi Forest.

(xv) Encroachment of the forest reserve around Mount Kilimanjaro National Park should be stopped.

(xvi) A number of forests on volcanic soil are in need of improved protection: *Critical Sites* 8 above specifies locations.

11. A survey of bird species dependent on montane grassland habitat is needed to establish conservation requirements see *Critical Species 9* above).

12. Marine areas need a variety of assessment and protective activity:

(i) The seabird colony on Fungu Kisimkase (Latham Island) should be gazetted as a game reserve.

(ii) The status of the roseate tern needs investigation, with respect to possible breeding sites on Mafia Island and at Dar es Salaam.

(iii) The current legislation for marine reserves at Tanga Coral Gardens, Tutia, Chole, Fungu Yasini, Pangavini, Bongoyo and Mbudya should be implemented and management strategies developed.

(iv) Further research on reef resources, including mapping of reefs, is urgently needed. Additional marine protected areas should be declared as considered necessary.

(v) The dynamiting of coral reefs should be stopped immediately.

(vi) Conservation needs of unprotected mangrove areas should be assessed and appropriate conservation action taken.

(vii) Surveys of coastal dugong populations are needed, with appropriate conservation action where necessary.

(viii) Surveys should be carried out of coastal fisheries to assess the extent of dolphin and porpoise catches and conservation action taken if necessary.

13. Active conservation, particularly in relation to poaching control and sustainable-yield hunting, is needed in relation to antelopes: *Critical Species* 3 above gives details of populations and sites.

14. Three well-guarded sanctuaries for black rhinos should be established at Lake Manyara, Ngorogoro Crater and Rubondo Island, and surviving animals from unprotectable populations should be translocated urgently.

15. Surveys are needed to assess the status and conservation requirements of three elephant-shrews: chequered elephant-shrew, the black-and-rufous elephant-shrew and the rare four-toed elephant-shrew subspecies *Petrodromus tetradactylus sangi.*

16. The impact of the international live animal trade on Tanzania's bird, reptile, and fish populations needs urgent assessment, with action if necessary. If the trade continues, means of channelling its revenue into conservation should be sought. This work might start by looking at lovebirds, tortoises, chameleons and freshwater fish.

17. A survey of the conservation requirements of the slender-snouted crocodile is needed, with subsequent appropriate conservation action.

18. Introductions of alien fish species into natural water bodies, including rivers, in the country should be prevented.

Chapter 49: Togo

Introduction

Area: 56,785 km^2. Cultivated: 25%. Pasture: 4%. Forest/woodland: 26%.

Population (1989 data): 3,449,000. Urban: 22%. Labour force in agriculture (1980): 73%. Density: 61/km^2. Annual growth rate: 3.4%, decreasing. Doubling time: 20 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 300. GNP annual growth rate: 1.3%.

Biogeographic affinities: Sudanian in the north and Guinea-Congolian/Sudanian Regional Transition Zone in the south.

Vegetation: Sudanian woodland in the north, with patches of lowland rainforest interspersed with secondary grassland in the south, and mangroves along the coast

Critical Sites

1. Although Togo is a small country, it has taken a number of steps in recent years to improve its conservation situation. Many of the most important areas are to be found in the north of the country in savanna woodlands. The Keran National Park and adjacent Hunting Reserve includes both woodland and a large flood plain area. The management plan for the area is being implemented, and as a result, poaching has decreased, and wildlife populations are increasing. A recent very positive move has been the creation of the Oti Valley Reserve in the northeast, near Mandouri, which now brings the protected areas of northern Togo very close to the Pendjari National Park in Benin. Wildlife populations are now increasing in the Oti Valley as a result of improved protection. In the northwest is the Fosse aux Lions Forest Reserve, which is dominated by grass savanna and gallery forests. The protection of this reserve has also been improved in recent years, despite being in an area of high human population density.

2. Further to the south is the Fazao-Malfakassa National Park, the largest protected area in Togo. This is an area of diverse habitats, consisting of savanna woodlands with patches of forest in the hills and valleys. The dry closed forest in the south of the Park is the largest and most important area of undisturbed vegetation in Togo and has been subjected to occasional encroachment by farmers on the west side. Poaching is a serious problem in the Park, as it is in the Togodo National Reserve in the southeast, an area of forest-woodland mosaic in an area of high human population density. The forests in the southern upland areas on the border with Ghana, including the Misahoue Classified Forest, have been severely cleared over the last decade, and only small fragments remain.

Critical Species

1. Plants. At least 2,300 species occur, probably more, with possibly 20 endemics.

2. Primates. 11 species occur, and another, the chimpanzee, is now believed to be extinct Three rare species occur in forest patches in the south: the white-throated guenon, diana guenon and the olive colobus.

3. Antelopes. 17 species occur: forest species, such as the bongo and the duikers, are rare and declining but some of the savanna species are now increasing in numbers in the northern protected areas.

4. Other Mammals. The buffalo occurs in healthy populations in several protected areas. Elephants number about 180 animals and are increasing through strict protection, and now occur mainly in the Keran National Park and Fosse aux Lions Forest Reserve. The wild dog is now extinct in Togo. A very unusual species of rodent, *Leimacomys buettneri*, is only known from "Bismarkburg" (in the Togo highlands close to the Ghana border), and has not been recorded since 1890. The Togo mole-rat occurs in the north, to the west of the Oti River (otherwise only in neighbouring Ghana). There is a diverse fruit bat fauna of ten species, with none of particular conservation concern at present.

5. Birds. It is likely that three threatened species occur. The roseate tern probably winters along the coast. It may well be that birds are being persecuted, but the situation is unknown. A flock of about 100 Damara terns spend the non-breeding season in Togo. Threats to seabirds are mainly from hunting, which constitutes a major problem for threatened species. The white-necked picathartes may possibly nest in forest in the Atacora Hills, which are partly in the Fazao-Malfakassa National Park near the border with Ghana. The Oti Valley Reserve has flocks of up to 350 white storks from November

Pel's fishing owl (Photo: WWF/H. De Saeger).

to January and is a wintering site for a few black storks and for the rare saddle-billed stork. This reserve is also a wintering ground for up to 500 black crowned cranes, and it is believed that a few pairs are permanent residents and breed there.

6. Crocodiles. All three species occur, but there are no recent data except for the Nile crocodile, which occurs in good numbers in Keran National Park, with some large animals being reported.

7. Marine Turtles. Three species have been recorded in Togolese waters: the green turtle, hawksbill and leatherback. The leatherback has been recorded nesting at Zebbe.

8. Amphibians. Three endemic species occur: *Arthroleptis brevipes, Hyperolius laticeps* and *Conraua derooi.* There are three other species of conservation concern, two shared with Ghana and one with Cameroon.

9. Invertebrates. It is possible that the African giant swallowtail butterfly occurs in forest patches in the south.

Threats

1. Protected area management in the centre and south of the country has not been sufficient to prevent poaching and encroachment.

2. The loss of forest from the last remaining patches in the south of the country represents a serious threat to biodiversity.

3. Marine and coastal areas are not included in the reserve system, and are receiving no special protection.

4. Until some benefits of conservation are obvious to local people, particularly in the northern reserves, encroachments and abuses of protected areas will continue.

5. There is a considerable wildlife export trade from Togo that has never been assessed in terms of its impact on conservation.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Ministry of Environment and Tourism is responsible for forest protection, the regulation of hunting, the management of National Parks and wildlife, and tourism.

(b) The Ministry of Rural Development is responsible for the "Office de Developpement et d'Exploitation Forestiere", which governs commercial forest exploitation, village-level forestry, and agroforestry.

2. Multi-agency Projects

(a) Development of National Conservation Strategy (Government/IUCN/EEC): provision of technical and financial assistance for the strategy.

(b) Forest management and reforestation (Government/UNDP): aims to bring about sustainable forest management through community-based programmes, and institution-building.

(c) Assistance in the conservation of soil and water (Government/UNDP).

(d) Development of the Tropical Forestry Action Plan in Togo (Government/FAO/UNDP).

3. GTZ Projects

(a) Improvement of forestry management with a view to ensuring that an adequate timber supply is available on a sustainable basis.

Suggested Conservation Activities

1. In order to protect remaining forest patches in the south, both the Fazao-Malfakassa National Park and the Togodo National Reserve should implement the same management improvements that have been carried out in the

Geographical features and protected areas of Togo. *Geographical features and some of the localities mentioned in the text* — 1: Fazao Mountains. 2: Togo Mountains. 3: Lake Togo. 4: Mono River. 5: Mo River. 6: Oti River. 7: Kara River. 8: Koumongou River. 9: Lome. 10: Tsevie. 11: Kpalime. 12: Atakpame. 13: Anie. 14: Blitta. 15: Sokode. 16: Bassar. 17: Bafilo. 18: Kara. 19: Niamtougou. 20: Mango. 21: Dapaong. 22: Mandouri. 23: Gulf of Benin. *Protected areas* — 24: Fazao (Fazao-Malfakassa) National Park (1920 sq km). 25: Keran National Park (1700 sq km). 26: Oti Valley Faunal Reserve. 27: Fosse aux Lions Forest Reserve (90 sq km). 28: Togodo National Reserve (350 sq km).

northern protected areas (*Critical Sites* 1 above). Primate protection is particularly important here (*Critical Species* 2 above).

2. Anti-poaching measures need to be strengthened considerably in the southern protected areas.

3. Reintroductions of some species of large mammal should be explored in relation to southern protected areas once improved conservation measures have been implemented.

4. Marine and coastal areas need inclusion in the protected areas system.

5. The conservation requirements of the rare white-throated gucnon, diana guenon and olive colobus need to be assessed, with appropriate conservation action following.

6. A survey of the rare endemic rodent *Leimacomys buettneri* is needed to establish its survival and conservation requirements.

7. A survey of coastal fisheries is needed to determine the extent of incidental dolphin and porpoise deaths, and to recommend solutions if a problem exists.

8. Investigations are needed into the extent of seabird persecution, with appropriate public awareness programmes and other conservation activity following as necessary. See *Critical Species* 5 above.

9. The current status and conservation requirements of all three species of crocodiles should be surveyed.

10. A survey of marine turtles is needed to assess their status and conservation requirements.

Chapter 50: Uganda

Introduction

Area: 236,578 km^2. Cultivated: 28%. Pasture: 21%. Forest/woodland: 25%.

Population (1989 data): 17,008,000. Urban: 9%. Labour force in agriculture (1980): 00%. Density: 72/km^2. Annual growth rate: 3.4%, increasing. Doubling time: 20 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 260. GNP annual growth rate: no data.

Biogeographic affinities: Predominantly Lake Victoria Regional Mosaic, with Sudanian in the northern third of the country, Somali-Masai in the extreme northeast, Guinca-Congolian in the southwest, and Afromontane in the mountains.

Vegetation: Predominantly fire-climax secondary grassland and cultivation, but the natural vegetation of much of the south and west is lowland forest, with Sudanian woodland in the north, and *Acacia/Commiphora* thicket and grasslands in the drier parts of the north-east. In the mountains, there is montane forest, bamboo, heath and moorland, and patches of lowland forest in the southwest. There are very extensive wetlands and floodplains, especially in the Nile Valley and around Lake Victoria.

Approximate major vegetation zones of Uganda. The savanna grassland zone in the northeast includes extensive areas of semi-arid thornbush. 1: Lake Mobutu (Albert). 2: Albert Nile. 3: Victoria Nile. 4: Lake Edward. 5: Lake George. 6: Kampala. 7: Ssesse Islands. 8: Mount Elgon. 9: Ruwenzori Mountains. 10: Bufumbira Volcanoes. 11: Lake Victoria.

Critical Sites

1. Uganda is a relatively small country with a rich diversity of species and habitats. Until the early 1970s, Uganda had a well organised and successful conservation effort. Since then, 15 years of political instability have inevitably taken a heavy toll on the country's protected area system, and the large mammals therein. There are now encouraging signs that both the conservation and security situations are improving. Uganda has four National Parks. In the southwest is the Queen Elizabeth (formerly Rwenzori) National Park (also a Biosphere Reserve), which consists of grassland, savanna woodlands, swamps, lake shore and part of the Maramagambo Forest. Many large mammal populations were lost from this area through poaching, but the management is now being restored. The Queen Elizabeth Park is part of a much larger complex of contiguous protected areas, the others being the Kigezi, Kyambura and Kibale Forest Corridor Game Reserves, the Kazinga Channel Sanctuary, and the Kasyoha-Kitomi, Maramagambo-Kalinzu and Kibale Forest Reserves, as well as the large Virunga National Park in Zaïre. The Lake Mburo National Park is also in the southwest, and has some important, though depleted, wildlife populations. It is principally an area of wooded savanna, swamps and lakes. The Murchison (formerly Kabalega) Falls National Park consists of grassland, wooded savanna, and some small forest patches (e.g. Rabongo Forest), and is bisected by the Nile. The Bugungu and Karuma Game Reserves are contiguous to it. The management of the area is now in need of improvement, following the years of political

instability. In the more arid northeast is the Kidepo Valley National Park, an area of bushed savanna. Wildlife populations have survived better here than elsewhere in Uganda, but there is a continuing problem with poaching which needs collaboration with the authorities in the adjacent Kidepo Game Reserve in Sudan. There is also a large army presence there, which puts additional pressure on the park's resources.

2. Apart from these national parks and contiguous reserves, Uganda has a number of other reserves in the savanna zone, almost all of which have become seriously compromised over the last 15 years. One of the most important is the Toro Game Reserve south of Lake Albert (Mobutu), where wildlife populations have been much reduced through poaching. The Katonga Game Reserve in the southwest is suffering from serious overgrazing by livestock. Poaching has been the problem in four small wooded savanna reserves in the West Nile area: Ajai's Game Reserve, and Mount Kei, Otce and Dufile Sanctuaries. The white rhinoceros once occurred in this area but is now extinct. In the semi-arid northeastern province of Karamoja, there are three large and potentially important contiguous game reserves: Matheniko, Bokora Corridor and Pian-Upe. All have been subject to poaching and severe overgrazing by livestock, and wildlife populations are now sparse.

3. Uganda has biological resources in its forest ecosystems that are of international importance. The Bwindi (or Impenetrable) Forest Reserve is very important for its very wide altitudinal range of forest, and a number of very rare species: there has been severe encroachment of this area which was stopped in 1988, and the area is now proposed as a Nature Reserve. Of great richness is the Semliki (or Bwamba) Forest Reserve, which is contiguous with the huge Ituri Forest in Zaïre. The Rwenzori Forest Reserve, which includes the Rwenzori Mountains and is contiguous with the Virunga National Park in Zaïre. A substantial part of the Rwenzori mountains will shortly be declared a National Park. In the extreme southwest of the country is the Gorilla Game Reserve, which is contiguous with the Volcanoes National Park in Rwanda. Agricultural encroachment of this area is a serious problem. Part of this area (the Mgahinga Forest Reserve) is scheduled to be declared a National Park, with the surrounding Game Reserve being re-established as a buffer-zone and extending to lower altitude than at present. The Kibale Forest Reserve is an important area of intermediate-elevation forest that needs an increased level of protection. There are several other forest reserves in western Uganda that are generally managed for timber production as well as for conservation, and these require require careful management to integrate human and conservation needs, with strict protection where necessary. The reserves in question are: Budongo, Bugoma, Itwara, Kalinzu, Kasyoha-Kitomi and Maramagambo-Kalinzu. Similar measures are doubtless required for the remaining forests around Lake Victoria (Sango Bay, Lake Shore and Mabira), and also on Mount Elgon, where conifer plantations have been extended at the expense of natural forests in recent years and where a National Park to complement the one in Kenya is desirable.

4. Uganda possesses some major wetland resources, as follows: 8,832 km^2 of swamps; 365 km^2 of swamp forests; and 20,392 km^2 of other wetlands. Important areas include the Lake Opeta floodplain, the surrounds of Lake Kyoga (especially the southern and western sides), and of Lake Victoria (mainly on the northwestern edge of the lake). A large area of swamps adjacent to Lake George is so far the only Ramsar site in East Africa. However there are swamps, in particular papyrus swamps, in many other places, especially along the Nile Valley, and around the lakes in the Albertine Rift Valley. The unusual upland swamp forests of Kabale District are rapidly disappearing due to agricultural conversion. The conservation of all these areas needs addressing, probably in the context of well-designed integrated rural development projects.

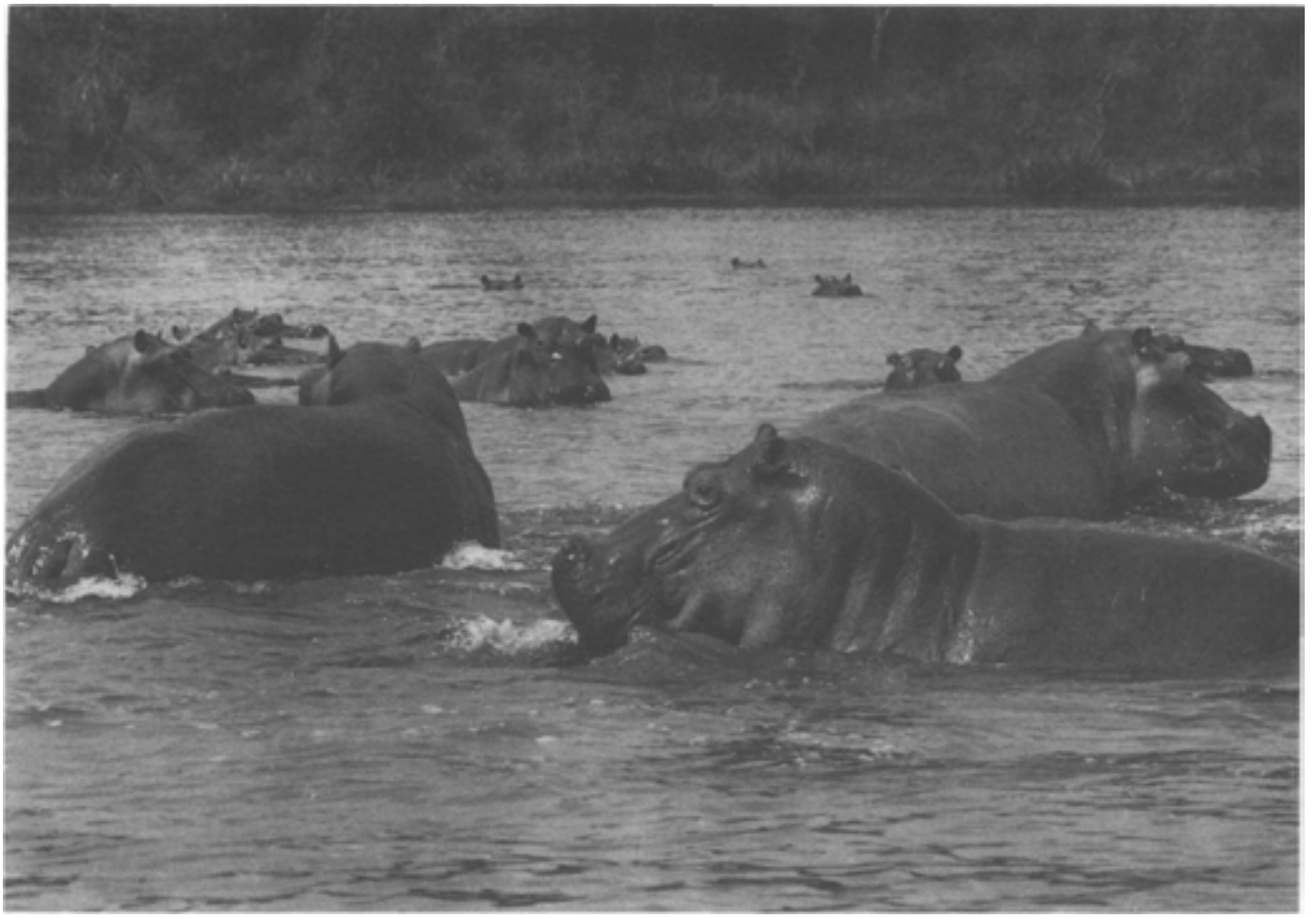
5. Uganda's lakes are of great interest and importance, especially Lakes Victoria, Kyoga, Bistna, Kwania, Albert, George and Edward. None of these lakes is included in any reserve and inclusion of open water in protected areas is proposed.

Critical Species

1. Higher Plants. More than 5,000 species occur, but endemicity is low, in the region of 30 species. The flora is extremely diverse for a small country, because of the number of different biogeographic regions: Sudanian in the north, Somali-Masai in the north-east, Guinea-Congolian in the west, Afromontane in the mountains, and the Lake Victoria Regional Mosaic covering most of the country.

2. Primates. 19 species occur. Those most of conservation concern are: L'Hoest's guenon in Kalinzu, Rwenzori, Bwindi, Kibale, Kalinzu and Budongo reserves; the Uganda red colobus in Kibale Forest Reserve and around the Mpanga River near Lake George; the chimpanzee in many of the forests in the west; the grey-cheeked mangabey in Kibale Forest and the mountain gorilla in the Bwindi Forest Reserve and the Gorilla Game Reserve.

3. Antelopes. 30 species formerly occurred, but three, the bongo, bay duiker and white-bellied duiker are extinct, and two, the giant eland and steenbok, are probably so. Another 14 species are considered threatened, at least to some degree, through increased cultivation, overgrazing and poaching, and the populations of most species are now small. There are important populations of kob in the Queen Elizabeth and Murchison Falls National Parks, and in the Toro Game Reserve, although some of these populations have been reduced through poaching, especially in the Toro Game



Hippopotamus, Murchison Falls National Park, Uganda (Photo: WWF/Donald Paterson).

Reserve. The papyrus areas are important for sitatunga, and this species is coming under increasing pressure due to threats to its habitat. It seems as if some antelope populations are now increasing.

4. Elephants and Rhinos. Elephants, once abundant, have been reduced to less than 10% of their former number through heavy poaching, especially during the years of instability. Elephants survive in Queen Elizabeth (a priority baseline population for East Africa), Murchison Falls and Kidepo Valley National Parks, as well as various forest reserves in the west. However, with the exception of Queen Elizabeth (250-500 animals) no recent counts have been carried out, though the overall population appears to be increasing. Both species of rhinoceros are now considered extinct through poaching, although recent reports indicate that a few black rhino may still reside in the Kidepo area, but outside the park and probably outside Uganda.

5. Rodents. Nine species of conservation concern occur: Carruthers's mountain squirrel *Funisciurus carruthersi* on Mount Ruwenzori (also in Zaïre); a species of groove-toothed rat, *Otomys denti* in secondary growth and forest in the mountains of the southwest (also in Zaïre, Rwanda, Tanzania and Malawi); Delany's mouse *Delanymys brooksi* in the mountains of the southwest (also in Zaïre and Rwanda); two species of creek rat, *Pelomys hopkinsi* in the south at the edge of papyrus swamps (also in Rwanda), and *P. isseli,* endemic to scrub and forest edge of Bugala, Bunyama and Kome Islands in Lake Victoria; a species of African climbing wood mouse *Hylomyscus denniae* in montane forest (widespread in central and eastern African mountains); the large *Thamnomys venustus* in montane forests in the southwest (also in Zaïre and Rwanda); the widespread but rare mill rat *Mylomys dybowskii*; and a species of African pygmy mouse *Mus acholi,* endemic to the northwest

6. Fruit Bats. 12 species occur, including one of conservation concern: *Rousettus lanosus,* which occurs in scattered populations in montane areas in Uganda, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Zaïre, where its status is very poorly known.

7. Other Mammals. Murchison Falls and Queen Elizabeth National Parks have major populations of buffalo and hippo (there being 8,000 buffalo and 3,500 hippos in Queen Elizabeth National Park alone, though these numbers are considerably down from their levels ten years ago). The wild dog is now considered extinct, except for occasional wanderers from Tanzania and Sudan. Jackson's mongoose occurs on Mount Elgon, and Pousargue's mongoose is widespread but rare. The conservation requirements of both these species need to be assessed. The chequered elephant shrew subspecies *Rhynchocyon cirnei stuhlmanni* is known from Semliki, Bugoma, Budongo and Mabira Forests. Its status and conservation requirements are unknown, also whether it occurs further to the south (for instance, in the Kibale and Maramagambo Forests). The status of the leopard is unclear and needs assessment

8. Birds. Ten threatened species occur, six of these being forest birds: Nahan's francolin (in Mabira, Kibale, Bugoma and Bundongo Forests, and probably others); the African green broadbill (Bwindi); the forest ground-thrush (Semliki); the Kibale ground-thrush (endemic to Kibale); Turner's eremomela (southwestern forests, but no recent records, and specific localities unclear); and Chapin's flycatcher (Bwindi). Three others are wetland species: the shoebill (widespread in and around papyrus swamps, over most of the country except the east, probably most common around Lake Kyoga); Grauer's swamp warbler (in high altitude swamps in Bwindi Forest); and the papyrus yellow warbler (known from swamps around Lakes George, Edward, Bunyoni and Mutanda). The Karamoja apalis occurs in the dry Karomoja Province, being known from several localities, including Mount Moroto and Kidepo Valley National Park.

9. Crocodiles. The Nile crocodile is seriously depleted and threatened with extinction, although there are positive signs, and it has recently been sighted further south than previously, at the Lake Edward end of the Kazinga channel. The slender-snouted crocodile might occur but has not been confirmed in recent years. The dwarf crocodile is very rare but has been reported recently.

10. Amphibians. There are ten species of conservation concern, but no endemics. Five of these species are shared only with Zaïre, two with Zaïre and Rwanda, two with Zaïre, Rwanda and Burundi, and one with Zaïre, Rwanda, Burundi and Tanzania. All occur in the south and west of Uganda.

11. Fish. There are very important populations of endemic fish, especially of cichlids, in Lake Victoria and in other lakes in Uganda.

12. Invertebrates. The rare African giant swallowtail butterfly is known from the Semliki, Budongo, Kibale and Kalinzu Forests. The cream-banded swallowtail occurs in the montane forests of the southwest (also in Zaïre, Rwanda and Burundi).

Threats

1. As a result of the security problems, Uganda's protected areas have suffered from very extensive poaching and from encroachment. However, due to recent measures, the country's biological resources are now under much firmer control.

2. In general, forest habitats which were in danger are now well-protected in Uganda, and these habitats no longer suffer very extensive encroachment and fragmentation. However, it is feared that some of Uganda's forests might not be large enough to support viable populations of some of the larger species.

3. Uganda's wetlands also suffer from lack of protection, and an effective planning framework governing use of their resources, although a ban on large scale drainage was intro-

Conservation areas of Uganda. 1: Murchison Falls National Park (3840 sq km). 2: Queen Elizabeth National Park (1980 sq km). 3: Kidepo Valley National Park (1400 sq km). 4: Lake Mburo National Park (540 sq km). 5: Toro (Semliki) Game Reserve (550 sq km). 6: Kadam-Debasien Game Reserve (440 sq km). 7: Ajai Game Reserve (158 sq km). 8: Kigezl Game Reserve (330 sq km). 9: Kibale Corridor Game Reserve (134 sq km). 10: Kyambura Game Reserve (155 sq km). 11: Karuma Game Reserve (720 sq km). 12: Bugungu Game Reserve (518 sq km). 13: Katonga Game Reserve (209 sq km). 14: Bokora Game Reserve (2034 sq km). 15: Matheniko Game Reserve (1560 sq km). 16: Bwindi Forest Reserve (297 sq km). 17: Kibale Forest Reserve (400 sq km). 18: Mount Elgon Forest Reserve (860 sq km). 19: Ruwenzori Mountains Forest Reserve (1300 sq km). 20: Budongo Forest Reserve. 21: Bwamba (Semliki) Forest Reserve (219 sq km). 22: Sango Bay Forest Reserve. 23: Mabira Forest Reserve. 24: Maramagambo-Kalinzu Forest Reserve (280 sq km). 25: Kasyoha-Kotomi Forest Reserve (400 sq km). 26: Bugoma Forest Reserve. 27: Itwara Forest Reserve (90 sq km). 28: Bufumbira Gorilla Sanctuary (48 sq km).

duced by the Government in 1986.

4. Fish introductions can have a major deleterious effect on native fish populations, as has happened in Lake Victoria. Such fish faunas can also be threatened by pollution and over-fishing.

5. The proposed hydroelectric scheme for Murchison Falls presents a serious threat to this area.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under two main ministries. The Ministry of Agriculture and Forestry is responsible for forests through its Forest Department. This department is charged with reforestation and conservation of the indigenous forests.

(b) The Ministry of Wildlife and Tourism has responsibility for the Game Department and Uganda National Parks. The Game Department has jurisdiction over all wildlife outside national parks, including in game reserves and nature reserves. Uganda National Parks has full legal and administrative control over the national parks system, and is run as a parastatal organisation with an independent board.

2. Multi-agency projects

(a) Wildlife and National Parks project (FAO/UNDP): assistance to the Game Department and National Parks with emphasis on training and a national protected areas systems review.

(b) Conservation education and material support (IFAW/GTZ): conservation education and provision of four-wheel-drive vehicles, mostly in Queen Elizabeth National Park.

(c) Support for Makerere University biological field station, Kibale Forest (WCI/USAID).

(d) Conservation of Impenetrable (Bwindi) Forest (WWF/FFPS): inventory of biological resources, identification of conservation priorities and development of protective strategies in the area, with a special focus on gorillas.

(e) Support for Institute of Environment and Natural Resources, Department of Zoology, Makerere University (AWFAUCN/WWF).

(f) National Wetlands Conservation and Management Programme (IUCN/Government/NORAD): established to review wetlands development, provide guidance for sustainable use, and develop a viable national wetlands policy.

(g) Support to Wildlife Clubs of Uganda (WWF/EAWS).

(h) Sustainable development and forest conservation (Government/IUCN/NORAD): promoting forest conservation through integrated rural development, concentrating on Mount Elgon, Semliki, and Kibale.

3. AWF Projects

(a) Survey of flora and fauna in Mgahinga Forest Reserve, including assessment of gorilla status.

4. EAWS Projects

(a) Study of ecology and status of crowned crane.

(b) Study of grassland birds in Queen Elizabeth National Park.

(c) Study of the survival of forest birds in formerly forested areas around Kampala.

5. EEC Projects

(a) Uganda National Parks Project: provision of infrastructural and technical management support to new and existing Parks.

(b) Natural Forest Management and Conservation Project provides for extension of Nature Reserves from 5% to 20% of area of natural forest, with a further 30% as buffer zones.

(c) Radio-tracking of elephants in Queen Elizabeth National Park.

6. WCI Projects

(a) Kibale Forest Conservation Project: a long-term research and conservation project in this important site.

(b) Study of chimpanzee ecology and behaviour.

(c) Research into the potential economic importance of wild species of coffee.

Suggested Conservation Activities

1. Two general threads of activity need to be pursued in most of Uganda's conservation activities at present: first, the continued improvement of management of protected areas and second, an emphasis on sustainable use of natural resources, given the relatively high population density.

2. Poaching remains a serious problem in some areas and control measures need to be rigorously pursued and maintained, particularly in relation to some species of antelope (see *Critical Species* 3 above) and elephants.

3. The southwestern and western complexes of protected areas which encompass a mixture of habitat types need improved protection and management and are particularly important for antelopes and elephants *(Critical Sites* 1 above lists principal locations). The land-use conflicts surrounding Lake Mburo National Park in particular need to be addressed in a way that provides for the needs of local people; at present the habitats of the park are still being degraded by cattle.

4. The degradation and wildlife depletions (particularly of antelopes) in the savanna reserves (see *Critical Sites 2* above) need to be reversed by protection from overgrazing and poaching; integrated development schemes may be the best strategy.

5. Forest Reserves need continued protection to guard against renewal of encroachment and poaching problems.

(i) The Bwindi Forest Reserve (important for plants, gorillas, birds and rodents) should be designated as a National Park.

(ii) Parts of the Rwenzori Forest Reserve should be redesignated as a National Park.

(iii) The Kibale Forest Reserve (important for primates and birds, see *Critical Species 2* and 8) should be designated as a strict nature reserve.

(iv) A number of other forest reserves in western Uganda, and the remaining forests around Lake Victoria, need management plans that involve careful zoning, regulated timber use and inviolate areas. *Critical Sites* 3 above specifies locations for these reserves.

(v) The Semliki (Bwamba) Forest Reserve should have the majority of its area designated as a strict nature reserve.

(vi) Agricultural encroachment of the Gorilla Game Reserve needs to be stopped, and the area developed as a National Park.

(vii) Research should be carried out to identify mature forest core species of taxa other than primates.

(viii) Possible solutions to the problem of fragmented and therefore non-viable large-mammal populations need to be identified, including an evaluation of possible translocation programmes.

6. A number of important wetland areas, important for Sitatunga, birds and terrapins in particular, need protection within the context of integrated rural development projects. *Critical Sites* 4 above indicates locations. It should be emphasised that small wetlands not mentioned above might be important as communication corridors between major wetlands for certain species, and should be conserved for this reason.

7. The boundaries of Queen Elizabeth National Park should be extended 500 metres out from the shores of Lakes Edward and George, and a similar extension should be made into Lake Albert in Murchison Falls National Park.

8. There is a need for a National Park on Mount Elgon to be contiguous with the existing Park in Kenya.

9. Tourism development consistent with conservation needs should be encouraged in protected areas as management improves and facilities can be developed.

10. Surveys are needed to assess the status and conservation requirements of threatened mammals: *Critical Species* 5, 6 and 7 above gives details.

11. The status of the Nile and slender-snouted crocodiles need to be assessed and conservation measures implemented, particularly for the former.

12. Introductions of alien fish species into natural water bodies should not be made.

Papyrus swamp, Murchison Falls National Park, Uganda (Photo: WWF/Rugen Schuhmacher).

Chapter 51: Zaïre

Introduction

Area: 2,345,410 km^2. Cultivated: 3%. Pasture: 4%. Forest/woodland: 75%.

Population (1989 data): 34,853,000. Urban: 40%. Labour force in agriculture (1980): 72%. Density: 15/km^2. Annual growth rate: 3.1%, increasing. Doubling time: 23 years.

Economy (1987 data): World Bank index: low-income economy. GNP/capita: US$ 160. GNP annual growth rate: -0.7%.

Biogeographic affinities: Predominantly Guinea-Congolian, with the southern third occupied by Guinea-Congolian/Zambesian Regional Transition Zone, and Zambezian. There is some Guinea-Congolian/Sudanian Regional Transition Zone in the far north, and Afromontane and Afroalpine elements in the eastern mountains.

Vegetation: Predominantly lowland rainforest (including swamp forest) in the centre, with a mosaic of forest patches and secondary grassland both to the north and south of this. There is miombo woodland in the south, and montane forest, grassland, heath and moorland in the mountains. There are extensive wetlands and floodplains in the south.

Critical Sites

1. Zaïre is the richest country in Africa in terms of biodiversity, and is one of the most biologically diverse countries in the world. It has some protected areas of international importance, but in almost all of these the management is inadequate and unplanned, with deficiencies in staff training. Some of Zaïre's most important protected areas are in the lowland forest zone, and these include Salonga National Park, Maiko National Park, most of Kahuzi-Biega National Park, some of Virunga National Park, the Rubi-Tele Game Reserve (near the northern forest boundary), Yangambi Biosphere Reserve, Luki Biosphere Reserve (now badly degraded and extensively settled), and Botende Game Reserve (including Lake Tumba), though the last three of these are believed to be effectively abandoned. There are also the very small Masoko Forest Reserve and the Kongolo Island Educational Reserve near Kisangani. Together, all these sites include a large proportion of the total variation in biodiversity in the lowland forest zone.

2. However, the existing lowland forest protected areas system does not include some species and ecosystems. The establishment of the proposed Okapi National Park in the Ituri Forest, with a surrounding buffer-zone, is a particularly high priority. Protection is needed in the Lomako-Yekokora forests for pygmy chimpanzees (especially urgent in view of forest exploitation proceeding in the area), between the Lomami and Lualaba Rivers (for at least three endemic subspecies of primate), in the Wamba Forest near Djolu (for the endemic Salongo guenon), in the Lukemie-Sankuru area in Kasai, in the Abumonbazi (Mobaye) area in the northwest (near Central African Republic), in the Maniema area (in southern Kivu), and in the Ngiri area (between the Zaïre and Oubangui Rivers near the Congo border). In addition, extensions to the Virunga National Park could be made to include Mount Hoyo and part of the Semliki Valley in the north, and

Bisoke Volcano, at 2800 m altitude, in Virunga National Park, Zaire (Photo: WWF/G. F. de Witte/IPNC).

Major natural vegetation zones of Zaïre (simplified). 1: Zaïre River. 2: Ugangi River. 3: Uele River. 4: Lualaba River. 5: Lomami River. 6: Luvua River. 7: Lufira River. 8: Luapula River. 9: Kasai River. 10: Atlantic Ocean. 11: Lake Mobutu (Albert). 12: Lake Edward. 13: Lake Kivu. 14: Lake Tanganyika. 15: Lake Upemba. 16: Lake Mweru. 17: Ituri Forest. 18: Kinshasa.

the Tongo Forest in the south. The western lowland forests are poorly represented in Zaïre's protected area system, and protection of this habitat in the Mayombe area (either adjacent to the Luki Biosphere Reserve, or near the Cabinda border) is a matter of urgency, especially in view of the severe forest clearance taking place in this area. Small areas in the vicinity of Kinshasa, at Lake Nagarenke, and of Maî Mpili-Lidji, need protection, as do the forest reserves on the small Shushu Islands in Lake Kivu. The expansion of Zaïre's protected area system would require a very considerable expansion in the country's conservation capability.

3. The mountain forests and afro-alpine vegetation in eastern Zaïre are the most biologically diverse of their type in Africa. Three existing protected areas include some montane forest: Virunga National Park; Kahuzi-Biega National Park; and Bushenyi Forest Reserve (on Idjwi Island in Lake Kivu). Management is inadequate and there is an ongoing problem of habitat clearance.

4. Many other areas of montane forests are important and lack any protection at this time. This is especially critical in view of the increasing human population pressure in eastern Zaïre. The Itombwe (or Uvira) Mountains are of particular importance, having the most diverse montane bird community in Africa, and being a centre of plant endemism. Other important sites include Mount Kabobo, the mountains west of Lake Edward, and the Lendu Plateau (west of Lake Mobutu). In addition, there are forests on the mountains west of Lake Kivu (outside Kahuzi-Biega National Park) that are also severely threatened. In many of these areas, reconciliation of human and conservation needs is central.

5. Some of Zaïre's existing protected areas encompass some important areas of forest-savanna mosaic. These include the Luama Game Reserve (on the southern forest boundary) and the Rutshuru Game Reserve (on the eastern forest boundary, acting as a buffer-zone between Virunga National Park and the Uganda border). These areas are inadequately managed and present opportunities for the sustainable utilisation of wildlife. In the southeast of the country, in the Marungu Highlands, there is a mosaic of savanna and small areas of montane forest which is a centre of endemism for plants but is currently unprotected. In the west of the country, the Bombo-Lumene Game Reserve includes some important areas of forest-savanna mosaic.

6. One of the reasons for Zaïre's exceptional levels of biodiversity is that it is the only country in Africa which contains examples of both the northern and southern savannas. In the north are the Garamba National Park and Bomu Nature Reserve, and in the south are the Upemba National Park, Kundelungu National Park (including the Lufira Valley Biosphere Reserve), and Shaba Elephant Reserve. With the exception of Garamba National Park (which is the subject of a rehabilitation programme), all these areas are suffering from management deficiencies and a high level of illegal hunting.

7. A few habitats in Zaïre are not represented in the protected area network: especially important are (i) dense muhulu dry forest in the Kyamasumba-Kolwezi area and (ii) the mangrove habitat at the mouth of the Zaïre River.

8. Zaïre's lakes are each unique and of great biological importance. Along the country's eastern border are the Lakes Mobutu, Edward, Kivu, Tanganyika and Mweru, and in the Zaïre basin are Lakes Tumba and Mai-Ndombe. It is important that all of these lakes are managed in such a way as to ensure that their biological resources can be used sustainably in the long-term.

Critical Species

1. Plants. Zaïre has a very rich flora of 11,000 species, with particularly high endemism (c. 3,200 species, or 29%). The species richness reflects the presence of lowland and montane forests, and northern and southern savannas and wood-

lands. Endemics are concentrated around the edges of the Zaïre basin. Two well known centres of plant endemism are in the Itombwe (or Uvira) Mountains, and the Marungu Highlands.

2. Primates. 31-32 species occur, the highest number in any African country. Of particular conservation importance are the black mangabey (south of the Zaïre River), Salongo guenon (endemic to Zaïre, only known from the Wamba Forest), owl-faced guenon (lowland and montane forests in the east, including Ituri, Kivu and Tshapo Districts, heavily hunted), L'Hoest's guenon (generally in montane forests in the east, including Ituri, Kivu and Tshapo districts, heavily hunted), eastern red colobus (four subspecies in the central, northern and eastern parts of the lowland forest), a subspecies of Hamlyn's monkey *Cercopithecus hamlyni kahuziensis* (endemic to the bamboo zone of Mount Kahuzi), pygmy chimpanzee (endemic to Zaïre, south of the Zaïre River), and gorilla (eastern lowland race in Virunga, Kahuzi-Biega and Maiko National Parks, mountain race in Virunga where much reduced in numbers, and western lowland race formerly in the Mayombe area, where probably now extinct). The expansion and effective protection of Zaïre's protected area system, as outlined above, would be sufficient to safeguard the country's diverse primate fauna.

3. Antelopes. 30 species occur, representing one of the richest faunas on the continent. The main threat comes from over-hunting, and the populations of many savanna species are depleted, though important populations of topi occur in Virunga National Park, and of kob and lelwel hartebeest in Garamba National Parks. Large and important populations of forest antelopes occur in the country, notably bongo, Sitatunga, and five species of forest duiker in Salonga National Park, with additional species (white-bellied duiker and Bates's pygmy antelope) in Maiko and Kahuzi-Biega National Parks. The main priority for antelope conservation in Zaïre is to improve the management of protected areas, and to introduce rural development schemes that ensure that the utilisation of antelopes is carried out sustainably.

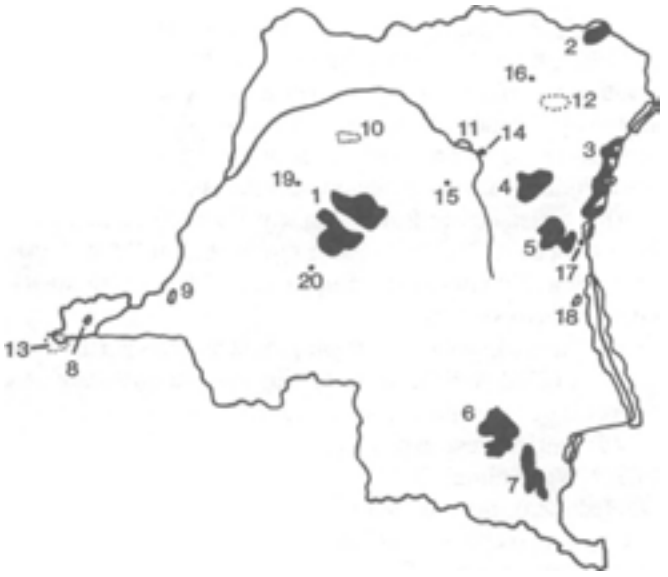
4. Rodents. At least 17 species of conservation concern occur in Zaïre, mainly in the montane and lowland forests in the east of the country. Examples include Carruthers's mountain squirrel *Funisciurus carruthersi,* two species of groove-toothed rat *Otomys tropicalis* and *0. denti,* Delany's mouse *Delanymus brooksi,* a long-tailed mouse *Dendromus kahuziensis* (only known from Mt. Kahuzi), a pygmy species of long-footed rat *Malacomys verschureni,* a harsh-furred rat *Lophuromus cinereus,* and a mouse *Mus pasha.*

5. Small Carnivores. Four rare species of viverrid occur in Zaïre, the giant genet and aquatic genet (both in the north-eastern lowland forests), Ansorge's cusimanse (forests south of the Zaïre River and in adjacent Angola), and Pousargue's mongoose (in Garamba National Park and surrounding areas, including adjacent Sudan, Uganda and Central African Republic).

The remarkable shoebill **is a rare species** confined **to central African wetlands (Photo: Mark N. Boulton).**

6. Fruit Bats. 18 species occur, of which four are of conservation concern: *Casinycteris argynnis* (known only from the lowland forests of Zaïre and Cameroon); *Micropteropus intermedius* (three localities in southwest Zaïre and one locality in northeast Angola); *Plerotes anchietae* (known only from west-central Angola, southeast Zaïre and north Zambia); and *Rousettus lanosus* (which occurs in scattered populations in montane areas in Zaïre, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda, where its status is very poorly known).

7. Other Mammals. Zaïre has several internationally important large mammal populations. The okapi is endemic to Zaïre, and its distribution is centred on the Ituri Forest (where an Okapi National Park is recommended) though it occurs more widely in the northern forests, including Virunga and and Maiko National Parks. There is a significant hippo population (>1,000) and the country's last giraffe population (2-300) in Garamba National Park. The water chevrotain is well-represented in Zaïre's existing and proposed protected areas, e.g. Salonga, Maiko and Okapi National Parks. Zaïre has a large population of the giant forest hog, with 2,000 animals occurring in Virunga National Park alone. Virunga also has Africa's largest population of the hippopotamus (over 20,000 animals). Important manatee populations survive in the lower Zaïre River, but their conservation requirements are not clear. Zaïre also has a large



Major conservation areas of Zaïre. 1: Salonga National Park (World Heritage Site) (36 560 sq km). 2: Garamba National Park (World Heritage Site) (4920 sq km). 3: Virunga National Park (World Heritage Site) (7800 sq km). 4: Maiko National Park (10 830 sq km). 5: Kahuzi-Biega National Park (World Heritage Site) (6000 sq km). 6: Upemba National Park (11 730 sq km). 7: Kundelungu National Park (7600 sq km, including 1470 sq km Lufira Valley Biosphere Reserve). 8: Luki Forest Reserve (Biosphere Reserve) (2100 sq km). 9: Bombo-Lumene Game Reserve (2400 sq km). 10: Lomako-Yekokora Reserve (proposed) (4000 sq km). 11: Yangambi Flora Reserve (Biosphere Reserve) (2100 sq km). 12: Okapi National Park (proposed). 13: Mangroves National Park/Marine National Park (proposed) (768 sq km). 14: Kisangani. 15: Opala. 16: Isiro. 17: Bukavu. 18: Luama Hunting Reserve. 19: Imbonga. 20: Bongimba.

buffalo population both in the savannas and forests (with particularly large numbers in Garamba). Garamba is also the only place where the northern white rhinoceros survives in the wild. It was reduced almost to extinction by illegal hunting, but has recovered to 25 animals under strict protection. These strict conservation measures need to be continued. Zaïre also has Africa's largest population of elephants, tentatively estimated to number 100,000. This number is being reduced rapidly through illegal hunting for ivory, and measures are needed to bring this situation under control. Three top priority elephant baseline populations occur in Zaïre, in Garamba, Kahuzi-Biega and Salonga National Parks and there is also a large population in Maiko.

8. Birds. Zaïre's bird fauna of 1,086 species is the richest in Africa, and 25 of these are considered to be threatened. The shocbill, wattled crane and black-lored waxbill (endemic to the Upemba area) are known from wetlands in the south. The remarkable, endemic Congo peacock is largely restricted to the southern and southeastern forest zone. The Ituri Forest is important for Nahan's Francolin, and the endemic golden-naped and yellow-legged weavers. Many rare species occur in the eastern highlands (especially the Itombwe Mountains): the endemic Itombwe owl, Schouteden's swift, Prigoginc's greenbul (northern highlands only), Kabobo apalis (Mount Kabobo only), Kungwe apalis (Idjwi Island), and many others. All of these depend upon forest conservation for their survival. The Marungu sunbird is endemic to tiny areas of riverine forest in the Marungu Highlands. The white-headed robin-chat occurs in forest patches in the Bombo-Lumene Game Reserve (as well as in northern Angola). The Loango slender-billed weaver occurs on the coast at the mouth of the Zaïre River. The endemic Lake Lufira weaver is only known from the vicinity of Lake Lufira in or near the Kundelungu National Park. The papyrus yellow warbler occurs in papyrus swamps along the Luapula River, just south of Lake Mwem.

9. Reptiles. The Upemba mud turtle is endemic to Zaïre and is largely restricted to Upemba National Park, where it is common. All three species of crocodile occur in Zaïre, but there is little information on their conservation status.

10. Amphibians. There are 51 species of amphibians endemic to Zaïre, of which 16 are only known from a single locality. Zaïre shares 16 species with just one other country, and there are 13 other species of conservation concern shared with more than one country. Amongst these, the hairy frog is of particular concern. There is a particular concentration of endemics in the eastern highlands (especially the Itombwe Mountains), with other concentrations in Shaba and in the central forests.

11. Fishes. There are concentrations of endemic fish in several lakes, especially Lake Tanganyika and Lake Tumba.

12. Invertebrates. There are two endemic species of dragonfly of conservation concern, *Pseudagrion quadrioculaium* (known only from Bambesa), and *Congothemis longistyla*. The rare African giant swallowtail butterfly occurs widely in the lowland forests, and the cream-banded swallowtail butterfly occurs in the mountains around Lake Kivu. Another rare butterfly, *Graphium aurivilliusi*, occurs in the lowland forests, but its distribution is unknown.

Threats

1. Protected area management has been generally benign and has not been able to prevent large-scale poaching of many species in the savanna regions, and of elephants everywhere.

2. Destruction of forest is taking place in certain high priority areas, most notably in lowland and montane areas in

the east, in the Lomako Forest, and in the Mayombe area. In view of the international importance of these areas as the most species-rich in Africa, urgent conservation planning and action is called for.

3. Fish introductions can have a major deleterious effect on native fish populations, as has happened in some neighbouring countries. Important fish populations are also at risk from pollution and over-fishing.

Current Conservation Measures

1. Government Administration of Conservation

(a) Environmental matters come under the Department of Lands, Environment, and the Conservation of Nature. The principal management and wildlife protection body, the Zaïre Institute for the Conservation of Nature (IZCN) comes under this ministry. The IZCN is responsible for the national parks and other protected areas. Other sections of the ministry deal with forestry and related environmental concerns.

2. Multi-agency projects

(a) Promotion of forest conservation (Government/IUCN/EEC): development of an action plan for forest conservation by: planning a protected areas system to include rainforest habitats; development of sustainable use programmes in the forest zone; assessing conservation needs of forest wildlife; and dissemination of results of research.

(b) Assistance to Zaïre Tropical Forestry Action Plan (Government/IUCN/EEC/FAO): ensuring that Zaïre TFAP has sufficient conservation emphasis and local community and NGO involvement.

(c) Environmental education programme on gorilla conservation (EEC/WWF), based in Virunga National Park and for gorilla conservation in particular.

(d) Ituri Forest and okapi conservation (TABAZaïre/WCI/WWF/Animals in Motion): includes protected area establishment, development of park infrastructure, tourist development, captive breeding, and research.

(e) Development of management plan for Kahuzi-Biega National Park with a sustainable use programme in the

Marabou storks at Vitchumbi fishing village on Lake Idi Amin (Edward) (Photo: WWF/Peter Jackson).

buffer-zone (IZCN/GTZ).

(f) Survey of Kahuzi-Biega National Park and Itwombe Forest (FFPS/WWF): study of the conservation needs of and pressures on the two areas.

(g) Garamba National Park, protection of rhino (FZS/ IUCN/IZCN/UNESCO/WWF): a range of measures to improve Garamba National Park management and focus specifically on the northern white rhino.

(h) Rehabilitation of Virunga National Park (EEC/ IZCN): rehabilitation of the Park infrastructure, including integrated development programmes.

(i) WWF Representative in Zaïre (IZCN/WWF): involves management of WWF projects, provision of technical support to IZCN, and co-operation in development of new projects.

(j) Staff training (UNESCO/WWF): funding of Zaïrean students (three in 1989) on courses at Garoua Wildlife College.

(k) Surveys of elephants in the forest zone to establish baseline population data (WCVWWF/EEC).

3. FZS Projects

(a) Resources for Virunga National Park: includes management support and provision of equipment

(b) Gorilla conservation in eastern Zaïre.

(c) Tongo chimpanzee project.

4. WCI Projects

(a) Survey and exploration of Maiko National Park.

(b) Survey and exploration of Rubi-Tele Game reserve.

Suggested Conservation Activities

1. Protected area management needs considerable improvement, including management plans for each area and increased staff training.

2. In many areas, conservation of wildlife, particularly bushmeat species, needs to be done on a sustainable-use basis in the context of integrated rural development. This is particularly important for primates (see *Critical Species 2* above), which are heavily hunted for food, and antelopes (see *Critical Species* 3 above). Recent research shows that maintenance of hunted antelope species depends on having core protected areas with surrounding utilisation areas.

3. Lowland forest protection needs to be improved in terms of both increased control of logging and agricultural clearance and provision of additional protected areas. Lowland forest conservation is central to the survival of many threatened and endemic species in Zaïre, and all the proposed improvements, particularly control of forest clearance, should be pursued as a matter of urgency.

(i) The proposed Okapi National Park (important for primates and the endemic Okapi) should be established immediately, with buffer zones.

(ii) Reserves should be established rapidly in the Lomako-Yekokora forests, between the Lomami and Lualaba Rivers, for pygmy chimpanzees and other primates.

(iii) Other reserves should be established at locations listed in *Critical Sites 2* above.

(iv) The Virunga National Park should be extended to include Mount Hoyo and part of the Semliki Valley in the north, and the Tongo Forest in the south.

(v) A new reserve in the Mayombe area of the western forests should be established, either by extending the Luki Biosphere Reserve or by protecting a new area near the Cabinda border.

(v) Two small reserves in the vicinity of Kinshasa, at Lake Nagarenke and Mai Mpili-Lidji, should be established.

(vi) Forest protection should be enforced on the Shushu Islands in Lake Kivu.

4. The forests and afro-alpine areas in eastern Zaïre (see *Critical Sites* 3 above) urgently need improved management and control of habitat clearance.

5. New montane forest reserve areas must be established:

(i) A protected area is urgently needed in the Itombwe (Uvira) Mountains, which are important for plants, birds, amphibians and primates.

(ii) A number of other sites, listed in *Critical Sites* 4 above, should be surveyed and appropriate protection implemented, with an emphasis on integrated development.

6. Forest-savanna mosaic areas (see *Critical Sites* 5 above) are in need of improved management, with an emphasis on sustainable-use approaches.

7. Conservation measures, focussing on endemic plants, are needed in the Marungu Highlands.

8. Management improvements are needed in nearly all the protected savanna areas in the country (see *Critical Sites* 6 above), with particular emphasis on controlling illegal hunting by introducing sustainable-yield approaches, particularly in relation to antelopes.

9. A new reserve should be set up to protect muhulu dry forest in the Kyamasumba-Kolwezi area.

10. An active management policy for lake habitats is needed, particularly to enable sustainable use of their wildlife and to prevent alien fish species introductions (see *Critical Sites* 8 above).

11. Strict anti-poaching measures are needed for the white rhino (Garamba National Park) and elephants (Garamba, Kahuzi-Biega and Salonga National Parks).

12. Surveys of manatee populations in the Zaïre River are needed to assess their conservation requirements and to propose action if necessary.

13. Surveys of all three species of crocodiles are needed to assess their status and conservation requirements.

14. Surveys are needed to assess the status and conservation needs of the hairy frog.

Chapter 52: Zambia

Introduction

Area: 752,617 km^2. Cultivated: 7%. Pasture: 47%. Forest/woodland: 39%.

Population (1989 data): 8,148,000. Urban: 43%. Labour force in agriculture (1980): 73%. Density: 11/km^2. Annual growth rate: 3.7%, increasing. Doubling time: 19 years.

Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: US$ 240. GNP annual growth rate: 0.6%.

Biogeographic affinities: Zambezian, with a small area of Afromontanc in the extreme north-east.

Vegetation: Predominantly miombo woodland, with drier mopane woodland in the Luangwa and Zambezi Valleys and parts of the west, extensive wetlands and floodplains in many areas, patches of lowland forest in the northwest, and montane forest and grassland in the northeast.

Critical Sites

1. Zambia is dominated by miombo (or *Brachystegia)* woodlands. The country is also noted for some drier areas of mopane woodland, and several important wetlands. Many of the critical sites in the country consist of complexes of protected areas with diverse habitats. One very important such complex is centred on the Luangwa Valley and the lower Zambezi Valley. This area consists of dry mopane woodland in the valley floors, with miombo woodland on, and above, the escarpments. There are also some important riverine habitats, and big concentrations of large mammals. The protected areas concerned are: the Lukusizi, Luambe, North Luangwa, South Luangwa and Lower Zambezi Valley National Parks, and the Luano, West Petauke, Chisomo, Sandwe, Lupande, Lumimba, Munyamadzi and Musalangu Game Management Areas. There is now an important project aimed at reconciling the human use of part of this area with conservation, the Luangwa Integrated Resource Development Project (LIRDP). The success of this initiative is essential if the heavy rate of poaching which has severely reduced elephant and rhino populations is to be brought under control.

2. Another important protected area complex is centred on the Kafue River System. This includes a diverse mosaic of miombo woodlands, grassland, seasonally inundated flood-plains (the Kafue Flats), and swamps. The protected areas are: the Kafue, Lochinvar and Blue Lagoon National Parks, and the Kafue Flats, Sichifula, Mulobezi, Namwala, Mumbwa, Kansonso-Busanga, Lunga-Luswishi, and Machiya-Fungulwe Game Management Areas. A variety of problems require effective management, including control of poaching in the National Parks and reconciliation of human-wildlife conflicts in the Kafue Flats and other Game Management Areas.

3. In the far west of the country is a large area of diverse habitats, including dry mopane woodland in the southwest, miombo woodland, extensive wetlands and floodplains around the Zambezi River, and the important grasslands of

Approximate natural vegetation zones *tit* Zambia (simplified). 1: Zambezi River. 2: Liuwa Plain. 3: Busanga Plain. 4: Kafue River. 5: Kafue Fltats. 6: Lukanga Swamp. 7: Lusaka. 8: Lake Kariba. 9: Luangwa River. 10: Lake Bangweulu. 11: Lake Mweru. 12: Lake Mweru Wantipa. 13: Lake Tanganyika.

the Liuwa Plain. There are two National Parks, Liuwa Plain and Sioma Ngwezi, and the huge West Zambesi Game Management Area. The area has ongoing problems with poaching.

4. A smaller, though still extensive, complex of miombo woodland, grassland, floodplains, wetlands and *Cryptosepalum* forest is centred on the West Lunga National Park, and the contiguous Chibikwa-Ntambu, Musele-Matebo and Lukwakwa Game Management Areas.

5. Another set of protected areas is concentrated in an area of swamps, floodplains and miombo woodlands south of Lake Bangweulu. These are: the Kasanka, Lavushi-Manda and Isangano National Parks, and the Mansa, Kalaso-Mukoso, Kafinda, Bangweulu, Chambeshi and Luwingu Game Management Areas. Protection needs to be extended to cover all of the Bangweulu Swamps and part of Lake Bangweulu itself, with an overall management plan covering both a strictly protected national park for a section of the Bangweulu Swamps and a sustained-yield utilisation area to ensure that the needs of people and wildlife are reconciled.

6. In the northeast is another important complex of protected areas that includes miombo woodland, grassland, extensive swamps and part of the shores of Lake Tanganyika. The protected areas concerned are: the Lusenga Plain, Mweru-Wantipa and Nsumbu National Parks, and the Kaputa and Tondwa Game Management Areas.

7. Outside these six main complexes of reserves are a number of smaller critical sites. Important savanna sites are the Chizera Game Management Area (miombo woodland) and the Mosi-oa-Tunya National Park (this covers the Zambian side of the Victoria Falls, including the gorges below and the riparian stretch of the Zambezi River above the falls). This latter area, which includes the Zambian half of the Victoria Falls, is subject to heavy poaching, and much stricter protection is needed.

8. Additional wetlands of importance are the swamps south of Lake Mweru along the Luapula River, and the Lukanga Swamp. The conservation needs of these areas are currently unknown.

9. Zambia's important lake habitats still receive no formal protection. These include Lakes Tanganyika, Bangweulu, Mweru and Kariba.

10. Zambia does not possess extensive areas of evergreen forest. There are some important montane forests in the northeast, principally in the Nyika National Park (contiguous with the national park of the same name in Malawi). There are additional unprotected areas of montane forest nearby in the Makutu and Mafinga Mountains, and possibly also further to the west on Sunzu Mountain. In the northwest near Mwinilunga there are isolated patches of lowland and gallery forest that are outliers of the main forest block in Zaïre. These forests occupy the headwaters region of the Zambezi River, and their clearance would have serious negative impacts downstream.

Critical Species

1. Plants. 4,600 species occur, of which about 211 are believed to be endemic. The highest diversity of species is found in the northeast around Mbala, and in the northwest in the Solwezi-Mwinilunga areas.

2. Antelopes. 22 species occur, of which 20 are considered to be of a satisfactory conservation status. However, 11 species are threatened outside the National Parks. There are some major populations of the following: Sitatunga (Bangweulu, Kasanka, Mweru-Wantipa); Waterbuck (Kafue National Park, Luangwa Valley); Kafue lechwe (endemic to the Kafue Flats); black lechwe (endemic to the Bangweulu floodplains and the upper Chambeshi River); red lechwe (Busanga Swamp in Kafue National Park, with scattered but important populations at various localities in the west); puku (Kafue National Park, Luangwa Valley, Mweru Wantipa, West Lunga, Nsumbu, Kasanka); southern reedbuck (Bangweulu, Kafue National Park, Mweru Wantipa); sable antelope (Kafue National Park, Sioma Ngwezi, Mweru Wantipa, West Lunga, Lukusuzi); Cookson's wildebeest (endemic to the Luangwa Valley); blue wildebeest (Kafue National Park, Sioma Ngwezi, Lochinvar, Liuwa Plain); Lichtenstein's hartebeest (Luangwa Valley, Nsumbu, Lukusuzi, Kafue National Park); tsessebe (Bangweulu, Liuwa Plain, Sioma-Ngwezi); oribi (Kafue National Park, Liuwa Plain, Bangweulu); impala (Kafue National Park, Luangwa Valley, Sioma Ngwezi, West Lunga); eland (Kafue National Park, Luangwa Valley, Sioma Ngwezi); greater kudu (Kafue National Park, Luangwa Valley, Sioma Ngwezi); roan (Kafue National Park, Sioma Ngwezi, Mweru Wantipa); Sharpe's grysbok (Kafue National Park, Luangwa Valley); and klipspringer (Luangwa Valley and Lower Zambezi escarpments).

3. Elephants and Rhinos. There has been a huge decline in elephant numbers as a result of poaching from 165,000 in 1981 to 40,000 in 1987. 15,000 animals still occur in Luangwa South National Park, and over half the surviving population in Zambia as a whole is in the general Luangwa Valley region. Only about 100 black rhinos survive in scattered populations, mainly in and around the Luangwa Valley, and are unlikely to survive unless offered very strict protection. The tiny population of introduced white rhinos in the enclosed zoological park near the Mosi-oa-Tunya National Park is believed to have been completely eliminated by poaching.

4. Fruit Bats. 11 species occur, of which one is of conservation concern: *Plerotes anchietae* (known only from north Zambia, west-central Angola and southeast Zaïre).

5. Other Mammals. The Luangwa Valley is important for its endemic and isolated subspecies of giraffe. There are

National parks of Zambia. 1: Kafue (22 400 sq km). 2: Liuwa Plain (3660 sq km). 3: West Lunga (1684 sq km). 4: Sioma Ngwezi (5276 sq km). 5: Mosi-Oa-Tunya (66 sq km). 6: Blue Lagoon (450 sq km). 7: Lochinvar (410 sq km). 8: Lower Zambezi (4140 sq km). 9: Mweru Wantipa (3134 sq km). 10: Nsumbu (2020 sq km). 11: Lusenga Plain (880 sq km). 12: Isangano (840 sq km). 13: Nyika (80 sq km). 14: Kasanka (390 sq km). 15: Lavushi Manila (1500 sq km). 16: North Luangwa (4636 sq km). 17: South Luangwa (9050 sq km). 18: Luambe (254 sq km). 19: Lukusuzi (2720 sq km).

major populations of buffalo and hippo in Kafue National Park and the Luangwa Valley, with the Luangwa hippo population being one of the largest in Africa (13,000). Mweru Marsh National Park also has a hippo population of between 2,000 and 3,000. The wild dog is widespread, but is declining in many areas. It has recently suffered from an outbreak of anthrax in the Luangwa Valley. Two rodent species of conservation concern occur: the greater hamster rat *Beamys major* mainly in montane forests in the northeast (also in Malawi and Tanzania); and a possible species of African pygmy mouse *Mus neavei*, endemic to Zambia, occurring at two localities in the southeast.

6. Birds. Seven threatened species occur. The slaty egret has been recorded in the Kafue Flats, Liuwa Plain and Bangweulu Swamp, probably as a non-breeding visitor from northern Botswana. The shoebill is widespread, occurring in the Bangweulu Swamp, Lukanga Swamp, and Kasanka, Mweru-Wantipa and Nsumbu National Park, and probably several other wetland areas. The wattled crane has its main breeding populations in Zambia, principally in the Kafue Hats, Liuwa Plain, Bangweulu Swamp, and Busanga Swamp in the Kafue National Park. It wanders widely within Zambia. The white-winged flufftail is known from two records of migrating birds (possibly having come from South Africa). The black-cheeked lovebird is almost endemic to Zambia, being restricted to a small area in the southwest between the Machili River, Livingstone and the southern tip of the Kafue National Park. It is threatened by the aviary bird trade. The white-chested tinkerbird is endemic to Zambia and is only known from one record from *Cryptosepalum* thickets in the northwest, near West Lunga National Park. Nothing is known of the status or conservation requirements of this species. The papyrus yellow warbler occurs in swamps along the Luapula River near the southern end of Lake Mweru. Its conservation requirements are also unknown. The Luangwa Valley (especially the National Park) is a major wintering ground for the eastern population of the white stork.

7. Crocodiles. The Nile crocodile is still widespread in Zambia, with big populations in Lake Kariba and Mweru-Wantipa National Park. There have been some local declines. The slender-snouted crocodile is only known from Lake Mweru, where its current conservation requirements are not known. Nile crocodiles are kept in four commercial farms, two of which operate on a large scale.

8. Amphibians. One endemic species occurs, a treefrog *Hyperolius kachalolae*, at Kachalola near the Mozambique border. Seven other species are shared with just one country, three of these being with Zaïre, two with Tanzania, and one each with Malawi and Angola.

9. Freshwater Fishes. Two threatened species are known: the ocellated spiny-eel *Afromasculatus vanderwaali* (occurring at Katima Mulilo and Impalila on the Zambezi River); and the broad-headed catfish *Clariallabes platyprosopos* (occurring at the same sites).

10. Invertebrates. Two species of dragonfly of conservation concern occur only in northern Zambia and neighbouring Angola, *Aciagrion rarum* and *Monardithemis flava* (this latter species occurring in Mwinilunga Province).

Threats

1. Zambia's protected areas have suffered from insufficient management in the past, and as a result, elephant and rhino poaching has been very serious. Poaching of all wildlife outside protected areas has resulted in some greatly reduced populations of many species.

2. Some of the montane forest areas, for instance in the Makutu and Mafinga Mountains, are probably threatened by fire.

3. Fish introductions can have a major deleterious effect on native fish populations, as has happened in some neighbouring countries.

Current Conservation Measures

1. Government Administration of Conservation

(a) Responsibility for the environment is divided between several ministries, with coordination provided by the National Conservation Committee (NCC) Secretariat. In the Ministry of Agriculture and Water Development, there are Departments of Veterinary and Tsetse Control Services, Water Affairs, and Fisheries, a Land Use Services Division (with responsibility for water catchments and soil conservation), and a Natural Resources Development College (NRDC).

(b) Within the Ministry of Lands and Natural Resources are Departments on Forests (which includes Divisions on Research, Management, Extension Services, and Bee Keeping), Natural Resources (with responsibility for general natural resource and fisheries conservation), and the National Parks and Wildlife Service (NPWS). This last department operates a revolving fund whereby profits from wildlife and protected areas are channeled directly to conservation operations, rather than to central government

(c) The Ministry of Tourism has the responsibility of developing Zambia's tourism potential, and also oversees the country's museums, one of which, the Livingstone Museum, is involved in conservation-related research programmes.

(d) The National Council for Scientific Research (NCSR) is involved in a number of research programmes in the environmental field, and its influence on the country's conservation policies is quite significant

2. National Parks and Wildlife Service ADMADE Programme (USAID/WWF)

Many of these projects also involve funding from other agencies and where these are known, they are indicated. If a funding agency is omitted it is so because the information was not available to the compilers.

(a) Maize grinding mills for food supplies to wildlife personnel and communities close to reserves.

(b) Provision of four-wheel-drive vehicles for Game Management Area Units.

(c) Tourist Development for North Luangwa NP (ODA/ private investors).

(d) Support for Luano and Rufunsa Game Management Areas (Save the Rhino Trust).

(e) Creation of new Game Management Areas (various agencies).

(f) Training of village scouts.

3. Multi-agency Projects

(a) Technical assistance to the National Conservation Committee Secretariat (IUCN/NORAD/SIDA): promotion of implementation of National Conservation Strategy.

(b) Advisor to National Commission for Development Planning (IUCN/SIDA): integration of an environmental unit into the NCDP.

(c) Kafue Flats and Bangweulu Basin: maintenance of productivity of wetlands, improve benefits derived by local people from wetland resources and mobilise local support for conservation (Debt-for-Nature funds/ODA/WWF).

(d) Wildlife clubs development (WCSZ/WWF).

(e) Conservation education in primary schools (WCSZ/ WWF).

(f) Environmental education programme (WCSZ/ WWF).

(g) Luangwa Integrated Rural Development Project: incorporation of conservation principles and wildlife utilisation into rural development (IUCN/NORAD/WWF).

(h) Southern African Wetlands Project (SADCC/IUCN/ NORAD): aims to develop a regional wetlands strategy based on a review of the status of wetland resources, the identification of priority conservation actions, and the development of integrated land-use in wetlands management.

(i) Zambia Natural Resources Data Base (IUCN/ NORAD/University of Zambia): aims to make data on natural resources more readily available to decision-makers and resource users.

(j) Developing Environmental Impact Assessments in North-West Province as an aspect on rural development (IUCN/BMZ).

4. FINNIDA Projects

(a) Environmental training course for African communicators: course available to nationals of English-speaking SADCC countries.

5. Netherlands Government Projects

(a) Environmental profile of Western Province.

6. PTES Projects

(a) Study of poaching impact on black rhinos in the Luangwa Valley.

7. WWF Projects

(a) Provision of helicopter spare parts for elephant anti-poaching operations.

Suggested Conservation Activities

1. Integrated rural development programmes that permit the sustainable use of wildlife are important, particularly in the following areas:

(i) The project in the Luangwa Valley (LIRDP) should continue to be developed.

(ii) New programmes, based on Game Management Areas, should be established in the Kafue River system.

(iii) Improved management to reduce poaching is needed in the West Zambesi Game Management Area.

(iv) The Game Management Areas in the woodlands, wetlands and floodplains south of Lake Bangweulu should be extended to cover all the swamps and part of the Lake itself. Part of the swamps should be accorded full protection by gazetting as a National Park, but in the context of an overall management plan which gives a strong emphasis to appropriate integrated development

2. Nsumbu National Park should be extended to include part of Lake Tanganyika.

3. New forest reserves are needed in several areas, as specified in *Critical Sites* 10 above. In some of these, notably the Makutu and Mafinga Mountains, it might be necessary to construct fire breaks to protect the forest.

4. Greatly improved protection is needed in the Mosi-oa-Tunya National Park.

5. Wetland areas need assessment for conservation action, particularly the swamps south of Lake Mweru along the Luapula River, and the Lukanga swamp.

6. Anti-poaching measures in all areas are greatly in need of improvement In the south, co-operation with Zimbabwean anti-poaching authorities should be increased.

7. The transfer of small rhino populations to highly-guarded sanctuaries is essential to their survival and should be carried out as soon as possible.

8. Assessment of means to conserve the wild dog, including vaccination against anthrax, is required.

9. Capture and export of the black-cheeked lovebird should be banned and strictly enforced.

10. The conservation requirements of the endemic white-chested tinkerbird need to be assessed.

11. The conservation requirements of the papyrus yellow warbler need assessment.

12. The current conservation needs of the slender-snouted crocodile should be assessed.

13. Introductions of alien fish species into natural lakes and rivers should be prevented, and the conservation needs for threatened freshwater fish species need to be assessed.

Chapter 53: Zimbabwe

Introduction

Area: 390,759 km^2. Cultivated: 7%. Pasture: 12%. Forest/woodland: 61%.

Population (1989 data): 10,119,000. Urban: 24%. Labour force in agriculture (1980): 73%. Density: 26 km^2. Annual growth rate: 3.6%, increasing. Doubling time: 19 years.

Economy (1987 data): World Bank index: low middle-income economy. GNP/capita: $590. GNP annual growth rate: 3.1%.

Biogeographic affinities: Zambezian, with Afromontane elements in the eastern highlands.

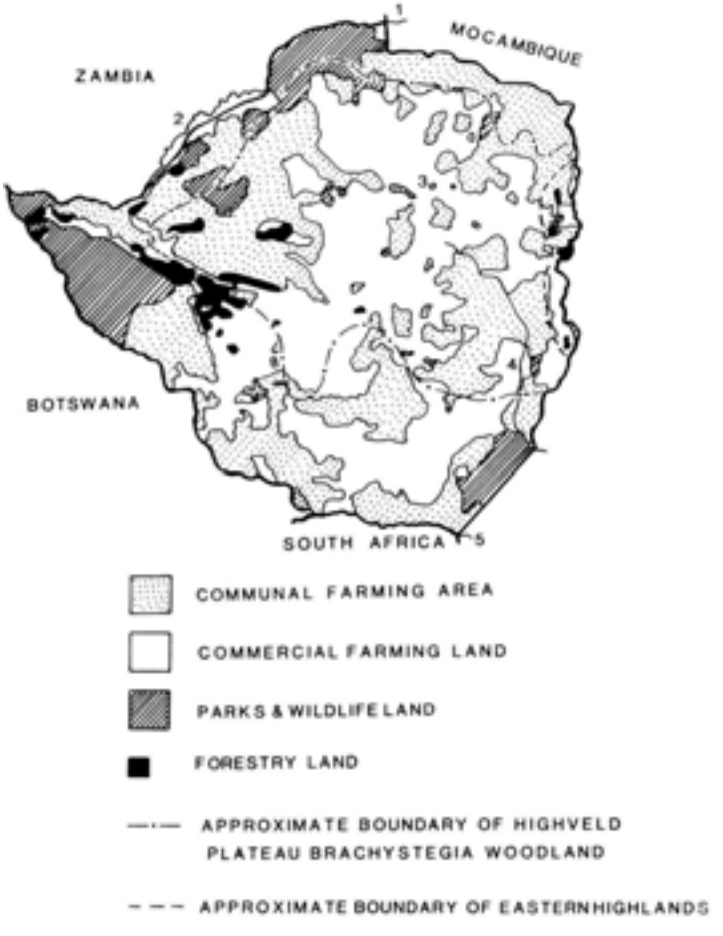
Vegetation: Predominantly dry miombo woodland (now extensively cleared for agriculture), with mopane woodland in the Zambezi and Limpopo Valleys. Grassland occurs along the Great Dyke. In the mountains there is montane grassland and heath, with patches of montane forest.

Critical Sites

1. Zimbabwe is rightly renowned internationally for its well-organised, effective and enlightened conservation effort. As in Zambia, some of the most important critical sites in the country are in complexes of contiguous protected areas. One of the most important is the Zambezi Valley area in the far north of the country. The valley floor is dominated by mopane woodland, but the escarpments and higher ground are characterised mainly by miombo woodland. This is an important area for large mammals. The protected areas concerned are the Mana Pools National Park, and the Chewore, Sapi, Dande, Urungwe, Doma and Charara Safari Areas. Though generally well managed, there is a serious problem of poachers crossing from Zambia to kill rhinos. While already high, the level of anti-poaching activity needs to be increased further, with greater co-operation from the Zambian authorities.

2. Further to the west is another important reserve area in the Lake Kariba and Sebungwe regions. Again, mopane woodland dominates in lower, drier areas, and miombo woodland on the higher ground. The protected areas concerned are: the Chizarira and Matusadona National Parks; the Chirisa Sarari Area (which includes the Sengwa Wildlife Research Area); the Lake Kariba Recreational Park; and the Chete and Sibilobilo Safari Areas. This area is also vulnerable to poaching from neighbouring Zambia, and increased vigilance may be needed.

3. In the extreme northwest of the country in an area of dry woodland and grassland is another important complex of reserves. These are: the Hwange (Wankie), Kazuma Pan, Victoria Falls, and Zambezi National Parks; and the Matetsi and Deka Safari Areas. This area is well managed, though the current anti-poaching effort will need to be maintained. The Victoria Falls have been registered as a World Heritage Site, and include interesting areas of forest around the falls themselves.



Major land categories of Zimbabwe. 1: Zambezi River. 2: Lake Kariba. 3: Harare. 4: Sabi River. 5: Limpopo River.

4. There are many other scattered protected areas in the savanna zone. The largest is the Gonarezhou National Park, which includes a variety of different kinds of savanna woodland habitat This area is currently subjected to some poaching from neighbouring Mozambique and increased protection has been provided. The area has also suffered from serious droughts. The Matobo (Matopos) National Park is an important area of rocky hills and woodland with good wildlife populations. Other isolated protected areas of reasonable size include the Umfurudzi, Chegetu and Chipinge Safari Areas. These last two are in great need of improved protection and management. Most of the remaining savanna woodland protected areas are relatively small, but they nevertheless include some important refuges for a variety of species. The most important are: the Mushandike Sanctuary; the Tuli Safari Area; and the Lake Kyle, McIlwaine, Sebakwe, Umfuli, Ngezi, Bangala, Lake Mayfaire and Umzingwane Recreation Parks. The endemic plant species of the Great Dyke adjacent to the Sebakwe Recreation Park need protection.

5. In the eastern highlands of Zimbabwe, there are a number of important sites that include endemic and near-endemic species. Of particular importance are the various forms of montane vegetation, including grassland, heathland, and evergreen forest Important areas are: the Chimanimani National Park; Inyanga National Park; Mtarazi Falls National Park; Vumba Botanical Reserve and Gardens; Bunga Forest Botanical Reserve; Chimanimani (Melsctter) Eland Sanctuary; Cecil Kop Nature Reserve; and Chirinda Forest on Mount Sclinda. Strict protection of all these areas, including from fire in the evergreen forests, is of great importance. The potential for using these areas for public recreation is probably considerable.

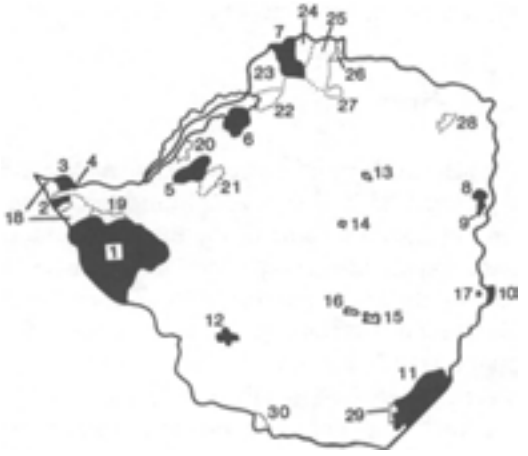
6. A few areas of lowland evergreen forest survive in the southeast, especially in the Lusitu-Haroni area. This interesting habitat is currently unprotected.

Critical Species

1. Plants. About 4,200 species occur, of which about 95 are endemic, including 42 in the Chimanimani Mountains, and 20 associated with the serpentine soils of the Great Dyke.

2. Antelopes. 24 species occur, of which 11 are believed to be threatened, at least to some degree. However, most of these are benefiting from careful conservation attention. Lichtenstein's hartebeest is in a precarious situation, with a total population of not more than 100-150 in Gonarezhou National Park, Mushandike Sanctuary and on farmland in the southeastern lowveld. There are some large populations of several species, notably the greater kudu and impala in the Hwange National Park and several reserves in the Sebungwe and Zambezi Valley areas, the sable in the Hwange-Matetsi area (one of Africa's largest populations of this species), the klipspringer in Matobo National Park. The impala also occurs in the Gonarezhou National Park. There are extensive populations of several species on private farmland, and for some, notably the tsessebe, this has been important in securing their populations.

3. Elephants and Rhinos. Zimbabwe's elephant population of over 50,000 (perhaps over 60,000) is one of the best managed on the African continent Poaching has been kept under control, and elephant numbers are generally maintained at specific levels as a result of management decisions. Official policy is now to reduce Zimbabwe's elephant population to around 35,000 to prevent serious damage to the vegetation. The main concentrations of elephants are: the Hwangwc-Matetsi area, 17,000-28,000; the Zambezi Valley, 11,200-12,000; Sebungwe, 9,200-10,000; and Gonarezhou, 4,500-5,000. Zimbabwe has Africa's largest population of black rhinos, some 2,200 animals, concentrated in the Zambezi Valley, Sebungwe, Hwange and Gonarezhou. Poaching from Zambia and Mozambique has resulted in population declines in the Zambezi Valley and Gonarezhou respectively. The policy of moving the more vulnerable rhinos to farms in the interior, where they can be protected more easily, is vital to their continued protection. The white rhino population is



Conservation areas of Zimbabwe of major importance. *National parks* — 1: Hwangwe (14 650 sq km). 2: Kazuma Pan (313 sq km). 3: Zambezi (564 sq km). 4: Victoria Falls (19 sq km). 5: Chizarira (1910 sq km). 6: Matusadona (1370 sq km). 7: Mana Pools (2196 sq km). 8: Nyanga (289 sq km). 9: Mtarazi Falls (25 sq km). 10: Chimanimani (171 sq km). 11: Gonarezhou (5053 sq km). 12: Matobo (432 sq km). *Recreational parks* — 13: McIlwaine (61 sq km). 14: Ngezi (58 sq km). 15: Kyle (169 sq km). *Sanctuaries* — 16: Mushandike (61 sq km). 17: Melsetter (12 sq km). *Safari areas* — 18: Matetsi (2920 sq km). 19: Deka (510 sq km). 20: Chete (1081 sq km). 21: Chirisa (1713 sq km). 22: Charara (1700 sq km). 23: Urungwe (2880 sq km). 24: Sapi (1180 sq km). 25: Chewore (3390 sq km). 26: Dande (523 sq km). 27: Doma (760 sq km). 28: Umfurudzi (760 sq km). 29: Malapati (162 sq km). 30: Tuli (404 sq km).

around 200 animals, about half of these being in Hwange National Park, with other concentrations at Matobo National Park, Lake Kyle Recreation Park, and on private farms.

4. Other Mammals. There are major populations of giraffe (about 3,000) and buffalo (10,000-15,000) in Hwange. The wild dog is rare, persecuted by farmers, and declining except for the population in Hwange National Park which may be increasing. It has recently been added to the Specially Protected Species list. One rodent species of conservation concern occurs, the Selinda veld rat *Aethomys silindensis,* on Mount Selinda (also in nearby Mozambique).

5. Birds. Five threatened species occur. The Cape vulture is greatly reduced and has not bred since 1971, though birds still roost at Wabai Hill. The wattled crane has also decreased to some 60 breeding pairs, scattered in the eastern highveld, in particular at the Gwebi Flats near Harare, and in the Charter Estate. The white-winged flufftail is known from just three records of migrating birds (perhaps from South Africa). The black-cheeked lovebird is known from the extreme northwest near the border with Zambia, though is possibly now extinct in Zimbabwe (probably because elephants have destroyed its habitat). Swynnerton's forest robin occurs in the forests of the eastern highlands at Chirinda Forest, the Vumba Highlands, and Stapleford, but not the Inyanga Mountains. Three near-threatened species, the forest prinia, Chirinda apalis and blue swallow, have similar, though slightly more extensive, ranges in the eastern highlands. The blue swallow is potentially threatened by afforestation programmes.

6. Crocodiles. The Nile crocodile occurs in good numbers in many waterways, especially in the Zambezi system, with good numbers on Lake Kariba. There are over 12 farms holding the species, supporting an industry worth over US$ 5 million annually.

7 Amphibians. Three species of conservation concern occur, two of which are endemic: *Schoutedenella troglodytes* in the Chimanimani Mountains; *Probreviceps rhodesianus* in the Inyanga Mountains; and *Rana johnstoni* in the eastern highlands and southern Malawi.

8. Invertebrates. The rare dragonfly subspecies *Eleuthemes buettikoferi quadriguttata* is known only from the Zimbabwe-Mozambique border area.

Threats

1. Zimbabwe's conservation effort is generally effective, and wildlife management has become the country's fastest growth industry. A few critical sites are at risk and are not included in the protected area system. These are the parts of the Great Dyke and lowland forests in the southeast

2. Rhino poaching is a major problem in the Zambezi Valley and Gonarezhou National Park.

3. The wild dog is subject to illegal persecution by farmers, which might be having a serious impact on their populations.

Current Conservation Measures

1. Government Administration of Conservation

(a) The Department of National Parks and Wild Life Management within the Ministry of Natural Resources and Tourism is responsible for all aspects of wildlife and protected areas management, though management responsibility of wildlife has been delegated to villagers on communal lands, and to private land-owners in many places. The department has a Branch of Terrestrial Ecology with 20 professional ecologists on staff that make a major contribution to research and management of terrestrial ecosystems in Zimbabwe. The Management Branch is responsible for the vital law enforcement needed to protect vulnerable species such as the black rhino. The conservation and management of forests comes under the Forestry Commission.

2. Multi-agency Projects

(a) Research on components of black rhino conservation strategy (Governmeni/WWF): development of effective survey techniques for black rhinos and examination of rhino translocation techniques.

(b) Zambezi Valley, black rhino translocation programme (Government/WWF): strengthening of existing breeding populations and setting up one new breeding nucleus.

(c) Rhino Survival Campaign (Government/ZNCT): raising funds and equipment for the anti-poaching programme carried out by the Department of National Parks and Wildlife.

(d) Wildlife capture and translocation revolving fund (Government/ZNCT): providing support to the Department of National Parks and Wildlife's capture units through the maintenance of a revolving fund by selling animals to farmers for stocking purposes.

(e) Southern African Wetlands Project (SADCC/ IUCN/NORAD): aims to develop a regional wetlands strategy based on a review of the status of wetland resources, the identification of priority conservation actions, and the development of integrated land-use in wetlands management.

3. EWT Projects

(a) Sponsorship of Department of National Parks and Wild Life staff on training courses.

4. FINNIDA Projects

(a) Environmental training course for African communicators: course available to nationals of English-speaking SADCC countries.

5. ODA Projects

(a) Environmental impact assessment of tsetse fly spraying: examination of the effects of DDT ground spraying on selected populations of animals.

(b) Tree breeding: annual reviews to implement revised breeding programme.

(c) Forest products research: expertise and equipment to support establishment of a forest products laboratory.

6. PTES Projects

(a) Research on wild dog in Hwange National Park, assessment of conservation needs, and liaison with farmers who have dogs on their land.

7. UNDP Projects

(a) A project is being developed which will lead to a national donors conference on the environment. This project has as its primary objective the provision of support to the Government in transforming the National Conservation Strategy into a programme of action.

8. WHF Projects

(a) Support for planning of conservation in Zambezi Valley, especially in the World Heritage Site.

9. WWF Projects

(a) Multispecies animal production systems: development and evaluation of multispecies wildlife use as a sustainable land-use alternative to cattle.

(b) Support for National Conservation Trust: cover of administration costs.

10. ZNCT Projects

(a) Captive breeding programme for African vipers.

(b) Assistance to education camps of the Zimbabwe Hunters' Association.

(c) Support to the Zimbabwe Falconers' Club's captive breeding programme of peregrine falcons.

(d) Assistance to "Quiet Waters" conservation scheme, being developed by Falcon College.

(e) Annual "Young Conservationist of the Year" award.

(f) Establishment of a foot-and-mouth-free buffalo herd in Matusadona National Park to provide a nucleus of animals for safe distribution to game ranches.

Suggested Conservation Activities

1. The protected area system needs extending to include parts of the Great Dyke and lowland forests in the southeast:

(i) Protected areas are needed to include important parts of the Great Dyke to conserve the endemic plant species there.

(ii) A reserve should be created in the Lusitu-Haroni area.

2. Current levels of anti-poaching activity need to be rigorously maintained in all areas, and perhaps increased in Gonarczhou National Park, Chegutu Safari Area and the Safari Areas along the northwest border with Zambia.

3. Zimbabwe's rhino conservation strategy needs to be implemented. The policy of moving vulnerable rhinos to interior sanctuaries should continue.

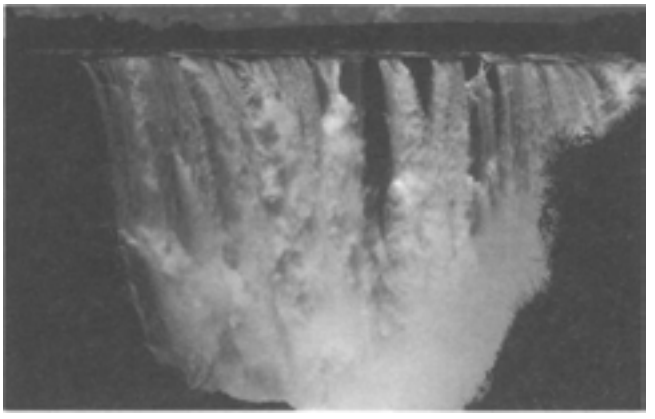
4. Community-based wildlife utilisation schemes should be fostered.

5. Continued conservation action is needed for Lichtenstcin's hartebeest, through an intensive breeding programme.

6. The involvement of private fanners and village cooperatives in the conservation of large mammals should continue.

7. Illegal hunting of the wild dog by farmers should be brought under control.

8. The effects of veterinary fences on migratory wildlife should be carefully monitored.



Victoria Falls (Photo: WWF/L. Bott).

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