Review of the Protected Areas System in the Afrotropical Realm

REVIEW OF THE PROTECTED AREAS SYSTEM IN THE AFROTROPICAL REALM

Prepared by the

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

COMMISSION ON NATIONAL PARKS AND PROTECTED AREAS

in collaboration with the

UNITED NATIONS ENVIRONMENT PROGRAMME

John and Kathy MacKinnon
Consultants

December 1986

Published by: International Union for Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland, and Cambridge, UK.
Prepared and published in collaboration with the United Nations Environment Programme (UNEP .
A contribution to GEMS the Global Environment Monitoring System.

ISBN: 2 88032 609 5

Cover design: James Butler

Cover photo: The wide range of Africa's biological diversity is reflected in this view of glacier clad Mount Kilimanjaro, Tanzania, as seen from the savanna zone of Amboseli National Park, Kenya.

Photo credit: IUCN/Thorsell

Printed by: Stephen Austin & Sons Ltd. Hertford, England.

Available from: IUCN Conservation Monitoring Centre,
219c Huntingdon Road, Cambridge, CB3 oDL, UK
or
IUCN Publications Services,
Avenue du Mont Blanc, CH-1196 Gland, Switzerland

CONTENTS

COUNTRIES OF THE AFROTROPICAL REALM

with abbreviations used in the tables

AN	Angola
BN	Benin
BT	Botswana
BF	Burkina Faso
BR	Burundi
CM	Cameroon
CR	Central African Republic
CH	Chad (part)
CO	Comoros
CN	Congo
DJ	Djibouti
EG	Equatorial Guinea
ET	Ethiopia
GA	Gabon
GM	Gambia
GH	Ghana
GU	Guinea
GB	Guinea Bissau
IC	Ivory Coast
KY	Kenya
LE	Lesotho
LB	Liberia
MD	Madagascar
MW	Malawi
ML	Mali (part)
MR	Mauritania (part)
MA	Mauritius
MZ	Mozambique
NM	Namibia
NG	Niger (part)
NI	Nigeria
RE	Reunion
RW	Rwanda
SP	São Tomé and Principe
SN	Senegal
SY	Seychelles
SL	Sierra Leone
SM	Somalia
SA	South Africa
SC	South Yemen (Socotra)
SH	St Helena
SD	Sudan (part)
SW	Swaziland
TZ	Tanzania
TG	Togo
UG	Uganda
ZR	Zaire
ZM	Zambia
ZW	Zimbabwe

Foreword

The 1985 UN List of National Parks and Protected Areas notes that there are over 88 million ha of land included in 426 protected areas in the Afrotropical Realm. This amounts to 4.4% of the area of the realm. Virtually every African country has established protected areas as a tool for conservation and development and it has been estimated that African Governments spend US$150 million annually on managing these areas and the species they contain.

A substantial investment in land area and in funds thus already exists. We know, however, that much of the protected area system is under stress, that additional resources need to be devoted to allow more effective management, and that there are still additional areas that merit protected status.

Therefore, at the working session of IUCN's Commission on National Parks and Protected Areas held in Victoria Falls, Zimbabwe, in May 1983, it was decided that a broad review of the protected area system needed to be undertaken based on the work carried out by Hugh Lamprey for the 1974 IUCN meeting in Serengeti. The essential issues addressed are (1) how effective is the current coverage of protected areas in sub-Saharan Africa, and (2) where and how many more areas need to be established to ensure that samples of all Africa's biological diversity can be maintained.

In undertaking a large scale review it is accepted that such a broad-brush treatment may result in over-generalisation and not every region will be treated equally. But it is hoped that this total realm survey will stimulate action at the national level. IUCN and UNEP will now promote national reviews of protected areas which will allow finer resolution and more detailed responses to the above issues.

We are certain that this review will be useful both in providing a continental overview as well as outlining a methodology based on the emerging field of conservation science. The results will also be of interest to those currently seeking means to focus support on priority areas and to ensure that inappropriate developments will not affect those key biophysical resources of the Continent that will assist in ensuring a sustainable future.

Reuben Olembo, Director
Environmental Management
UNEP

Walter Lusigi (Kenya)
CNPPA Vice-Chairman
Afrotropical Realm

December 1986

Executive Summary

1 INTRODUCTION

Traditionally African reserves and parks have been created to protect spectacular species or large concentrations of game. As a consequence many of Africa's finest parks protect vast areas of savanna grasslands while other, often biologically richer, habitats are poorly represented within the protected area network. This review was commissioned by the Commission on National Parks and Protected Areas of IUCN to determine how adequate was the existing system of protected areas of the Afrotropical Realm in terms of biogeographical coverage, coverage of major vegetation types and in affording protection to centres of biological richness and species endemism.

The UNESCO/AETFAT/UNSO vegetation map of Africa was used as the basis of the review. The major phytochoria described by White (1983) have been used as the major biogeographic divisions and within each unit the review considers the extent and adequacy of protected area coverage of the main vegetation types. The review concentrates on the terrestrial reserve system and for practical reasons we have considered only protected areas larger than 5000 ha on mainland Africa and over 2000 ha on Madagascar and the offshore islands. Small reserves, particularly on islands, may serve a useful conservation role in preserving rare and endemic species but we were concerned primarily with the larger picture of which biogeographical units and habitats within the Afrotropical Realm were adequately protected and which need greater protection.

2 THE AFROTROPICAL REALM

In this review the Afrotropical Realm is taken to be the whole of Africa south of the Sahara together with the island continent of Madagascar, the southern tip of Yemen and the island of Socotra, the offshore islands of the Gulf of Guinea and the oceanic islands of the western Indian Ocean (Mascarenes, Comoros, Aldabra and Seychelles). The northern boundary of phytochorion XVI – the Sahel Regional Transition Zone – has been taken as the northernmost limit of the Realm.

Africa is an ancient and arid continent with a highly distinct flora and fauna. Compared with Indo-Malaya and the Neotropics, Africa can be regarded as somewhat impoverished in flora and some animal groups, but it has the most varied mammal fauna of all the tropical realms, with 38 families excluding bats. Analyses of data on flora, birds and mammal distributions have revealed several areas of high species richness and endemism.

Africa was the cradle of human evolution and, although the continent today is still not as densely populated overall as many other tropical regions, Man has had a long and dramtic effect on the African landscape. Fire, clearance of forest for agriculture and grazing of stock have all made an impact on the environment and much of the continent's natural habitat and wildlife have been affected by the activities of men and their livestock.

3 PROTECTED AREA COVERAGE BY BIOGEOGRAPHIC UNITS

For each of the major Afrotropical phytochoria we have assessed the total area protected and the extent of coverage of the main natural vegetation types. Particular attention has been paid to distinct habitats such as mangroves, swamp forest, lowland rainforests, alpine vegatation, Cape fynbos etc. We have also considered the biological richness and endemism of each unit and the adequacy of protection of species of special biological, conservation and/or economic interest. Major gaps in the protected area systems have been identified and proposals made for extending and improving protection of the reserve network of those units. Additional conservation needs have also been identified where appropriate.

Of the 17 phytochoria analysed only four:- Cape Regional Centre (V), Karoo-Namib (VI), Lake Victoria Mosaic (XII) and Kalahari Highveld (XIV) are regarded as having adequate protection and

even these show some gaps in their coverage at vegetation type level. At the other extreme, four phytochoria stand out as needing much greater conservation efforts:- Guinea-Congolian (I), East Malagasy (XIX), West Malagasy (XX) and Afromontane (VIII). These regions are some of the most biologically rich in the Realm and also sites of high species endemism, yet they have been greatly neglected in conservation programmes to date. These four units should be the main focus for future support with emphasis on enlarging the protected area systems of these units. There is also scope for improving conservation efforts in all the remaining phytochoria but this can largely be achieved by improving the levels of management of existing and proposed protected areas.

In all units there are some vegetation types that are not adequately protected and specific recommendations to fill these gaps in the reserve network are given in the relevant phytochoria and country sections of this report.

Priority ratings have been accorded to all existing and proposed protected areas. Sites of global importance (Priority A) are those with major wildlife resources, unique examples of a biological community (ecosystem), the best protected examples of each major biological community in the Realm or sites of other special interest. Priority B is accorded to most of the protected areas which make valuable contributions to representative protection of their biotic types and Priority C areas are those regarded as having only regional or national interest.

4 GENERAL CONSERVATION ISSUES

Africa today has many human problems and it would be unrealistic to expect the conservation situation to improve unless the needs of the human population are taken into account in the preparation of national conservation strategies. This section considers problems faced by both people and wildlife and the conflicts between the two. In particular we have considered the need for protection of fragile environments such as the Sahel and critical habitats such as wetlands; the problems of poaching and tsetse control, and the adequacy of the protected area system in providing protection for certain indicator species.

Analyses of selected species lists for diurnal primates, ungulates, threatened mammals and coraciform birds indicate that very few species are not protected within the existing protected area network and most species occur in several reserves. Where gaps have been identified, such as the inadequate protection of the endemic bird and plant species of the Angolan mountains and escarpment forests and of the Imatong Hills of Sudan, Taita Hills of Kenya, mountains of Cameroon, mountains of Malawi (Mulanje etc.) and Ulugurus of Tanzania, specific proposals have been made for additional reserves. The findings of this part of the review mirror closely those from evaluation of vegetation type coverage. Again the areas where protection is weakest are the lowland rainforests of West Africa, Madagascar, and isolated mountains and island communities.

Even where species are recorded from reserves this does not mean they are necessarily secure. Case studies of the elephant and rhinoceros show that poaching is the greatest threat to these and other large mammals.

The protection of wetland sites is a matter of particular concern. The report underlines the neglect so far shown towards protecting waterbodies and rivers throughout the realm. Wetlands, more than most other habitats, are particularly vulnerable to landuse practices outside their boundaries which affect the quality and quantity of water flow. Establishment of wetland protected areas is therefore only one element in a more comprehensive approach to water resource and landuse planning. While small lakes and rivers are protected within reserves too little attention has been paid to the biological richness and general importance of these habitats to wildlife. In particular, more protection must be given to conserve habitats of endemic fish—L. Malawi, L. Tanganyika, L. Victoria, L. Tumba, L. Mai-Ndombe, to conserving eroding mangrove resources and to protecting the major feeding and nesting sites of waterbirds.

5 COUNTRY ACTION REQUIREMENTS

This section reviews national protected area networks on a country by country basis and gives recommendations for extending and improving national reserve systems. Other conservation action is recommended where appropriate and the responsible agencies identified. General recommendations applicable to most countries of the Realm include the need for more detailed landuse plans, with

conservation areas being regarded as a viable alternative form of landuse, and the development of national conservation strategies but most of all the need for conservation education programmes to make the general public and government decision makers aware of the need for conservation action.

In the long-term expanding human populations will be a major factor in reducing areas of natural habitat and countries with large and expanding human populations need to pay particular attention *now* to incorporating protected areas into land-use plans. Nevertheless reserves are of little value or benefit to either wildlife or human communities if they exist only on paper. The greatest conservation priority in the Afrotropical Realm today is improving the levels of management in existing parks and protected areas—by stopping poaching, increasing levels of trained staff, increasing budgets and equipment and improving training. Even those few African countries with adequate and effectively-managed systems of protected areas will need to sustain high levels of financing and interest in conservation if they are to maintain present standards.

6 THE FUTURE OF CONSERVATION IN AFRICA

a. Protection of Critical Habitats

It is not possible to predict with any reliability to what extent the existing protected areas will succeed in maintaining their current species compositions. It is particularly important therefore to consider the protection of wildlife resources and critical habitats outside the protected areas system for these comprise the greater part of the Realm's wildlife estate. Moreover there are a large number of wide-ranging or migratory species which cannot be protected by a system of small isolated protected areas.

Successful conservation in the future requires a new approach—a departure from the current division of land into closed protected areas and unprotected lands where no control is exercised over use. Instead, we need to develop a situation where most rangeland and forestland in the Realm (and elsewhere in the world) is classified as wildlife habitat, with perhaps less land given total protection but some sort of control established over much more land to give better protection to living resources.

It is therefore important to identify critical habitats outside protected areas where specific types of protection are needed. A start has been made by identifying important wetland sites for migrating birds and migration corridors for elephants and other game. In the Sahel region of Africa migration patterns over large areas are critical for the survival of many species, yet it is impossible to protect all these traditional migration routes within the protected area concept. The solution of these conservation needs must be tied to the overall solution of the human problems of the Sahel which will be extremely complex but can be identified as involving largescale resettlement of people from some affected areas to allow the natural environment to recover from its current overutilization and severe degradation. This recovery may also require largescale reafforestation of the northern edge of the rainforest belt to the south of the Sahel from where, through transpiration, the Sahel derives much of its rain.

b. The Cost of Conservation

For most countries of the Realm improving the levels of management in parks and protected areas must be the top conservation priority but this will not be cheap nor easy. To develop and manage an efficient modern national park of moderate size to realistic standards can cost several hundred thousand dollars over a 5 year development schedule. To conserve the Realm's natural heritage will require at least 100 top class reserves (Priority A areas are identified in the report). A realistic budget to develop and manage these areas for the next 10 years at current costs (without inflation) is therefore in the order of 1 billion dollars. There is no way that the impoverished countries of the Realm are going to be able to raise such budgets, especially when politicians are more concerned with economic development and still lack an understanding of the value of wildlife resources to human welfare. This, then, is the challenge for the international conservation agencies. Instead of expending so much energy on trying to find the best conservation return for small sums of money, these agencies must adopt a new approach to generate a tenfold increase in fund-raising if they expect to have any significant impact on the conservation of the Realm. There is no difficulty in finding worthwhile conservation projects for support in Africa, but there is a serious lack of funds, trained manpower and other resources.

c. Species or Ecosystems?

Much of early conservation emphasis in Africa was focused on large mammals (a hang-over from the game hunting era). The distribution of existing protected areas still reflects this bias. More recently, increasing interest has been directed towards identifying sites of importance for birds, plants, reptiles,

butterflies and other groups. In addition the idea of protecting representative samples of all ecosystems has led to the establishment of a more balanced system of protected areas in the realm.

The ecosystem approach to conservation has many pragmatic advantages. Once one has decided on a system of classifying ecosystems these can be mapped, measured and quantified more easily than species numbers and densities. Ecosystems can be monitored by remote sensing methods and indirect indices of conditions—tree cover, bioproductiviy, species richness per unit area, nutritional levels etc. Moreover by conserving ecosystems we save whole pockets of thousands of inter-related species.

The species approach cannot be neglected, however. Ecosystems are made up of individual species and ultimately it is only through monitoring species that we can tell whether ecosystems are healthy or not. Biogeography is an inexact science and the clear lines on the biogeographer's map are very vague and indistinct on the ground. Species' distributions do not fall into neat packets, instead there is a great continuum of overlapping forms.

We have almost gone as far as we can go on the biogeographical approach. The next decade will see the development of far more refined species-based systems for classifying and monitoring ecosystems, using large computerised databases and more detailed field measures of individual species' occurrence and abundance. Only by tackling conservation at the species level can we address the azonal and non-habitat related threats of hunting, poaching, levels of utilization, competition with domestic animals, indirect impact from other human developments, pollution, and other factors affecting the status of wildlife species in the realm. Both the species-orientated and ecosystem-orientated approaches must be maintained during the current phase of conservation in Africa.

d. **International Assistance**

Many of the African nations with some of the most important habitats for conservation are among the poorer countries of the world. Development of adequate protected area systems and improving the management of existing reserves will require continued international assistance both in the form of training and support for planning and implementation on the ground.

International conservation organisations also have a role to play in trying to develop a stronger web of inter-relating cooperation between different countries, between NGOs and Government bodies and between the different international organisations themselves. Good progress has been made in the development of training schools (Mweka, Garoua etc.) but more could be achieved in sharing of management expertise, along the lines of TEDC (technical exchange between developing countries) of the UNDP; in the control of the international poaching and smuggling of wildlife products and in providing indirect assistance where direct assistance may be impossible. It is possible that the establishment of an African Union for Conservation, perhaps within the framework of the Organisation for African Unity (OAU), may be a way to facilitate such increased cooperation.

Résumé

1 INTRODUCTION

Traditionnellement, les parcs et réserves d'Afrique ont été créés pour protéger des espèces spectaculaires ou d'immenses troupeaux. C'est pourquoi, les plus beaux parcs d'Afrique protègent, généralement, de vastes régions de savanes tandis que d'autres biotopes, très riches sur le plan biologique, sont mal représentés dans le réseau des aires protégées. Cet examen a été commandé par la Commission des parcs nationaux et des aires protégées de l'UICN, en vue de déterminer l'adéquation du réseau actuel d'aires protégées du domaine afro-tropical, en terme de couverture biogéographique, couverture des principaux types de végétation et protection accordée aux centres d'endémisme ou biologiquement riches.

La carte de la végétation d'Afrique établie par l'Unesco/AETFAT/BNUS a servi de base à cet examen. Les principales unités de répartition de la végétation décrites par White (1983) ont été utilisées comme principales divisions biogéographiques et dans chaque unité, on a examiné l'étendue et l'adéquation de la couverture des principaux types de végétation dans les aires protégées. L'examen est axé sur le réseau de réserves terrestres et, pour des raisons pratiques, nous n'avons étudié que des aires protégées de plus de 5000 ha sur le continent africain et de plus de 2000 ha à Madagascar et sur les îles situées au large. Les petites réserves, notamment celles qui se trouvent sur des îles, peuvent jouer un rôle utile du point de vue de la conservation en préservant des espèces rares et endémiques mais nous avons surtout cherché à savoir si des unités géographiques et des biotypes du domaine afro-tropical étaient protégés de façon appropriée et lesquels méritaient d'être mieux protégés.

2 LE DOMAINE AFRO-TROPICAL

Pour les besoins du présent examen, le domaine afro-tropical correspond à l'ensemble de l'Afrique au sud du Sahara avec l'île de Socotra, les îles du golfe de Guinée et les îles océaniques de l'océan Indien occidental (Mascareignes, Comores, Aldabra, Seychelles). La limite nord de l'unité XVI de répartition de la végétation—Zone de transition régional du Sahel—a été adoptée comme la limite la plus septentrionale du domaine.

L'Afrique est un continent ancien et aride, possédant une faune et une flore extrêmement particulières. En comparaison avec les domaines indo-malais et néotropical, on peut estimer que la flore de l'Afrique, de même que certains de ses groupes animaux sont quelque peu appauvris. Néanmoins, l'Afrique possède la faune de Mammifères la plus variée de tous les domaines tropicaux, comptant 38 familles à l'exclusion des Chiroptères. Les analyses de données sur la distribution de la flore, des oiseaux et des Mammifères ont révélé plusieurs centres très riches du point de vue des espèces et de l'endémisme.

L'Afrique fut le berceau de l'evolution de l'homme et si, globalement, le continent est aujourd'hui encore moins densément peuplé que nombre de régions tropicales, l'homme exerce depuis longtemps une influence considérable sur le paysage africain. Les feux de brousse, le défrichement pour l'agriculture, l'action du bétail ont tous un impact sur le milieu naturel et bien des biotopes naturels et des espèces sauvages ont subi, d'une manière ou d'une autre, les activités de l'homme et de ses troupeaux domestiques.

3 COUVERTURE DES AIRES PROTEGEES SELON LES UNITES BIOGEOGRAPHIQUES

Pour chacune des grandes unités de répartition de la végétation afro-tropicales, nous avons évalué la superficie totale protégée et les principaux types de végétation naturelle couverts. Une attention spéciale a été accordée à des biotopes particuliers tels que les mangroves, les forêts marécageuses, les forêts pluviales de plaine, la végétation alpine, les fynbos du Cap, etc. Nous avons aussi étudié la richesse biologique et l'endémisme de chacune des unités et le degré de protection des espèces particulièrement intéressantes du point du vue de la biologie, de la conservation et/ou de l'économie. Nous avons relevé les principales lacunes existant dans les réseaux d'aires protégées et fait des propositions en vue d'étendre ou d'améliorer la protection du réseau de réserves de ces unités. Les besoins de conservation supplémentaires ont également été déterminés, le cas échéant.

Nous avons analysé 17 unités de répartition de la végétation parmi lesquelles on considère que quatre seulement—Centre régional du Cap (V), Karoo-Namib (VI), Mosaïque du lac Victoria (XII) et Highveld du Kalahari(XIV)—bénéficient d'une protection adéquate. Cependant même dans ces cas, il existe des lacunes dans la couverture des types végétaux. A l'autre extrême, dans le cas de quatre unités, les efforts de conservation doivent, de toute évidence, être accrus: Guinéenne-congolaise (I), Est-malgache (XIX), Ouest-malgache (XX) et Afro-montagneuse (VIII). Ces régions sont parmi les plus riches du domaine sur le plan biologique et présentent un degré élevé d'endémisme. Cependant elles ont été fort négligées à ce jour, par les programmes de conservation. Ces quatres unités devraient retenir une attention prioritaire dans les programmes à venir et l'accent devrait être mis sur l'extension du réseau d'aires protégées de ces unités. Il y a aussi largement place pour améliorer les efforts de conservation dans toutes les autres unités de répartition de la végétation mais cela peu généralement être fait en améliorant les niveaux de gestion des aires protégées existantes ou proposées.

Dans toutes les unités, il existe des types de végétation qui ne sont pas protégés de manière appropriée et, dans ce rapport, nous présentons des recommandations précises en vue de combler les lacunes dans les chapitres consacrés à telle ou telle unité et au pays concerné.

Des degrés de priorité ont été acordés à toutes les aires protégées existantes ou proposées. Les sites d'importance mondiale (Priorité A) sont ceux qui possèdent des ressources principales de la faune et de la flore sauvages, des échantillons uniques d'une communauté biologique (éco-système), les meilleurs exemples protégés de chacune des communautés biologiques prinicipales du domaine ou des sites présentant un autre intérêt particulier. La Priorité B est accordée à la plupart des aires protégées qui apportent une contribution de valeur à la protection de leurs types biologiques et la Priorité C à des aires ayant une importance régionale ou nationale uniquement.

4 PROBLEMES GENERAUX DE CONSERVATION

Aujourd'hui, l'Afrique et ses peuples ont beaucoup de problèmes et il serait utopique de croire que la situation puisse s'améliorer du point de vue de la conservation à moins que les besoins de l'homme ne soient pris en compte dans la préparation de stratégies nationales de conservation. Ce chapitre examine les problèmes auxquels sont confrontés aussi bien les hommes que les espèces animales sauvages, sans oublier les conflits qui les opposent. Nous avons, en particulier, étudié les besoins de protection de milieux fragiles tels que le Sahel et de biotopes d'importance critique tels que les zones humides; les problèmes du braconnage et de l'éradication de la mouche tsé-tsé et enfin l'adéquation du réseau d'aires protégées par rapport à la protection de certaines espèces servant d'indicateurs.

Des analyses de listes d'espèces sélectionnées (Primates diurnes, Ongulés, Mammifères menacés et Oiseaux Coraciformes) indiquent que bien peu d'espèces ne sont pas protégées dans le réseau actuel d'aires protégées et que la plupart des espèces sont présentes dans plusieurs réserves. Dans les cas où des lacunes ont été découvertes—protection inadéquate des espèces endémiques

d'oiseaux et de plantes des montagnes et des forêts, d'escarpement d'Angola et des collines d'Imatong au Soudan, des monts Taita, au Kenya, des montagnes du Cameroun, du Malawi (Mulanje, etc.) et des Ulugurus en Tanzanie, des propositions spécifiques ont été rédigées concernant la création de nouvelles réserves. Les conclusions de ce chapitre reflètent étroitement celles de l'évaluation de la couverture des types végétaux. Une fois encore, les régions où la protection est le moins bien assurée sont les forêts pluviales de plaine d'Afrique occidentale, de Madagascar et les montagnes et communautés isolées.

Les espèces qui sont répertoriées dans des réserves ne sont pas nécessairement en sécurité. Des études portants sur les éléphants et les rhinocéros montrent que le braconnage est la principale menace pesant sur eux, de même que sur d'autres espèces de grands Mammifères.

La protection des sites de zones humides suscite une inquiétude particulière. Le rapport démontre que, jusqu'à présent, la protection des étendues d'eau et des rivières a été fort négligée. Les zones humides, plus que tout autre biotope, sont vulnérables aux pratiques d'aménagement des terres qui ont lieu hors de leurs limites et affectent la qualité et le débit des eaux. La création d'une aire protégée dans une région humide n'est donc qu'un élément d'un plan de gestion plus complet des ressources hydrauliques et de l'occupation des sols. De petits lacs et des rivières sont certes protégés à l'intérieur des réserves mais la richesse biologique et l'importance générale de ces biotopes pour la faune sauvage reçoivent trop peu d'attention. Il faut, en particulier, améliorer la protection d'habitats de poissons endémiques—lac Malawi, lac Tanganyika, lac Victoria, lac Tumba, lac Mai-Ndombe—conserver les ressources de mangroves en régression et protéger les principaux sites de nourrissage et de nidification des oiseaux d'eau.

5 MESURES NECESSAIRES SELON LES PAYS

Ce chapitre étudie les réseaux nationaux d'aires protégées, pays par pays et présente des recommandations en vue de les élargir ou de les améliorer. Le cas échéant, d'autres mesures de conservation sont recommandées et les organismes pouvant en prendre la responsabilité ont été identifiés. Parmi les recommandations générales, applicables à la plupart des pays du domaine, on note, la nécessité de préparer des plans d'occupation des sols plus détaillés dans lesquels les régions consacrées à la conservation seraient considérées comme des formes possibles d'occupation des sols, la préparation de stratégies nationales de conservation mais surtout, la nécessité de mettre en place des programmes d'éducation afin de rendre le grand public et les décideurs conscients du besoin de prendre des mesures de conservation.

A long terme, la croissance démographique sera un facteur essentiel dans la réduction des habitats naturels et les pays ayant une forte population, qui plus est, en expansion, doivent s'efforcer tout particulièrement d'incorporer, *dès maintentant,* des aires protégées dans leurs plans d'occupation des sols. Quoi qu'il en soit, les réserves ont bien peu d'intérêt, que ce soit pour la faune ou pour l'homme, si elles n'existent que sur le papier. Aujourd'hui, dans le domaine afro-tropical, la plus grande priorité du point de vue de la conservation consiste à améliorer le niveau de la gestion des parcs et aires protégées—en faisant cesser le braconnage, en améliorant le niveau du personnel formé, en augmentant les budgets et l'équipement et en améliorant la formation. Les rares pays africains qui ont des réseaux d'aires protégées adéquats et gérés de façon efficace doivent eux-mêmes maintenir un niveau de financement et un intérêt pour la conservation élevés s'ils veulent préserver la qualité actuelle.

6 L'AVENIR DE LA CONSERVATION EN AFRIQUE

a) Protection des biotopes d'importance critique

Il est impossible de prévoir avec la moindre précision dans quelle mesure les aires protégées existantes parviendront à préserver leur composition actuellee en espèces. Il est donc tout particulièrement important d'envisager la protection des ressources sauvages et des biotopes d'importance critique, en dehors du réseau d'aires protégées car c'est là que se trouve la majeure

partie de la faune et de la flore sauvages du domaine. En outre, de nombreuses espèces sont migratrices ou ont une aire de répartition très étendue de sorte qu'elles ne peuvent être sauvegardées dans un réseau de petites aires protégées isolées.

Pour que la conservation obtienne des résultats positifs, à l'avenir, il faudra adopter une démarche nouvelle, radicalement différente de la division actuelle des sols en aires protégées fermées et régions non protégées où l'utilisation des sols ne fait l'objet d'aucun contrôle. Il faudra en venir à une situation où la plupart des pâturages et des forêts du domaine (comme ailleurs dans le monde) seront classés 'habitats de la faune et de la flore sauvages', où moins de terres seront sans doute totalement protégées mais où une réglementation d'une sorte ou d'une autre sera exercée sur beaucoup plus de terres afin de mieux protéger les ressources vivantes.

Il importe donc de déterminer les habitats d'importance critique se trouvant en dehors des aires protégées qui ont besoin de formes spécifiques de protection. On a déjà commencé en identifiant des sites humides particulièrement importants pour les oiseaux migrateurs et des couloirs de migration pour les éléphants et autres animaux. Dans la région du Sahel, la migration sur de vastes espaces est vitale pour de nombreuses espèces or, il est impossible de protéger toutes ces voies traditionnelles de migration dans le cadre des aires protégées. La solution des problèmes de conservation doit être liée à celle des problèmes humains dans la région du Sahel. Ce sera extrêmement complexe mais on peut imaginer qu'il faudra déplacer des populations des régions touchées par la sécheresse pour permettre au milieu naturel de se régénérer après avoir été surexploité et gravement dégradé. Pour contribuer à la régénération, il faudra sans doute aussi reboiser de vastes régions, à la limite septentrionale de la ceinture de forêts pluviales du sud du Sahel qui, par le phénomène d'évapotranspiration, produit une bonne partie des pluies qui arrosent le Sahel.

b) **Le prix de la conservation**

Sur le plan de la conservation, la priorité droit être donnée à l'amélioration de la qualité de la gestion des parcs et des aires protégées dans la plupart des pays du domaine. Cependant, ce ne sera ni bon marché, ni facile. Etablir et administrer efficacement un parc national moderne de taille modérée, selon des normes réalistes, peut coûter plusieurs centaines de milliers de dollars pour un plan de développement d'une durée de cinq ans. Pour conserver le patrimoine naturel du domaine il faut au moins 100 réserves de très haute qualité (les régions classées "Priorité A" sont présentées dans ce rapport). Le budget réaliste de mise en place et d'administration de ces régions pour les 10 ans à venir, aux prix actuels (sans inflation) est donc de l'ordre de 1 milliard de dollars. Les pays pauvres du domaine ne seront en aucune manière à même de se doter de tels budgets, d'autant plus que les hommes politiques sont plus concernés par le développement économique et ne comprennent pas encore la valeur des ressources sauvages pour le bien-être de l'homme. Tel est donc le défi posé aux organismes internationaux de la conservation. Au lieu de brûler tant d'énergie à chercher comment obtenir le meilleur résultat en matière de conservation pour un faible investissement financier, ces organismes doivent changer de stratégie et s'efforcer de multiplier leur revenu par dix s'ils veulent avoir une influence notable sur la conservation du domaine. Il est aisé de trouver des projets de conservation valables pour l'Afrique mais ce sont les fonds, le personnel formé et autres ressources qui font cruellement défaut.

c) **Les espèces ou les écosystèmes?**

Par le passé, bien des projets de conservation en Afrique ont mis l'accent sur les grands Mammifères (héritage de l'époque des grandes chasses). La répartition des aires protégées reflète encore ce soucis. Depuis quelque temps, on s'intéresse de plus en plus à l'identification de sites importants pour les oiseaux, les plantes, les reptiles, les papillons, etc. En outre, l'idée de protéger des échantillons représentatifs de tous les écosystèmes a conduit à la mise en place d'un réseau plus équilibré d'aires protégées du domaine.

Considérer la conservation sous l'angle des écosystèmes a bien des avantages pratiques. Dès que l'on a décidé dun système de classification des écosystèmes, ceux-ci peuvent être cartographiés, mesurés et quantifiés plus facilement que le nombre et la densité des espèces. Les

écosystèmes peuvent être surveillés par télédétection ou grâce à des indices indirects des conditions—couverture arborée, productivité biologique, richesse en espèces par unité de surface, niveaux nutritionnels, etc. De plus, en conservant des écosystèmes nous pouvons sauver des milliers d'espèces liées les unes aux autres.

Il ne faut cependant pas négliger les espèces. Les écosystèmes se composent d'espèces individuelles et, en fin de compte, ce n'est qu'en surveillant en permanence les espèces que nous pouvons déterminer si l'écosystème est ou non en bonne santé. La biogéographie est une science inexacte et les lignes précises de la carte biogéographique s'estompent rapidement sur le terrain. La distribution des espèces ne peut être délimité d'un trait de crayon: c'est un vaste continuum dans lequel toutes les formes de vie se rencontrent et se mêlent.

Nous avons pratiquement poussé la démarche biogéographique au plus loin. Dans la prochaine décennie, seront mis au point des systèmes de classification et de surveillance continue des écosystèmes fondés sur les espèces et beaucoup plus élaborés. Ils utiliseront de vastes banques de données informatisées et des mesures de terrain beaucoup plus précises sur la présence et l'abondance des espèces individuelles. Ce n'est qu'en abordant la conservation au niveau des espèces que nous viendrons à bout des menaces extérieures aux zones protégées: la chasse, le braconnage, l'utilisation intensive, la concurrence des animaux domestiques, les impacts indirects d'autres activités de l'homme, la pollution et autres facteurs affectant l'état des espèces sauvages dans le domaine. A l'étape actuelle de la conservation en Afrique, il convient d'utiliser aussi bien la démarche orientée sur les espèces que celle qui prend appui sur les écosystèmes.

d) **Assistance internationale**

Bien des pays africains possédant certains des biotopes les plus importants du point de vue de la conservation sont parmi les plus pauvres du monde. L'établissement de réseaux adéquats d'aires protégées et l'amélioration de la gestion des réserves existantes nécessitent une assistance internationale permanente, au niveau de la formation et du financement de la planification et de la mise en œuvre sur le terrain.

Les organismes internationaux concernés par la conservation de la nature ont aussi un rôle à jouer en ce qui concerne l'instauration d'un réseau de coopération renforcé entre les différents pays, les ONG et les organismes gouvernementaux mais aussi entre les différentes organisations internationales elles-mêmes. Des progrès notables ont été accomplis par l'établissement d'écoles de formation (Mweka, Garoua, etc.) mais on pourrait faire bien davantage grâce au partage de l'expérience en matière de gestion (sur le modèle de l'Echange technique entre pays en développement du PNUD); au contrôle du braconnage et de la contrebande des produits d'origine sauvage, à l'échelle internationale et à l'octroi d'une assistance indirecte lorsqu'il est impossible d'apporter une assistance directe. Il se peut que la création d'une Union africaine pour la conservation de la nature, éventuellement dans le contexte de l'Organisation de l'unité africaine (OUA) soit un moyen d'encourageer une coopération accrue.

Acknowledgements

We would like to express our thanks to the many people who have helped and contributed to the present review. Data have come from many sources (see bibliography) but several individuals deserve special mention.

The concept for this review was first proposed at a meeting of members of the Commission on National Parks and Protected Areas held at Victoria Falls, Zimbabwe, in 1983. Many of the African parks managers and biologists who attended that meeting have been involved with the project since its inception and we have benefited greatly from their help, comments and encouragement.

Dr. Jerry Harrison of the Protected Areas Data Unit of the IUCN Conservation Monitoring Centre provided us with our primary starting material—the draft of the IUCN Directory of Protected Areas of the Afrotropical Realm. He and his staff have continued to cooperate with us in exchange and update of information, and by supplying us with maps, reports, figures etc. throughout the review process.

Dr. Frank White provided valuable advice as to how to make best use of the UNESCO vegetation map in assessing protected area coverage and gave us some general comments on conservation priorities in the Realm.

Dr. Brian Huntley contributed a great deal of information about protected areas in southern Africa and supplied us with figures on remaining and protected areas of natural vegetation types in the southern parts of the Realm, as well as providing much valuable comment and encouragement.

Dr. David Cumming and his staff assisted in measuring vegetation types off the UNESCO vegetation maps and prepared preliminary tables of protected areas by vegetation type throughout the Realm. Dave also gave us much useful information and comment, and organised a tour of Zimbabwe parks for John MacKinnon.

Dr. Richard Bell provided information on conservation needs in Malawi and gave a good deal of constructive comment on the methodology and details of the review. He also generously made the arrangements for a regional workshop for experts from the Afrotropical Realm to discuss the review in Malawi in June 1985. Mr. Moses Kampumula and his staff kindly helped organise this workshop in the Kasungu National Park, Malawi, and provided useful insight into the needs of protected area managers and administrators.

Dr. Hugh Lamprey gave valuable insight into the background of the current conservation situation in eastern and northern Africa and updated his excellent summary of conservation needs (1974) for consideration in the present review. Dr. David Western gave us constructive comment and advice about the review methodology and general descriptions.

In the course of preparing this review John MacKinnon attended the regional workshop in Malawi and also visited Zimbabwe, Kenya, Gabon, Cameroon, Liberia, Ivory Coast, Sierra Leone and Senegal to see some of these countries' national parks and protected areas and discuss conservation needs and priorities with the relevant conservation departments and field staff. Thanks are due to numerous officials and foreign experts in these countries but in particular to David Momo, Ngog-Nje and Waga Bekreo (Cameroon), Emmanuel Emeh and Alexander Peal (Liberia), P.D. Palmer, M. Gordon and E.P. Koroma (Sierra Leone), Christopher Sagna and Al-Hassane Seck Mane (Senegal), Cisse Habout Dramane (Ivory Coast), and Mr. Dipouma and Joseph Maroga-Mbina (Gabon). Dr. Rob Malpas offered up-to-date advice on conservation needs in East Africa as well as providing temporary office space in Nairobi during the preparation of the Review. In November 1985 Kathy MacKinnon attended the conference on Conservation and Development in Madagascar and received much help and useful comment from officials of Eaux et Forêts, J. Andriamampimini, B. Vaohita, Udo Hirsch and many visiting and local scientists engaged in conservation-orientated projects in Madagascar.

Ms. Anne Burrill compiled the chapter on elephant conservation based on the files and reports collected by Dr. Iain Douglas-Hamilton for the Elephant Survey and Conservation Programme, funded by World Wildlife Fund-US and New York Zoological Society.

The Threatened Plants and Species Conservation Monitoring Units of the Conservation Monitoring Centre of IUCN provided data on species status and conservation priorities. Nigel Collar and Paul Goriup of the International Council for Bird Preservation provided information on threatened African birds.

Chairmen of the various Species Survival Commission's specialist groups of IUCN and ICBP took time to contribute their own group conservation priorities for inclusion in the review including allowing us access to several prepublication reports, papers and books.

Dr. Jim Thorsell of CNPPA kept us supplied with up-to-date incoming reports and information, and provided the finance and encouragement to permit the review to take place. John Kundaeli assembled a comprehensive literature collection on conservation reports of the whole realm.

The technical production of the report was assisted by Anne Burrill, Sophie Burkett, Hilary Tye, Haruko Uryu and Mair Fryer.

Thanks are due to many other experts and national conservation officers with whom we held discussions, who provided reports, lists or other information or who assisted us to visit many of the Realm's protected areas during the course of the current review. We are also grateful to the many people who gave freely of their time to comment on the first draft of this review and provided valuable information on their particular fields of expertise. We have tried to make this review as comprehensive as possible and hope that it will be a useful tool for determining conservation priorities in the Afrotropical Realm.

John and Kathy MacKinnon
Haddenham, U.K., 1986.

Part One
INTRODUCTION

Part One – INTRODUCTION

1.1 OBJECTIVES AND CRITERIA OF PROTECTED AREAS

Protected areas are territories with legally defined boundaries, established to afford protection to certain natural characteristics of particular value or interest. The establishment and management of such protected areas are regarded as two of the most important ways of ensuring that the World's natural resources are conserved to meet the material and cultural needs of mankind now and in the future.

The World Conservation Strategy, launched jointly by IUCN, WWF and UNEP in 1980, advocates conservation of living resources as essential for sustaining development by:

– maintaining the essential ecological processes and life-support systems on which human survival and development depend;
– preserving genetic diversity on which depend the breeding programmes necessary for the protection and improvement of cultivated plants and domesticated animals, as well as much scientific advance, technical innovation, and the security of the many industries that use living resources; and
– ensuring the sustainable utilisation of species and ecosystems which support millions of human communities as well as major industries.

An essential element in any programme attempting to achieve these objectives is the establishment of networks of protected areas for *in situ* conservation of species and ecosystems.

Protected areas are needed to ensure that representative samples of important natural regions of the Earth are retained in perpetuity, that the Earth's biological and physical diversity is maintained, and that wild genetic materials are conserved. At the national level, protected areas are needed to preserve the nation's natural and cultural heritage, to protect water supplies and to provide many other real economic and aesthetic benefits. The need for protected areas is accepted by most national governments and all the governments in the Afrotropical Realm have established at least some protected areas.

Objective 1 of the Bali Action Plan prepared by IUCN as an outcome of the Third World National Parks Congress in Bali in 1982 is: TO ESTABLISH BY 1992 A WORLD-WIDE NETWORK OF NATIONAL PARKS AND PROTECTED AREAS, EXEMPLIFYING ALL TERRESTRIAL ECOLOGICAL REGIONS. It was also agreed at the Congress that a biogeographical approach should be used in selecting additional protected areas.

Protected areas may be established for several reasons including:

– to protect characteristic or unique examples of ecosystems such as tropical rainforest or freshwater systems;
– to protect species of special interest, value or rarity or species under threat;
– to protect landscapes or geophysical features of aesthetic or scientific value;
– to protect hydrological protective functions, soil, water, and climate;
– to provide facilities for nature recreation, tourism and education;
– to protect sites of special scientific interest such as areas of long-standing research; and
– to protect cultural sites such as sacred sites, temples, shrines or archaeological excavations.

Many protected areas will serve several of these functions at the same time.

The objectives of the protected area will determine the type and degree of protective management needed. In practice most countries have a number of different categories of protected area each requiring different levels of protection. Each country has its own criteria and terminology for protected areas. Worldwide, there exist over a hundred different names for legally protected areas, though many have the same management objectives. To simplify the situation IUCN have defined eight distinct functional categories which can be related to most of these different national criteria. This allows better comparison of the respective conservation efforts of each country. It also clarifies to individual countries the international standards being applied to protected areas.

There is a recognised need for some redefinition of the categories of protected areas and IUCN has started the process of reviewing their existing classification. Until such a new system is adopted, however, we must follow the existing definitions. The following categories of protected areas are currently recognised by IUCN (McNeely & Miller, 1984):

CATEGORY I. Scientific Reserve/Strict Nature Reserve
Management Objectives: To protect nature (communities and species) 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, education, and for the maintenance of genetic resources in a dynamic and evolutionary state. Research activities need to be planned and undertaken carefully to minimize disturbance.

CATEGORY II. National Park.
Management Objectives: To protect natural and scenic areas of national or international significance for scientific, educational, and recreational use. The area should perpetuate in a natural state representative samples of physiographic regions, biotic communities and genetic resources, and species in danger of extinction to provide ecological stability and diversity.

CATEGORY III. Natural Monument/Natural Landmark.
Management Objectives: To protect and preserve nationally significant natural features because of their special interest or unique characteristics and, to the extent consistent with this, provide opportunities for interpretation, education, research, and public appreciation.

CATEGORY IV. Nature Conservation Reserve/Managed Nature Reserve/Wildlife Sanctuary.
Management Objectives: To assure the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment where these may require specific manipulation for their perpetuation. Scientific research, environmental monitoring, and educational use are the primary activities associated with this category.

CATEGORY V. Protected Landscape or Seascape.
Management Objectives: To maintain nationally significant natural landscapes which are 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 the areas. These are mixed cultural and natural landscapes of high scenic value where traditional land-uses are maintained. These areas also provide for ecological diversity, scientific, cultural and educational purposes.

CATEGORY VI. Resource Reserve.
Management Objectives: To restrict use of these areas until adequate studies have been completed on how to best utilize these remaining resources; 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 which are based upon appropriate knowledge and planning.

CATEGORY VII. Natural Biotic Area/Anthropological Reserve.
Management Objectives: To allow the way of life of indigenous societies living in harmony with the environment to continue undisturbed by modern technology. Research into the evolution of man and his interaction with the land would be a secondary objective.

CATEGORY VIII. Multiple Use Management Area/Managed Resource Area.
Management Objectives: To provide for the sustained production of water, timber, wildlife (including fish), pasture or marine products, and outdoor recreation. The conservation of nature may be primarily orientated to the support of the economic activities (although specific zones may also be designated within these areas to achieve specific conservation objectives), or conservation may be a primary objective in its own right and given equal importance to economic and social objectives. Within the overall area, zones may be established in which either the conservation of nature or sustainable development is the primary objective.

In addition there are two international categories which overlap with, and are usually selected from, pre-exisiting national protected areas which meet additional international criteria. Biosphere reserves are identified as part of the UNESCO Man and the Biosphere Programme. World Heritage Sites are nominated according to the International Convention concerning the Protection of the World Cultural and Natural Heritage (UNESCO 1972). Table 1.1 lists World Heritage Sites and Biosphere Reserves of the Afrotropical Realm.

Table 1.1 World Heritage Sites and Biosphere Reserves of the Afrotropical Realm

World Heritage Sites

ETHIOPIA
Simen National Park

GUINEA
Mount Nimba Strict Nature Reserve

IVORY COAST
Comoe National Park
Tai National Park
Mount Nimba Strict Nature Reserve

MALAWI
Lake Malawi National Park

SENEGAL
Djoudj National Park
Niokolo-Koba National Park

SEYCHELLES
Aldabra Atoll
Vallée de Mai Nature Reserve

TANZANIA
Ngorongoro Conservation Area
Serengeti National Park
Selous Game Reserve

ZAIRE
Kahuzi-Biega National Park
Salonga National Park
Virunga National Park
Garamba National Park

ZIMBABWE
Mana Pools National Park, Sapi and Chewore Safari Areas.

Biosphere Reserves

CAMEROON
Dja Reserve
Benoue National Park
Waza National Park

CONGO
Odzala National Park

GHANA
Bia National Park

IVORY COAST
Comoe National Park
Tai National Park

MALI
Boucle du Baoule National Park

NIGERIA
Omo Reserve

SENEGAL
Niokolo-Koba National Park
Delta du Sine Saloum
Samba Dia Forest

TANZANIA
Serengeti N.P. & Ngorongoro CA.
Lake Manyara National Park

ZAIRE
Yangambi Floristic Reserve
Luki Floristic Reserve
Lufira Valley

CENTRAL AFRICAN REPUBLIC
Bamingui-Bangoran Conservation Area
Basse-Lobaye Forest

GABON
Ipassa Makokou Reserve

GUINEA
Massif du Ziama Biosphere Reserve
Mount Nimba Biosphere Reserve

KENYA
Mount Kulal Biosphere Reserve
Mount Kenya Biosphere Reserve
Kiunga Marine National Reserve
Malindi-Watamu Biosphere Reserve

MAURITIUS
Macchabee/Bel Ombre Nature Reserve

RWANDA
Volcanoes National Park

SUDAN
Radom National Park
Dinder National Park

UGANDA
Queen Elizabeth National Park

CATEGORY IX. Biosphere Reserve.
Management Objectives: To conserve for present and future use the diversity and integrity of biotic communities of plants and animals within natural ecosystems, and to safeguard the genetic diversity of species on which their continuing evolution depends. Biosphere reserves provide opportunities for ecological research, particularly baseline studies, both within natural and altered environments. These reserves have particular value as benchmarks or standards for measurement of long-term changes in the biosphere as a whole and are consequently important sites for environmental monitoring. Biosphere reserves provide facilities for education and training.

CATEGORY X. World Heritage Site (Natural).
Management Objectives: To protect the natural features for which the area was considered to be of World Heritage quality; to provide information for world-wide public enlightenment; and to provide for research and environmental monitoring.

IUCN encourages countries to employ a broad range of protection categories to give their systems greater flexibity, give some protection to areas that can never be acquired as totally protected areas and to help integrate conservation more closely with development and production. Utilisation in protected areas, however, must be undertaken with the utmost care to ensure that vital protection needs are not compromised.

1.2 AIMS AND SCOPE OF THE PRESENT REVIEW

The current review aims to examine the existing system of protected areas of the Afrotropical Biogeographical Realm with a view to:
- evaluating the representational coverage and conservation importance of the existing protected areas system of the realm;
- identifying gaps and shortcomings in the system;
- evaluating the conservation importance of proposed reserves and other areas of biological richness and recommending where additional protected areas are needed;
- identifying priorities for strengthening protection;
- considering the suitability of the status, boundaries, design and effectiveness of the existing reserve system ; and
- identifying conservation management needs in critical habitats outside protected areas.

This review concentrates on terrestrial protected areas; recommendations for extending and improving the protection of marine habitats of eastern Africa have been prepared by Salm and Chong (UNEP 1984). The review is based on the work of the IUCN Conservation Monitoring Centre which, in cooperation with the Commission on National Parks and Protected Areas (CNPPA), has already prepared an up-dated directory of protected areas in the countries of the Realm, with information for each area on status, condition, contents and management (PADU/IUCN 1986). Other information has been provided by the Species Specialist Groups of IUCN and parks planners and managers throughout the Afrotropical Realm.

The current review will evaluate protected area data from a number of different viewpoints:
- how much of each biogeographical sub-division is protected;
- coverage of the regional and altitudinal range of each sub- division and inclusion of other features (e.g. physical or ethnic interests) that need protection;
- coverage in relation to species richness, centres of high biological distinctiveness or endemism and in relation to threats to habitat;
- coverage in relation to commercial interest or value of content (e.g. genepools etc.);
- the category status of the individual protected areas and whether this is appropriate or needs revision;
- evaluation of the design of protected areas systems on the basis of island biogeographical theory;
- management effectiveness in individual reserves; and
- consideration of adjacent land-use and critical habitat requirements.

1.3 BIOGEOGRAPHY THEORY AND PROTECTED AREAS SYSTEM DESIGN

Before selecting new areas as protected areas it is necessary to have some overall design for planning the whole system of protected areas. The main questions to be answered are:
- How much land needs to be reserved to protect all species and habitat types?

– How many reserves are needed?
– Where should reserves be?, and
– How large must reserves be?

In recent years a great deal of scientific effort has gone into the theory and practice of reserve design. Two main lines of research have been most helpful in designing reserves.

a. **The Theory of Minimum Critical Size.**

Since politicians tend to see the establishment of very large reserves as a wasteful use of land resources, and pressure for land in most countries is now severe, it is important to develop a strong scientific justification for the size of protected areas. Various attempts have, therefore, been made to identify the minimum size required to include viable populations of all essential component species in each ecotype. The topic has been well reviewed by Frankel and Soulé 1981, Soulé et al. 1979, Diamond 1975, Lovejoy and Oren 1981 and Wilcox 1984.

The theory depends on determining what is the minimum viable population size for plant and animal species to ensure their survival, then estimating what area is needed to support populations of this size. This area can be estimated by measuring the densities in nature of the rarest species in the ecosystem and multiplying this figure up till it gives an adequate population size for the most extinction-prone species of the system. There are two ways of estimating the minimum viable size of populations:

i. Genetic and mathematical estimates can be made of the numbers of breeding individuals needed to maintain natural levels of genetic heterozygosity for a given species' sex ratio and levels of outbreeding and generation length. Estimates for this vary widely but are usually between 500 and 10,000 with 5000 individuals as a medium figure (see Toda in Richardson 1970, Terborgh 1974, East 1981).

ii. The second approach involves looking at populations on small islands to see what are numerically the smallest stable surviving isolated populations. Again figures in the order of 5000 individuals are suggested.

If we use this figure of 5000 individuals as a crude rule of thumb we can estimate the area of rich lowland rainforest needed to protect most tree species. Since most tree species are present at densities of less than one tree per hectare, and many species at densities as low as 1 tree per 10 hectares, to include viable populations of most tree species would require a reserve of at least 50,000 ha for the richest habitat. Slightly smaller areas would suffice for less species-rich habitats because densities of constituent species are higher. Although there is still sufficient land to establish such large reserves in the larger countries of the realm, for smaller countries such extensive areas can only be achieved by buffering reserves with areas of partially protected natural habitat, linking smaller reserves by means of protected corridors or forming transfrontier reserves with neighbouring countries. The smaller and more densely populated the country the more difficult it is to protect sufficient land to conserve populations of all the native animals.

Even the smallest invertebrates are present at very low densities in rainforest (Elton 1975) and the rarest animals in the forest occur at densities of less than 1 per 10 ha. Leopards in rainforest, for instance, may be as rare as 1 per 10 sq. km. so that a population of 5,000 leopards would require a reserve of 5 million hectares. Clearly it is impossible to acquire such large reserves. Outbreeding for such animals can only be achieved by artifical translocation between different undersized populations.

b. **Island Biogeography Theory.**

There is an extensive literature on the continuing controversy over the value of Island Biogeography Theory in evaluating protected area design and management (see Soulé and Simberloff 1986 and Stuart, in press).

Several classic studies of the biogeography of islands (Diamond 1975, Simberloff 1974) have shown that small islands are unable to support as many species as larger islands of similar habitat and that isolated islands support fewer species than islands close to the mainland. According to the Theory of Island Biogeography (MacArthur and Wilson 1967) a given island can support only a limited number of species and species numbers will return to this equilibrium point, even after artificial attempts to enrich or impoverish the island fauna by adding or removing species. Equilibrium is maintained by a balance between species immigration and extinction, these rates being set by island area and distance from a colonising source (see figure 1.1).

As a rough guide a tenfold increase in land area results in a near doubling of the number of species that an island can support at equilibrium. This holds true for even the largest island and total species lists of both plants and animals, for example, on different Indonesian islands closely fit the predicted pattern (figs 1.2 and 1.3).

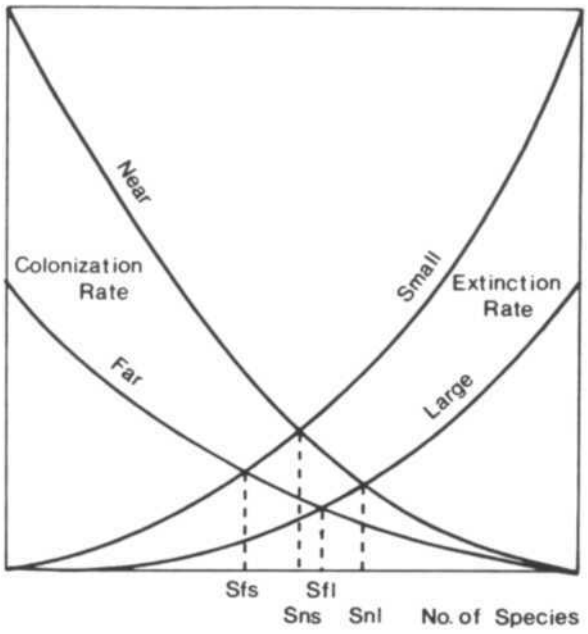


Figure 1.1 *The relative number of species on small, distant islands (Sfs). small, near islands (Sns). large, distant islands (Sfl) and large, near islands (Snl) is governed by the relative balance between extinction rate and rate of colonization.*

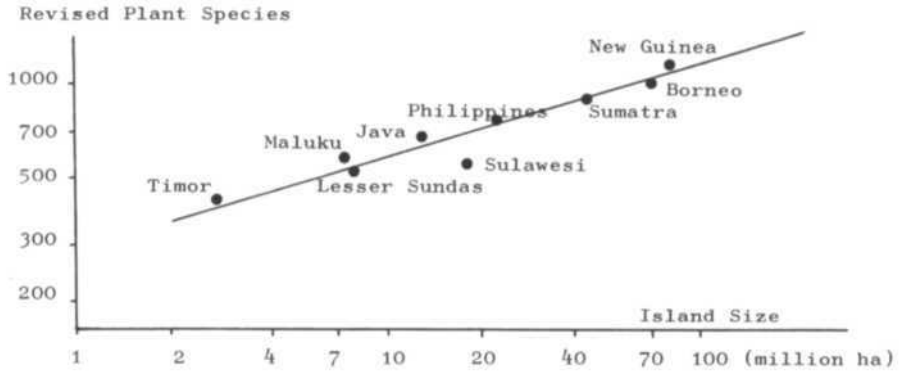


Figure 1.2 *Relationship between number of plant species (in 115 revised plant genera) and island size for Indonesian islands.*

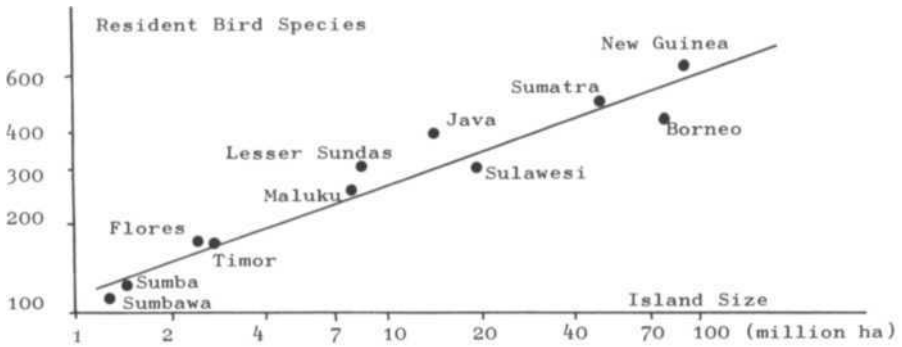


Figure 1.3 *Relationship between number of resident bird species and island size for Indonesian islands*

Equilibrium theory can be applied to conservation problems, where reserves or habitat patches are considered to be 'islands' (Diamond 1975, Wilson and Willis 1975). The theory holds that a patch of habitat or reserve can not retain all its original species once it has been cut off from similar habitat and that species number will fall due to reduced immigration until a new (and lower) equilibrium level is achieved. However, it is clear that the larger the reserve the less severe these species losses will be and the slower the rate at which they will be lost, i.e. the longer the 'relaxation period' over which the reserve will revert to its new species equilibrium level.

In fact it is not possible to predict with any reliability to what extent existing protected areas in Africa will succeed in maintaining their current species compositions. Island biogeographers would lead us to expect quite extensive levels of local extinctions even in some of the largest reserves (Terborgh 1974, Wilcox 1984) but this may not be the case since:

a) open country reserves are not totally isolated from one another and many animals are able to migrate across unprotected rangelands between them,

b) species losses can be countered by active management and artificially maintained levels of immigration and outbreeding (translocation),

c) the rainforests of Africa already show faunal impoverishment from the Pleistocene restrictions and have not attained their full potential species richness, and

d) in many cases local factors affecting species distribution, e.g. poaching, fire, clearing of forests for agriculture, are more important and obscure longterm biogeographical phenomena.

Nevertheless from both Island Biogeography Theory and the Theory of Minimum Critical Size it is evident that very large areas must be protected if we wish to conserve most of the plant and animal species native to the Afrotropical Realm. Working from the premise that reserves should be extensive, how should we design a national system? Should there be one huge reserve in the richest part of the richest biogeographical unit or should all biogeograhic units be equally well covered? If all units are to be covered should there be one large reserve per unit or several smaller ones?

If extinction patterns were random we should adopt a system of many small reserves. In fact extinction patterns are not random and we can identify many extinction-prone species—generally large animals, animals at the top of trophic food pyramids and plants and animals with slow reproductive capacity and poor dispersal. Although many of the local extinctions will follow random unpredictable patterns, it will certainly be the extinction-prone species which are among the first to vanish from almost all small reserves.

Using biogeographical principles Diamond (1975) has presented some designs for reserve shape and size reproduced in fig. 1.4. According to Diamond's model one large reserve is better than a number of small reserves of the same total area. This is *not* true if the small reserves succeed in protecting a wider range of habitats than the single large reserve or if they fall within separate biogeographical units. The islands of Indonesia provide a theoretical model of reserve design. For instance if we examine the species lists of a cluster of small islands, we find that the total species list is *less* than would be expected for a single island of the same area. When we look at a rather scattered group of islands such as the Moluccas or Lesser Sundas we find that the total species list is about the same as would be expected for a single island of the same total area. If we select individual islands from around the archipelago and add their species lists, we get a total species list very much greater than could be expected from a single island of the same total area (MacKinnon in prep.).

Moreover, sometimes a rare species can survive in small reserves once equilibrium is reached because the species-impoverished reserve may have greatly reduced levels of competition and therefore sustain larger population densities of that species than when more species are present. In addition there are many practical advantages in having a system of small compartmentalised reserves (better management and protection, easier to monitor, ties up less land in total etc.).

In practice it seems that selection for reserves of wide landscape heterogeneity is an easier way of protecting a wide range of species than making very large reserves. In addition it is much easier to protect and manage smaller reserves and take active management measures when species loss seems imminent.

It seems there are advantages in both a system of large reserves and a system of many smaller reserves.

Since we are unable to predict what species will be useful to Man in the future and because almost all habitat types on the planet contain some unique species, conservation strategy should attempt to preserve viable examples of all distinct ecosystems and all species. It is impossible to do this with just a few large reserves. Clearly to implement such a policy there should be protected areas in each distinct biogeographic zone and within each zone every major habitat type should be represented in a protected area.

In view of these suggestions the following model for an effective protected areas system design is

Fig.1.4 Biogeographical Principles in Reserve Design

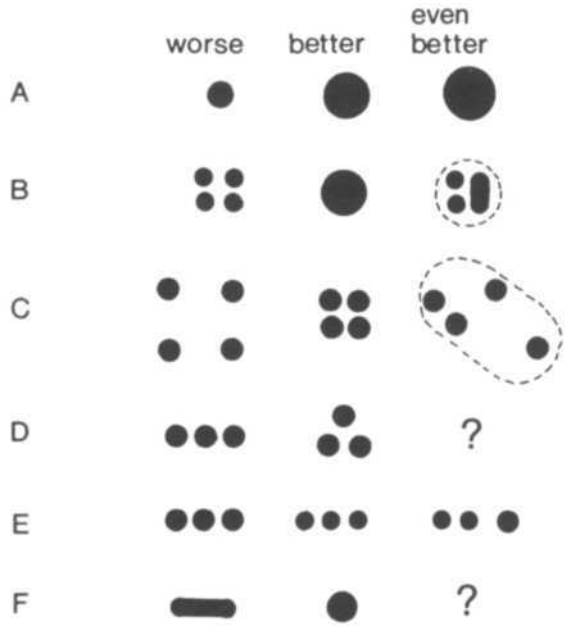


Figure 1.4 *Diamond (1975) proposed that the shapes in the centre column (better) would prove better at conserving species over time than reserve shapes in the left (worse) column. On the basis of field observation. Soulé (1983) has proposed that for most animal groups, the shapes in the right-hand column would in fact prove even better and protect 'single' populations from disease spread or cyclical events. The hatched line indicates integrated scientific management.*

recommended for adoption by the respective countries of the Realm. The design is based on regional objectives. The respective responsibilities of individual countries will depend on their size and content.

1. The major biogeographic divisions of the Afrotropical Realm must be identified and a representative system of reserves established in each.

2. Within each biogeographical division, the main priority should be the establishment of large major ecosystem reserves selected to include a continuum of many habitat types including, if possible, the richest examples of those habitats.

3. Smaller reserves should augment these major reserves by protecting additional habitat types or covering regional variants of habitats.

4. Small reserves may be included in the system to provide additional needed recreational, educational or research facilities or to protect unique sites of special interest or beauty.

5. Some small reserves may be included to protect specific localised species or sites e.g. nesting areas of important species, caves, wetlands etc.

Even with an extensive system of protected areas we must expect some extinction of species within each biogeographic division. Species protected in several divisions have a better chance of overall survival so preference should be shown to protecting endemic species. In addition, to get a higher species gain per area protected, the system should be biased somewhat in favour of areas of high species richness. Thus Myers (1980) has recommended targets for conservation should be to protect 20% of tropical forests, 10% of temperate forests and 5% of boreal systems.

Local extinctions in small reserves will occur as a result of increasing isolation and low levels of immigration. Immigration rates can be artificially increased by active management such as translocation of plants and animals to replace local chance losses but in practice this is difficult and expensive. Even so it is often cheaper to compensate small reserve size with active management if more land is unavailable. One reason for local extinctions is that ecosystems pass through cyclical phases of change with corresponding community oscillations. If the whole community is in phase within the limits of a given protected area, species losses can be expected as the system changes from one phase to another. One way to combat this is to maintain semi-permeable divisions within a protected area so that different parts of the reserve are out of phase with each other. Such an approach would be very relevant for instance in the management of large forest ungulates.

1.4 METHODS AND APPROACH OF REVIEW

a. Biogeographical considerations

For many years IUCN and UNEP have been advocating the establishment of a global system of protected areas of various categories – national parks, game reserves, etc. (see McNeely and Miller, 1983) which should be representative of the full range of biogeographic variation found on the planet.

Work initiated by Dasmann (1973) and continued by Udvardy (1975) has been aimed at classifying the world's ecosystems into a number of distinct major biogeographical units (realms, provinces, biomes, etc.) to see how well these units are covered by the current protected areas system. The theory of dividing the planet into distinct biogeographical units and giving adequate protection to representative examples of each seems sensible and straight-forward but it is very difficult to implement. The distribution of species across the planet does not make clear compartmentalization possible. Since our knowledge of plant and animal distribution is far from complete, the lines of the biogeographer's map become somewhat arbitrary and depend upon which groups of plants or animals formed the basis of the classification (see the cautionary paper by Simpson, 1977).

Transition zones create further problems for those selecting protected areas. We cannot just ignore transition zones for while they may include no unique species nor features they do constitute unique combinations of species and thus unique ecosystems. Moreover, species genotypes may vary more widely within transition zones, making such areas particularly important for species regarded as genetic resources (Pielou, 1979). Yet transition zones are often highly vulnerable* as they are isolated from the parent biogeographical units which are the source of their component species.

The academic ramifications of defining and revising biogeographical lines are endless, but park planners have an urgent practical job to do and simply cannot wait for perfect methods or data. As pressure for land increases, land-use options are irrevocably closed. The next decade may be the last chance for conservationists to add large new protected areas to the existing system. We must take our opportunities whilst we can and make the best job possible with the facts available. Time and funds are limited and options for revising the protected area systems of most countries are fast running out. We can ensure against our inadequacies by taking two precautions.

First, out of prudence, we should not be content with single protected areas to represent major biogeographical units or particular ecotypes. We should seek to protect more than one reserve of each ecosytem, both to avoid "putting all our eggs in one basket" and also to protect regional variants of types. We should also try to divide responsibility for protecting prime ecosystems between different countries to avoid the risk of losing out in the case of some political upheaval affecting all our protected habitat at once.

Second, while it is useful to adopt an ecosystem approach for selecting protected areas, we should not lose sight of the constituent species we want to protect. Checking that individual conspicuous species are adequately catered for by the protected area system is vital to ensure that the system is indeed representative of the whole range of variability. Monitoring the fate of plant and animal species' populations in protected areas is the best way of assessing the effectiveness of the design and management of the areas concerned. By ensuring conservation of these conspicuous indicator species we assume that most of the inconspicuous species will be protected as well. Some species are more useful as indicators than others and care must be taken in selecting significant groups for consideration.

b. Practical aspects of the Review

The first aim of the review was to decide on suitable biogeographical sub-divisions for the realm. The major units recognised by Udvardy (1975) require some revision.

The traditional approach of dividing the Afrotropical fauna into east, west and southern African appears to be based more on convenience and geographical and linguistic considerations rather than on the distribution of species. A few classifications are, however, based largely on vegetation type (e.g. Chapin, 1923). In some cases interpretation of species distribution patterns has been based on incorrect inferences about palaeoclimatic conditions (e.g. Moreau 1966). The present distributions of wildlife are more easily explained on the basis of the present distribution of vegetation and the recognition of several Pleistocene refugia of forest flora and fauna (Hamilton 1976, Diamond and Hamilton 1980, Carcasson 1964, Crowe and Crowe 1982.)

The floristic divisions of Africa are clearer than those for fauna. A number of floristically distinct biogeographical divisions or phytochoria can be recognised and are mapped by White (1983) in the recent UNESCO vegetation map for Africa. These phytochoria are to some extent independent of current vegetation type but seem relevant to the great majority of plant species' distributions. They constitute the

most solid biogeographic divisions of the continent and , as they correlate rather closely with the various faunal-based biogeographical classifications, they have been used as the biogeographical units in this review of the protected areas system (see map 3.6). Each biogeographical unit has been further subdivided into distinct habitat types according to the vegetation types on the UNESCO map.

To obtain details of the rate of forest loss or relative threat to habitat, we have made interpretation of some satellite imagery of the region, the latest forestry maps of the respective countries and the forest statistics of FAO (1981).

Assessing the degree of loss of non-forested habitats proved more difficult. We have made crude indices for the degree of degradation for each vegetation type based on knowledge of how much of the area is protected , how much has been converted to agriculture and pasture and a scoring on a ten (completely natural) to zero (completely destroyed) scale for the condition of the remaining unprotected rangeland based on evaluations by experts familiar with each area.

Areas of high local endemism and high species richness have been identified from species distribution data of selected groups and site-specific survey reports where available.

Comments on design – size, shape, degree of isolation, etc., of the reserves and their consequences for management are based largely on the theories of island biogeography elaborated by MacArthur and Wilson (1967) and applied to reserve design by Diamond (1975), Simberloff (1974), Terborgh (1975), and others, as outlined above in section 1.3.

To see how well the protected areas system covers individual species, we have analysed protected area records for threatened species (qualitatively) and for indicator species (quantitatively) of widespread, conspicuous, well-known animal groups of significant habitat specificity, namely ungulates, diurnal primates and passerine birds. Dendrograms have been employed to reveal the importance of individual protected areas in providing coverage for such groups. Thus reserves that are largely duplicative in their protective function are plotted close together whilst reserves with unique species combinations or protecting different species are drawn apart by such methods.

c. **Scoring Methods**

A simple scoring system has been used to: – 1) obtain a more objective evaluation of the effective conservation afforded to different biogeographical units, 2) evaluate the conservation importance of individual protected areas and 3) help determine the priority for further action in different biogeographic units.

i. EFFECTIVE CONTRIBUTION OF INDIVIDUAL PROTECTED AREAS (C).

This score (c) is based on a combination of Size (s), Protection Objectives (p) and Management Effectiveness (m), such that :

$$c = s \times (p \times m)$$

where s is the area of the protected area expressed in square kilometers and p x m is scored from Table 1.2. Effective contribution scores are listed for each protected area in the tables of protected areas in chapter 3.

Table 1.2 shows that management contributes as much as category to the effectiveness score. Thus reserves of high protection objective that exist only on paper but have no effective management (eg. an unmanaged national park) are scored lower than an effectively-managed protected area with less stringent objectives (e.g. a well-controlled game safari area). An example will serve to illustrate this effectiveness score. A gazetted nature reserve (category I) of 5000 ha with no management is regarded as only equivalent to 1500 ha of fully protected habitat; improving the management of such an area effectively increases the area protected. It is more important how well a protected area is managed than what it is called.

For practical purposes, we have omitted from the review all mainland protected areas of very small size (less than 50 sq.km.) and category V and VII protected areas whose contribution on the regional scale is insignificant.

Table 1.2 Matrix for scoring Effective Contribution of Protected Areas

Protection Objective	Effective management	Moderate management	Poor control	No effective control
Total protection	1.0	0.8	0.5	0.3
Nonconsumptive uses only	0.9	0.7	0.5	0.3
Managed for visitor uses	0.8	0.6	0.4	0.2
Managed for protection & production	0.7	o.5	0.4	0.2
Resource reserved for future	0.6	0.5	0.3	0.2
Multiple use, no habitation	0.4	0.3	0.2	0.1
Multiple use, with habitation	0.2	0.2	0.1	0.1

ii. EFFECTIVE PROTECTION PER BIOGEOGRAPHIC UNIT (P).

This score consists of summing the conservation contributions of the individual protected areas in the unit and making suitable reductions for inadequacies in habitat coverage or the altitudinal range of the protected areas system. The resulting score (p) is expressed as a percentage of the total area of the unit.

$$P = \frac{(\text{sum of } c)}{S} \times \frac{h}{H} \times \frac{a}{A} \times 100$$

where c = conservation contribution of the individual protected areas, S = total size of the unit, h = the number of distinct habitat types included (for practical purposes taken to be at least 2% of original area) in the protected areas system, H = the total number of distinct habitat types recognised in the whole unit, a = the altitudinal range covered by the protected areas system and A = the total altitudinal range of the biogeographic unit.

Under this scoring method a reserve system which offers total protection to 10% of the unit area will score 10 points only if it also has effective management, includes adequate areas of all habitat types of the unit and covers the complete altitudinal range of the unit. This complies with the target set by the Bali Action Plan and so any unit reaching this score is regarded as having 'good coverage'. Inadequacies in areal coverage and habitat representation or management weakness will reduce the score of the unit. Scores between 5 and 10 are regarded as moderate, between 2 and 5 as inadequate and below 2 as very inadequate.

iii. PRIORITY FOR ACTION

This score is the product of two components – urgency for improvement and conservation importance.

Urgency for establishing new protected areas is determined from a theoretical model (fig. 1.5) which reflects the decreasing need for conservation action as more land is set aside for conservation and as management of protected areas improves. The need for protection increases (splaying of vertical cells) as the remaining area of the natural habitat in the unit diminishes, but is countered by reduced opportunity for action as scope or potential for additional protection decreases. Such scope for added protection includes improving the objectives and effectiveness of management as well as the area of protected areas.

Thus the highest urgency for action is given to highly underprotected units where there is still adequate room to improve the protection and lowest urgency is given to unthreatened units already adequately protected or units so fully developed or destroyed that there is no further scope for further protection. Action should be aimed where it can have the most effect, not on lost causes.

The second part of the score – conservation importance – is calculated on the basis of species richness and levels of endemism of both plants and animals in the following manner:-

Conservation importance is taken to be the mean of importance for plants and importance for animals, where importance for animals is itself the mean of importance for selected bird groups (passerines) and selected mammal groups (ungulates and diurnal primates). Mammal importance is scored by plotting the distribution of species by unit and allocating each species a total value of 1 to be divided by the number of units in which the species occurs. Thus an endemic to a single unit scores 1 to that unit, a species shared between two units scores one half to each of the two units and a species common to ten units would only

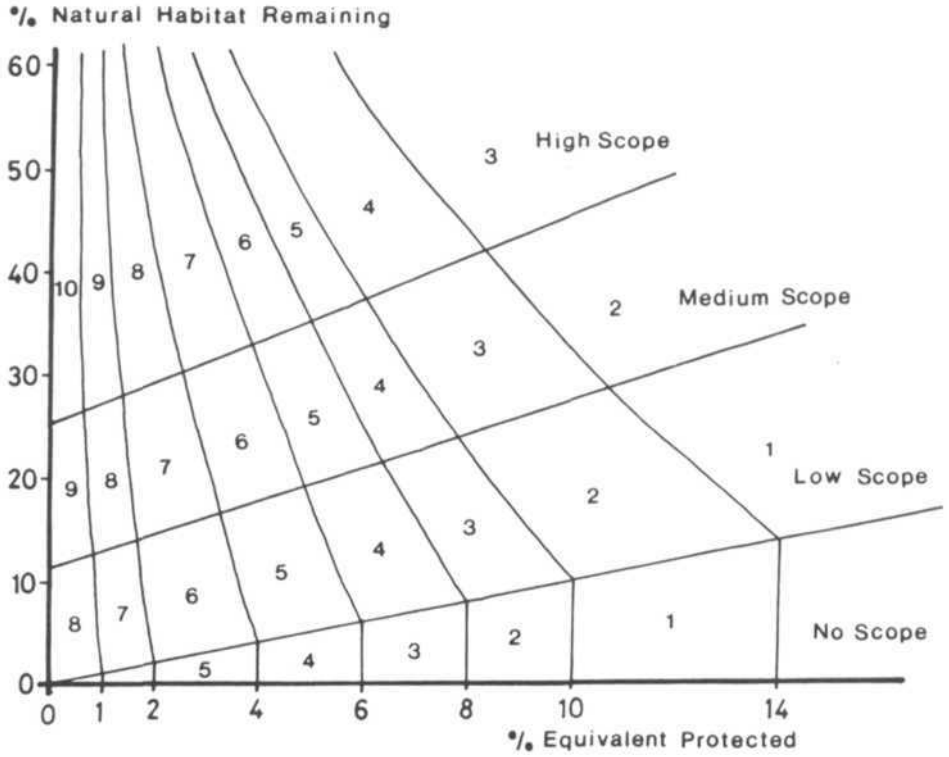


Figure 1.5 *Model for scoring 'urgency' for conservation action, based on the relative amount of natural habitat remaining, the degree of protection already afforded and the consequent scope for selection of new conservation areas.*

score one tenth of a point for each. Total scores per unit thus reflect both species richness and distinctiveness. The highest scoring unit is awarded a final score of 1.0 and the other units are scaled down accordingly. The scoring of importance for plants and birds (for which detailed distribution data were not so readily available) is done in the same way except that the score is approximated by the formula -

$$\text{Score} = \frac{\text{Total species of unit}}{\text{mean no. of units per species}} + e(1) + \frac{e(2)}{2}$$

where e(1) = number of endemics to unit and
e(2) = number of near endemics shared with only one other unit.

The combined importance score is simply multiplied by the urgency score to give the final score of priority for action.

iv. CLUSTER ANALYSIS OF SPECIES COMPOSITION OF UNITS AND RESERVES

Dendrograms are used throughout the review to show the relationships between species composition of biogeographical areas or individual protected areas. These dendrograms are based on simple cluster analysis procedures, comparing species lists of all possible dual combinations of samples. The method takes the pair of species lists with the lowest degree of divergence as the next branch in the dendrogram then pools those two samples and repeats the whole process to identify the next branch point. Unless stated otherwise the degree of divergence is taken to be the percentage of the shorter of two lists that are not found on the longer list (following Simpson 1977).

Part Two
THE AFROTROPICAL REALM

Figure 2.1 *Limits of the Afrotropical Realm.*

Part Two – THE AFROTROPICAL REALM

2.1 PHYSICAL LIMITS

In this review the Afrotropical Biogeographical Realm is taken to be the whole of Africa south of the Sahara together with the island continent of Madagascar, the oceanic islands of the western half of the Indian Ocean (Mascarenes, Comoros, Seychelles and Aldabra), the small island of Socotra off the Horn of Africa and a small part of the southern tip of Yemen, which is African in its floral affinites, insect life and bird fauna. Udvardy (1984) now also includes the tip of Arabia within the Realm. The Cape Verde Islands have not been included in this review.

The outer islands of the Seychelles are somewhat intermediate in their faunal affinities with the Afrotropical Realm and the Indo-Malayan Realm. On this basis they have been placed previously in the Indo-Malayan Realm (Udvardy, 1975) but their flora is in fact most closely related to that of Madagascar (White, 1983) and on this basis we are including the Seychelles islands in the Afrotropical Realm for the current review.

The boundaries of the Realm and national boundaries are shown in figure 2.1.

2.2 GEOLOGICAL AND BIOGEOGRAPHICAL HISTORY

Africa is an ancient land-mass and it is necessary to delve far back in its geological history to understand its present biology.

The whole continent is a single continuous crystalline shield, variously exposed in many places and of largely Pre-Cambrian age, formed over a timespan of 3,500 million years. For convenience the continent can be divided into two portions. Low Africa, to the north and west of a line drawn from Angola to the Red Sea (figure 2.2), consists of sedimentary basins and upland plains mostly between 150 and 600 m above sea level. Only a few isolated ranges rise above 1000 m. In contrast, nearly all of High Africa, to the south and east of the line, rises above 1000 m.

Throughout the Palaeozoic (350–230 million years b.p.) Africa was locked with the other major continents in a super-continent – Pangaea, and was never far from the South Pole. When Pangaea broke into two parts (c. 200 million years b.p.), Laurasia, the northern land mass, and Gondwanaland, the southern land mass, Africa remained in Gondwanaland lying between South America, Madagascar and India. Throughout the Triassic, Gondwanaland drifted north and started to split up. From about 135 million years ago Africa was separate and drifting towards the equator. As the oceans around Africa widened, freshwater and then marine deposits accumulated on its continental margins. Fractures developed in the east, letting down blocks of Karoo sediments which subsequently guided the relief and drainage patterns. In West Africa the Benue Fault opened a trough from the Gulf of Guinea into the Sahara. We have few fossils from the Cretaceous of Africa but these reveal the presence of lungfish, crocodiles and side-necked turtles. In addition there were probably pipid toads and early placental mammals, insectivores and condylarths as well as early bird families.

From the end of the Cretaceous (67 million years b.p.) until the end of the Oligocene (25 million years b.p.), the African fauna and flora evolved in relative isolation, giving rise to their great distinctiveness today. There was little species exchange with other land masses. Early primates, however, probably rafted to Africa from Laurasia and again from Africa to South America and to Madagascar, which had torn free from Africa during the Cretaceous period.

By the end of the Oligocene (25 million years b.p.), the African plate, with Arabia still firmly attached, abutted Eurasia. The forested Arabian connection permitted the invasion of Africa by Palaearctic placental mammals and other fauna. Modern carnivores and rodents filled the vacant niches of the huge tropical landmass. Cats, dogs, aardvarks and cricetid mice joined the locally-evolving elephants, monkeys and insectivores.

The transfer of fauna was not all one way. Elephants, mastodons, monkeys and apes spread out of Africa to Europe and Asia.

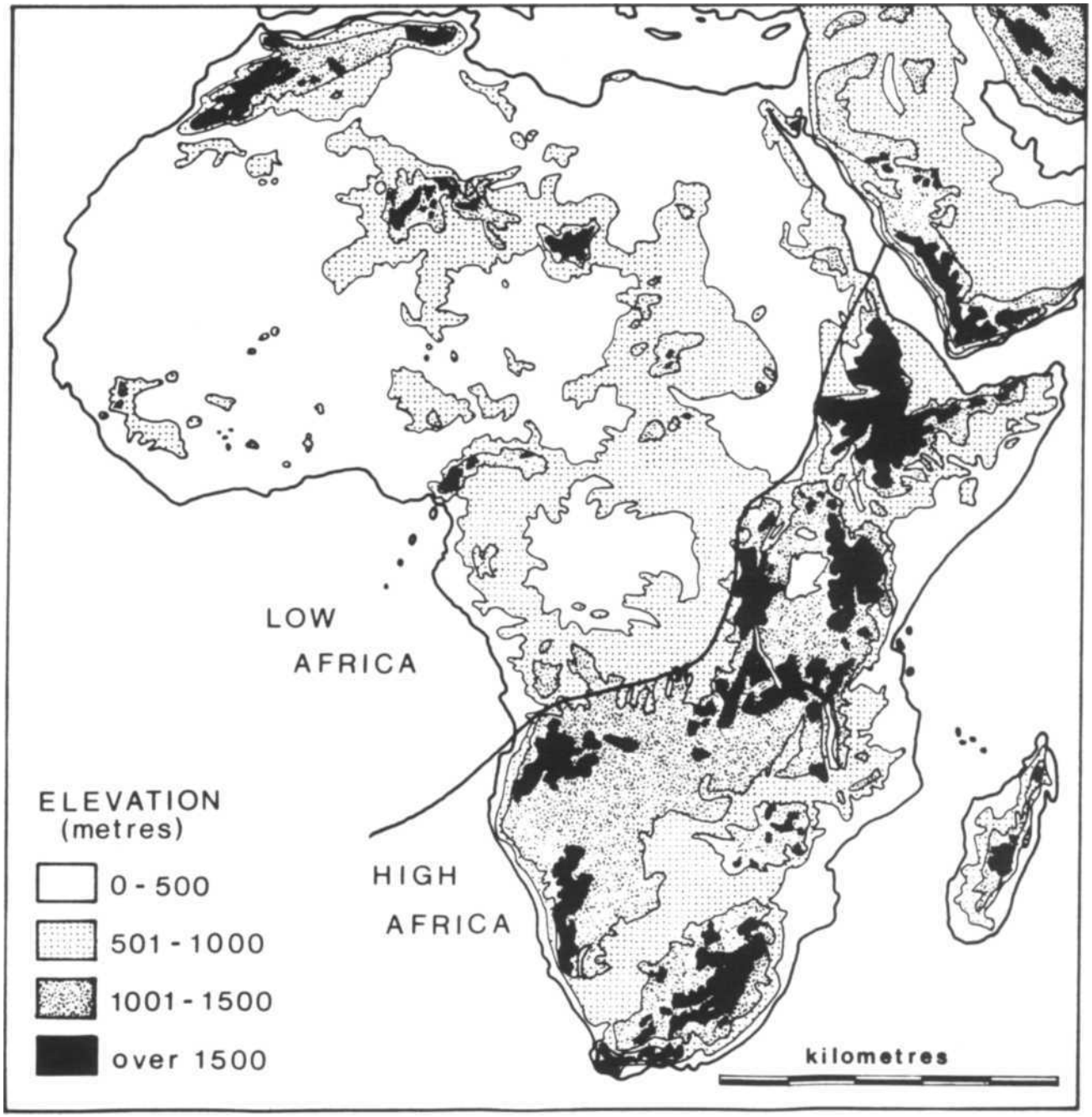


Figure 2.2 *Relief map of Africa.*

Through the late Miocene and Pliocene the climate changed and the Arabian connection became much drier. Forest gave way to grassland, allowing a different fauna of antelopes, giraffes, rhinoceros, hyaenas and murid mice to enter Africa. Desertification and the rifting apart of Arabia from Africa some 15 million years ago gradually closed the corridor so that Africa was isolated again throughout the Pleistocene and the African fauna evolved into their modern forms.

The rifting processes in eastern Africa have continued to the present day with a continuous rift valley system extending from Turkey to Zimbabwe and splitting, in East Africa, to form two rifts. This region is also still active volcanically and the highest mountains, Mt. Kenya and Mt. Kilamanjaro (both dormant volcanoes) and Rwenzori Mts. (a thrust block), are the only glacier-clad peaks on the continent. The rift valley system may have been a partial barrier to east-west migrations of some species. More significantly, the Great Rift lakes are some of the continent's most interesting freshwater habitats, where rapid speciation has led to the evolution of many endemic fish such as the cichlids in Lake Malawi, Lake Victoria and Lake Tanganyika.

Climatic conditions have varied erratically throughout Africa during the Pleistocene, i.e. the last two

million years. There is ample evidence that climates have been both hotter and wetter and both cooler and drier than those prevailing today. The exact details of these climatic fluctuations are not clear but it is generally agreed that the drier interpluvial periods corresponded with cold glacial periods in Europe and not with warm conditions as postulated by Moreau (1966). These shifts in climate have certainly profoundly affected the survival and distribution of many species in Africa. In particular the areas of moist forest have at times been considerably reduced. The absence of some expected families such as hylobatid gibbons, terrestrial leeches and many trees can be explained as Pleistocene extinctions. The general impoverishment of the African forest fauna and flora in comparison with the forests of the Neotropical or Indo-Malayan realms is most easily explained as losses due to climatic deteriorations of the Pleistocene. The pockets of high species richness and local endemism in Africa today are taken as representing Pleistocene refugia where forest patches must have survived the drier conditions. Indeed their locations correspond with areas that could be expected to have more stable climate (Hamilton 1976).

The great richness of the savanna fauna and flora of Africa also indicate that there have always been extensive areas of savanna and that the continent was never completely forested during the recent geological past.

Several pollen cores from various sites in East Africa suggest a relatively open grassy vegetation from

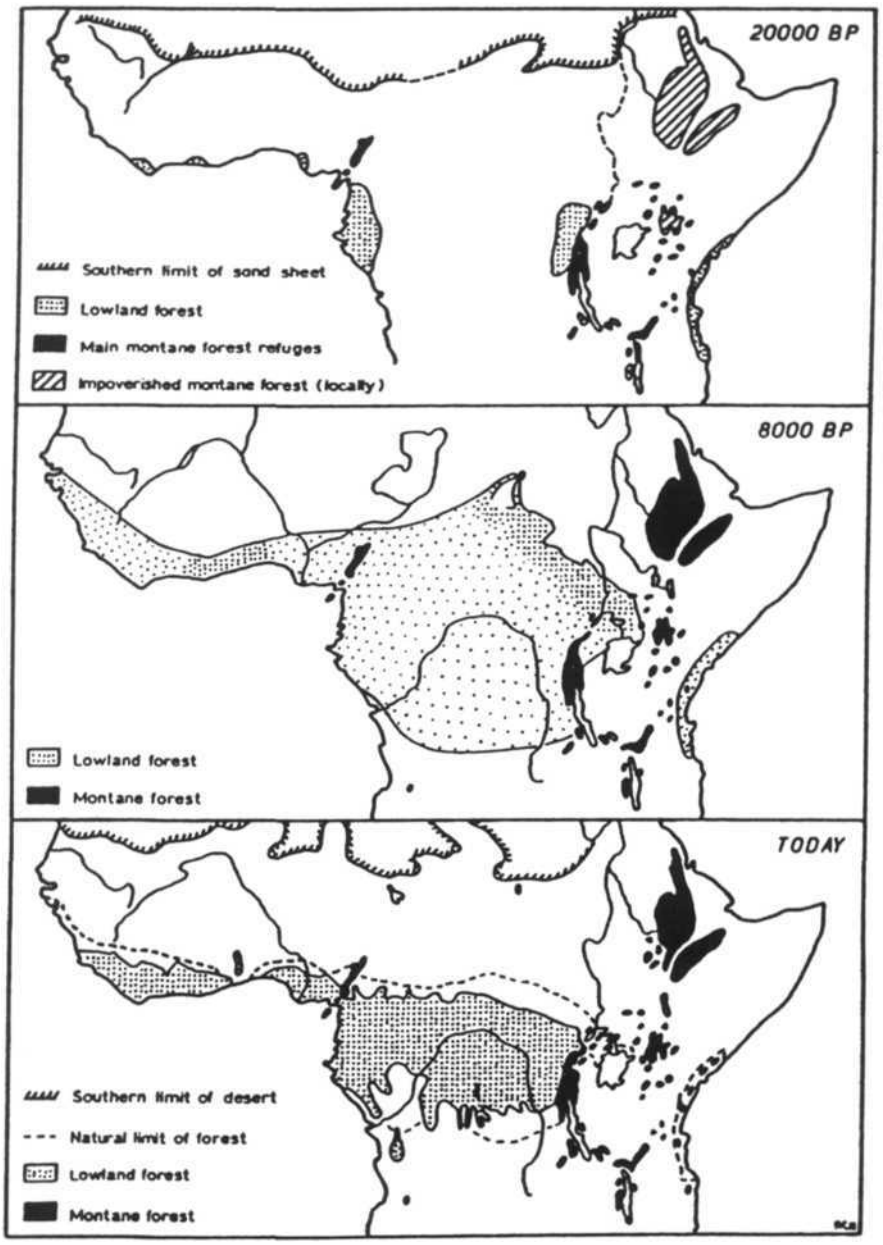


Figure 2.3 *The distribution of forest in Africa 20.000–0 BP. (from Hamilton, 1976).*

about 35,000 years b.p. to about 11,000 years b.p. followed by more closed vegetation with more forest taxa since that time (Coetzee, 1967; van Zinderen Bakker, 1964; Livingstone, 1967, 1975; Kendall, 1969 and Hamilton, 1972).

Studies of glacier retreat (Osmaston, 1965) confirm that during the height of the last glaciation (12,000 years b.p) montane temperatures were at least 4 degrees Celsius colder than today. Since that period, a pioneer forest of *Olea* was succeeded by a species assemblage suggesting moist evergreen forest which prevailed until about 6000 years b.p., when conditions became again progressively drier. Data are inadequate to summarise patterns in southern or western Africa but Hamilton (1976) presents hypothetical maps indicating the changes in forest distribution at the extremes of Pleistocene climate (figure 2.3).

There has been considerable speculation concerning the origins of the Afromontane flora and fauna. Montane habitat in Africa is extremely disjunct. White (1978) has proposed seven regional Afromontane systems (figure 2.4) which together constitute a montane archipelago with a quite distinct flora and are a distinctive regional centre of plant endemism of complex shape. For birds, Moreau (1966) has stressed the

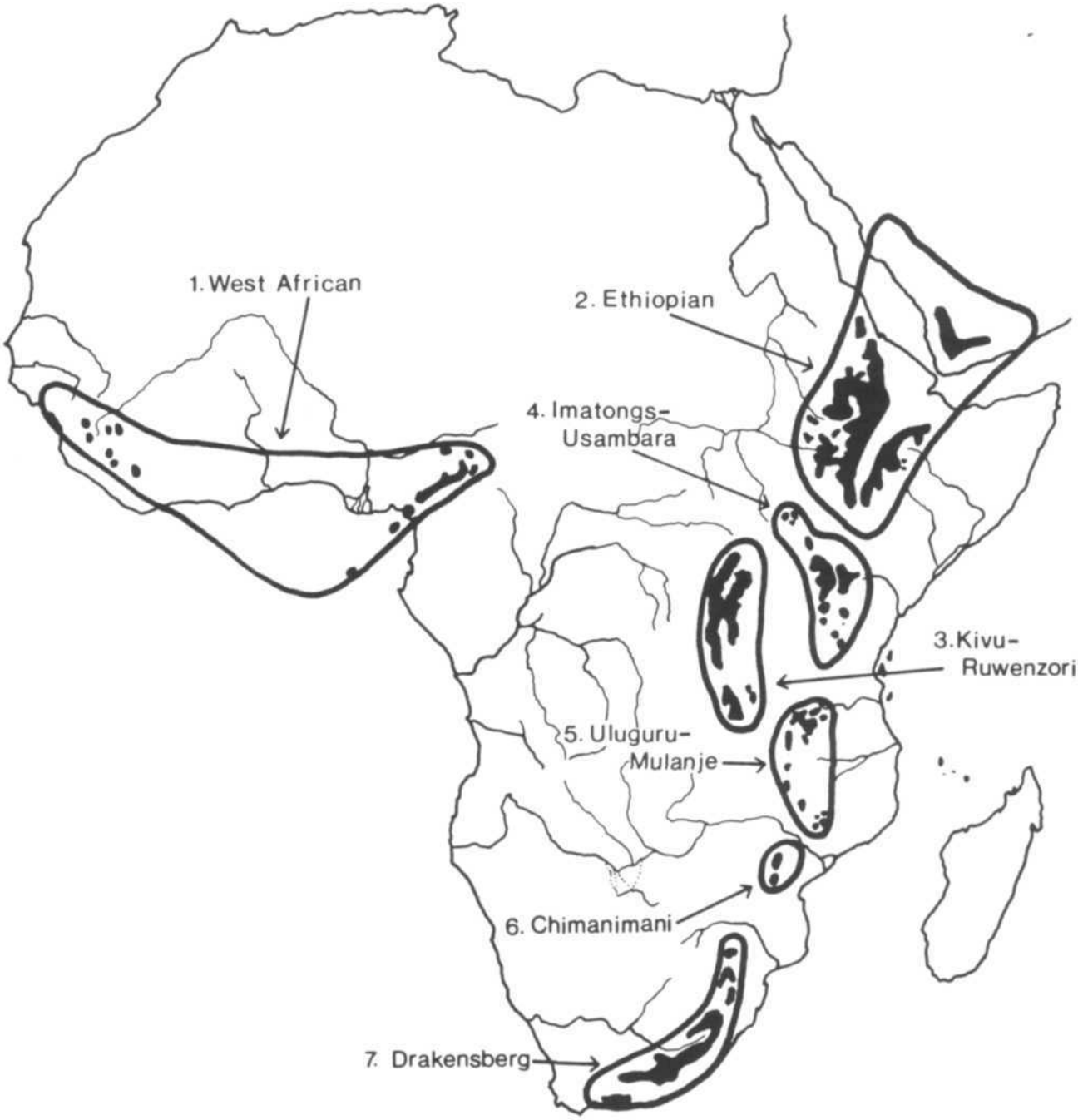


Figure 2.4 *Map of Seven Afromontane Systems (after White, 1978).*

major distinction between montane and lowland species and the interesting disjunct distribution patterns of montane birds.

The considerable similarities between the species composition of the Cameroon mountains and the distant highlands of Ethiopia and East Africa both in flora (Hooker, 1864) and fauna (Moreau, 1966) have led various authors to postulate a northern migration route linking the two areas. Moreau (1966) suggests that during the colder periods of the Pleistocene, reduced evaporation and generally wetter conditions would allow montane flora to appear as low as 500 m. and the two regions could have been connected by a continuous belt of montane habitat. Livingstone (1975) disputes the possiblitiy of such a connection on the basis of pollen analysis and concludes that conditions were not wetter but 'forest trees disappeared from the mountains ... were missing from the plateau as well... (and) were restricted to the best-watered parts of the lowland Zaire basin and West Africa'.

In fact White (1981) shows that the species quoted by Livingstone as evidence of much drier climate could also indicate quite moist and forested conditions. White presents strong evidence, citing the present day distributions of satellite populations of Afromontane species, that the montane forest areas of West Africa could have been colonised by long-distance dispersal and overland migration under conditions not far different from today and that in any event a southern migration route along the Zaire-Zambesi watershed and north along the west coast, which is cooled by the cold Guinea sea currents, has been more important for plant dispersal than the hypothetical northern route through Jebel Marra. Moreover, Afromontane flora is extremely complex and has not been derived in a simple manner but has evolved over a timespan far greater than the last 20,000 years.

The importance placed on the distinction between montane and lowland bird communities by Moreau (1966) has been challenged by Diamond and Hamilton (1980) who show that the absence of montane species in the intervening lowlands is often merely due to a lack of forest. These authors suggest that most of the montane avifauna are well-dispersed species capable of colonising offshore islands and quite capable of colonising the montane areas without there having been any continuous montane habitat. Similarly there are few specifically montane mammals. The mammalian fauna of most highland areas in Africa show greater similarity to the fauna of the surrounding lowlands than to more distant montane localities.

In total these findings suggest that the Afromontane area should be thought of as a true habitat archipelago that has enjoyed no recent interconnections. As such the Afromontane archipelago assumes considerable scientific importance as the world's largest 'archipelago' and deserves much greater study by biogeographers.

2.3 GEOGRAPHY AND PHYSIOGRAPHY

The uplifted areas of High Africa form the Great African Plateau, the world's largest plateau, lying almost entirely above 900 metres. The plateau is bowl-shaped with its rim higher than the interior. In southern Africa, the edge of the plateau is marked by the 'Great Escarpment', rising to its highest in the Drakensberg mountains. This escarpment was probably once a former coastline but with subsequent geological uplifting there is now a marginal plain, several hundred kilometres wide in places as in Kenya and Mozambique. To the west the plateau is bordered by the Angolan mountains and the Auas highlands which separate the coastal Namib desert from the Kalahari desert on the plateau. Between the Angolan highlands and the Great Escarpment, the plateau forms a wide, rather flat bowl, the watershed for the Limpopo, Zambezi, Orange and Cubango rivers. The Cubango has no outlet but drains into the wide Okavango swamp before disappearing in the heat of the Makgadikgadi salt pans.

At the northern end of the plateau the terrain is dominated by the Great African Rift Valley. There is a discontinuity in the plateau between the rugged Ethiopian highlands and the East African highlands linked by low hills on either side of Lake Turkana (Rudolf) in the floor of the rift. Here the Great Rift divides into eastern and western sectors and the wide Lake Victoria occupies the basin between, at an altitude of 1130 m. Lake Victoria is the source of the White Nile and the Ethiopian highlands are the source of the Blue Nile. The two rivers drain the whole of the Sudan region before meeting at Khartoum on their journey north.

The uplifted outer edge of the Western Rift is the eastern limit of the African rain forests. From here the land drops away steeply into the huge basin of the Zaire-Lualaba river system. The Cuvette Centrale of this basin was once a colossal lake, about five times the size of Lake Victoria today. Lake Tumba and Lake Mai-Ndombe (formerly Leopold II) remain as water bodies but the rest of the ancient lake is now

filled with sediments and supports swamp forest and riparian forests, surrounded on the higher ground by the true lowland rainforests.

To the north east was another huge lake which has much contracted to the present area of Lake Chad and lies in the depression between the Jos Plateau, Jebel Marra and the Tibesti mountains. The land relief of West Africa is made up of a narrow coastal plain along the Guinea coast, backed by low hills before the land falls away again into the southern Sahara. There are few mountainous areas. The volcano of Mt. Cameroon is an extension of the Adamaoua Massif as are the islands of Bioko (Fernando Po), Principe, São Tomé and Annobon.

2.4 CLIMATE AND VEGETATION

Compared to tropical America or tropical Asia, Africa is an arid continent. Evergreen rainforests are found only on the seaward side of Mt. Cameroon which receives some 4000 mm of rainfall per year and along the narrow equatorial belt where the rainfall is between 2000 2500 mm per year. Most of Africa has little rain and even that is seasonal so that the prevailing vegetation types are mainly extensive savanna, sub-desert scrub and true arid deserts.

A number of typical climatic patterns can be recognised (Moreau, 1966).

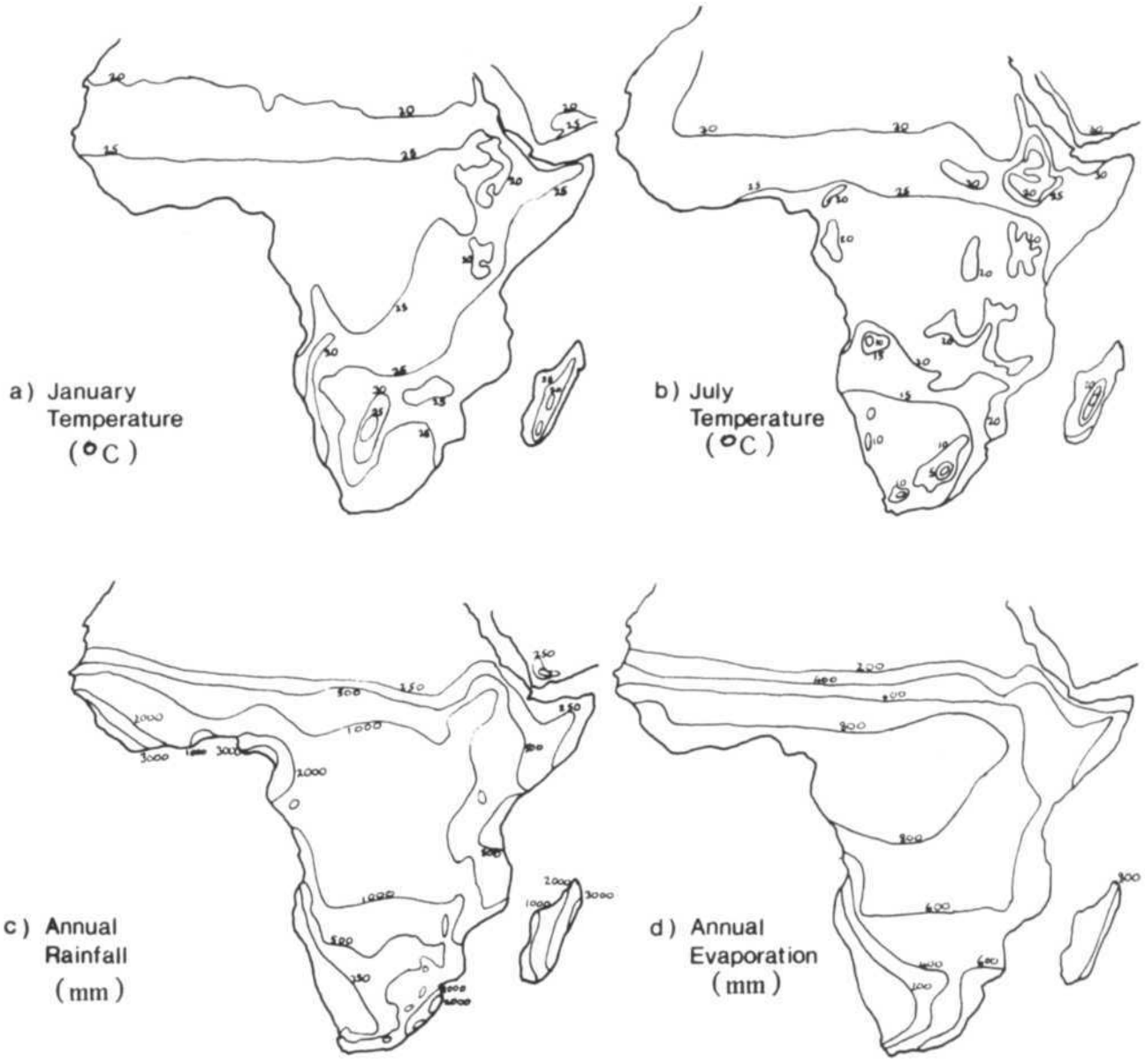


Figure 2.5 *Climate of Africa*

1. Much of tropical Africa receives most of its annual rainfall in the six months around the local summer solstice. Total rainfall and duration of rainy weather diminishes with increasing latitude north or south.
2. A narrow belt along, and to the north of, the Equator has rainfall fairly evenly distributed throughout the year.
3. Part of East Africa has two well-defined rainy seasons—a 'long rains' centred around the months of May and June and a 'short rains' around October.
4. The south-west corner of southern Africa enjoys a 'Mediterranean' climate with rainfall confined mainly to the winter half of the year.
5. On the eastern coast of southern Africa the rainfall is fairly evenly distributed throughout the year.

The climate of Africa is summarised in maps 2.5(a-d), showing the mean annual precipitation, the mean annual evaporation and the January and July mean temperatures for the entire realm. These maps correlate approximately with the present day distribution of vegetation but the extremes of climate and the duration of critical climatic conditions play a greater role in determining vegetation growth than do mean conditions. Some agroclimatic maps that combine several climatic features may give better correlation with vegetation maps. In addition, vegetation is greatly affected by long-term cycles or oscillations of climate which are not revealed by annual patterns (Tyson, 1978).

In lowland tropical areas, the main factor determining vegetation type is water balance. An area which has moderate rainfall, evenly distributed throughout the year, will support a lusher vegetation than an area with higher overall but more seasonal rainfall with longer dry periods. At the local level underground water patterns are important so that vegetation may be very lush close to a water course or in a moist depression but very arid on nearby areas that share the same climate.

Forest is confined to the wetter parts of the realm. Tall rainforest occurs in areas with high year-round humidity as in the Zaire basin and along the Guinea coast. Dry forests occur in areas with a more prolonged dry season as in parts of the Zambezian and Sudanian regions and extensively in Madagascar.

These moist forests are surrounded by a broad belt of deciduous savanna woodlands. These woodlands are in turn surrounded to the north, east and south by another belt of steppe-like grasslands. To the north this gives way with increasing aridity to the sub-desert (Sahel) and desert vegetation. Other desert and subdesert areas are found in the Namib and Kalahari regions of southern Africa and in the Ethiopian/ Somalia region in eastern Africa.

Temperate grasslands are found on the Drakensberg mountains and Mediterranean *Macchia* vegetation is confined to the Cape region at the extreme southern tip of the continent. Flood plains, freshwater swamps, salt-pans, mangrove swamps and other edaphic formations occur where conditions are suitable.

At higher elevations in the tropics and at temperate longitudes, temperature extremes become more important determinants of vegetation with the frost lines as a critical factor. Here micro-climate variations caused by humps and hollows, stones or even other plants can become very important (Coe, 1967). Relative cloud cover versus insolation are important climatic factors in montane habitats. Several distinct montane vegetation types can be recognised, dependent largely on altitude, aspect and rainfall. Montane zonation is compressed on smaller mountain blocks and on mountains near the sea.

In semi-arid areas, fire has a marked influence on vegetation. The incidence of natural fire is dependent on certain critical limits of temperature and dryness. In arid and semi-arid regions, showers and small amounts of rainfall, or even moisture from fog, can be vital to the vegetation (Walter, 1936).

Man's influence through fire and grazing has greatly influenced the natural vegetation in many areas. Forests have been extensively cleared under slash and burn agriculture systems and savannas have been extended through pastoralism. In other areas burning and overgrazing has led to bush encroachment of pasture.

Wind plays a role in determining some patterns of vegetation. Saboureau (1959) has demonstrated how patterns of cyclones and floods have affected the vegetation of Madagascar. Boudet (1972) identifies wind as a key factor in causing the *brousse tigree* patterns of vegetation typical of the arid sandy zone.

Mineral availability also greatly affects the vegetation both in type and quality. Eutrophic regions where adequate nutrients are available, as in the rift valley areas and near recent volcanoes, support richer more productive flora and consequently more wildlife.

The bimodality of the rainfall in eastern Africa also has an enriching effect, permitting better grass quality than is found where the same annual rainfall is distributed in a more seasonal way.

Sea currents affect climate in coastal regions. The east coast, warmed by the Mozambique current, supports wooded savanna, whilst the west coast, cooled by the Benguela current, has a coastline of desert backed by subdesert steppe.

Map 2.6 shows the distribution of the main vegetation types together with weather data for selected stations across the realm. For a more detailed account of the African vegetation see White (1983).

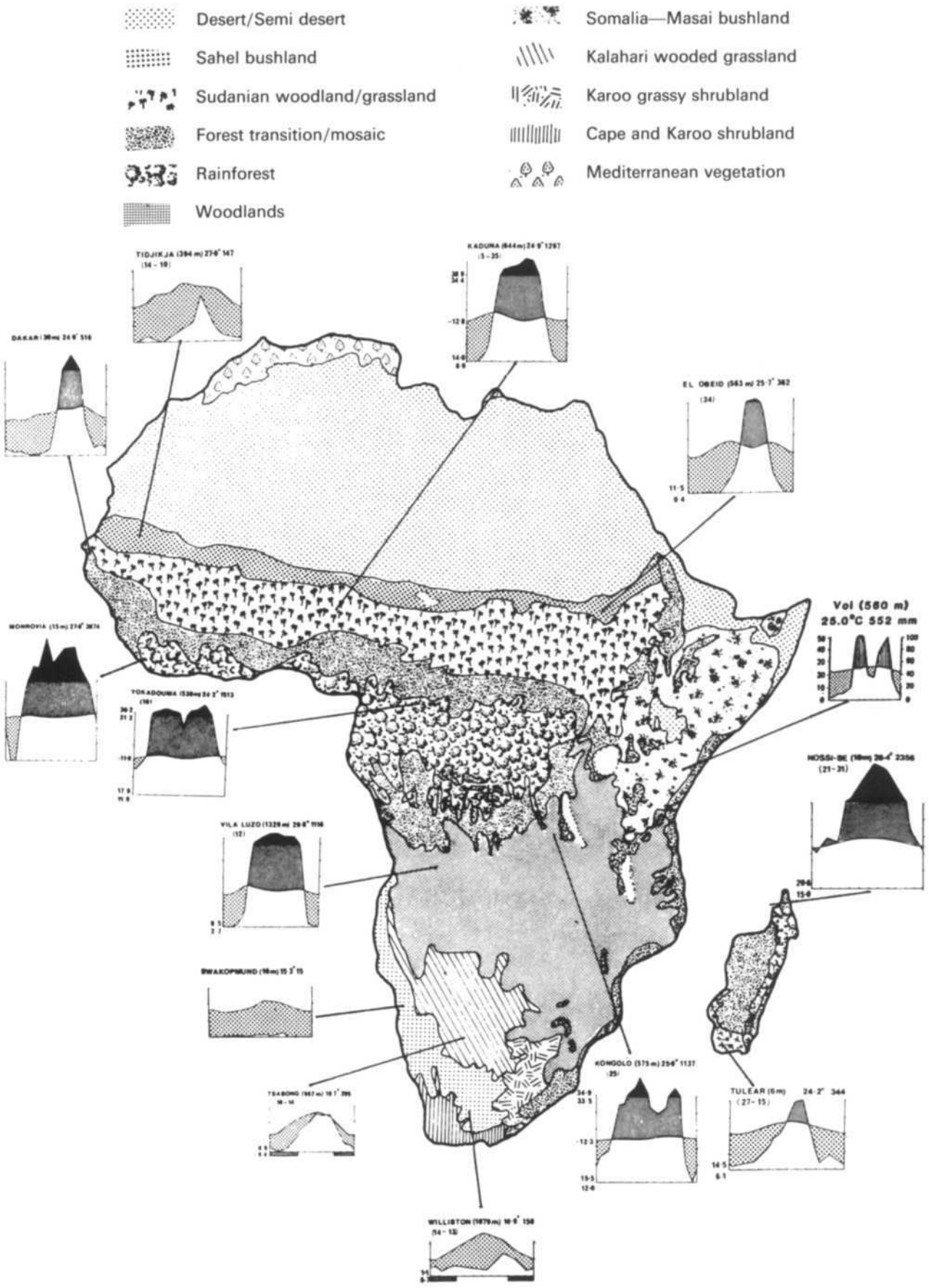


Figure 2.6 *Major Vegetation Types of Africa and Madagascar*
Climatic diagrams for selected stations show altitude, mean temperature and mean rainfall. They plot monthly rainfall and evaporation. Stippling indicates evaporation exceeds rainfall.

2.5 FLORAL CHARACTERISTICS

The Afrotropical Realm is a major part of the palaeotropical floristic kingdom. The realm shows closer floral affinities with the Indo-Malayan Realm rather than with the Holarctic (including the Palaearctic) from which its flora is almost totally different (White, 1983).

The flora is composed mostly of common pan-tropical and palaeo-tropical families. Several small families are confined to the realm. The flora is highly distinct at the generic and specific level. Thus in family Sapotaceae, Africa and Madagascar have a total of 44 genera of which 39 are endemic.

The Afrotropical flora forms a homogeneous whole, but with generic and specific variations from west to east, towards the centre and the south. The flora is in some ways impoverished compared to other continents (Richards, 1973). This is due to palaeogeographic factors, the relative aridity of the continent and to recent human influence. In its impoverishment, the flora follows the pattern of other groups in Africa such as birds (Moreau, 1966).

The rainforests of Africa are, like those of the Neotropics, largely dominated by the family Caesalpiniaceae, particularly of the Cynometreae – Amherstieae group. Caesalpiniaceae are also well represented in the drier forests to the north and even more so to the south of the equator, where *Brackystegia, Cryptosepalum, Daniella* and *Julbernardia* are dominant genera. To the north Sterculiaceae and Ulmaceae predominate in the forests, whilst to the south the dominant genus is *Brachystegia.* The open savanna woodlands are widely dominated by *Acacia* trees.

Conifers are absent from the lowlands of Africa. The montane forests have some Cupressaceae such as the genus *Widdringtonia,* confined to southern Africa and *Juniperus procera* – only tropical representative of its genus, found from Ethiopia to Malawi.

Family Dipterocarpaceae, which dominates the rainforests of the Indo-Malayan realm, is represented in Africa and Madagascar only by the endemic sub-family Monotoideae with its genera *Marquesia* and *Monotes* found in the drier forests.

The moist lowland forests of eastern Madagascar are dominated by Myristicaceae whilst the drier forests of western Madagascar are dominated by Burseraceae and Sarcolaenaceae. The flora of Madagascar shows strong African affinities but is also enriched with Asian, Australian and endemic genera (Humbert, 1965).

Palms are rather poorly represented in Africa. Some species are common in the understorey of Madagascar forests and characteristic *Borassus aethiopicum* form large open stands in parts of Africa. However, in total, Africa has only 16 genera of palms compared with 29 for Madagascar and the Mascarenes and 97 genera in the Indo-Malayan Realm (Moore in Meggers et al., 1973).

2.6 FAUNAL CHARACTERISTICS

George (1962) provides a general account of the Afrotropical fauna. The mammal fauna of the continent is the most varied of all realms, consisting of 38 families excluding bats. Of these Africa shares 15 families with both the Palaearctic and Indo-Malayan realms, three families - dormice, jerboas and coneys with only the Palaearctic, and eight families – lorises, apes, monkeys, pangolins, bamboo rats, elephants, rhinoceros and chevrotains with only the Indo-Malayan Realm. Families unique to Africa include giraffes, hippopotamuses, aardvarks, otter shrews, golden moles, elephant shrews and six families of rodents, including the Anomalurids or gliding scaly-tailed squirrels. The sub-family of antelopes that are so characteristic of the African mammal fauna are not confined to the continent but they certainly reach a diversity in Africa which is found nowhere else. The island of Madagascar has another three unique families of lemurs and the tenrec insectivores.

Africa differs from the Palaearctic in its lack of beavers, moles, bears, camels and deer. It differs from the Indo-Malayan Realm in its lack of moles, bears, deer, tapirs and the four endemic Indo-Malayan families—spiny dormice, tarsiers, tree shrews and flying lemurs.

The bird fauna of the Afrotropical Realm is only moderately rich with about 1500 species, compared to over 2000 species for the Indo-Malayan Realm and over 4000 species in the Neotropics. It is most similar to that of the Indo-Malayan Realm in its affinities with many cuckoos, starlings, woodpeckers, sunbirds and hornbills but fewer pigeons, parrots and pheasants. Eight families are confined to the Realm. These are the ostriches, secretary birds, hammerheads, shoebills, turacos, mousebirds, wood hoopoes and helmet shrikes. The island of Madagascar has another five endemic bird families: the vangas, mesites, asities, cuckoo rollers and ground rollers.

The Realm has a wide range of snakes, especially biting poisonous vipers and some interesting fresh-

water cobras. There is a rich fauna of lizards with the spiny Cordylidae confined to Africa. 46 of the 50 known chameleons are also confined to the Realm. There are many agamid and lacertid lizards but no iguanas on the African mainland, though several species occur on Madagascar. Crocodiles and turtles are abundant, including side-necked turtles related to the Neotropical pelomedusid family.

Afrotropical amphibians are less distinctive, with many widespread families of frogs and toads. The pipid clawed toads *Xenopus* are characteristic of the African fauna and are related to Neotropical forms. Hylid tree-frogs are absent but are replaced by a similar family, the polypedatids. There are no tailed amphibians.

The fish fauna of Africa is very diverse and distinctive. Some of the inland lakes such as Lakes Tanganyika, Malawi, Victoria and the Zaire lakes have great numbers of endemic species, particularly cichlids and endemic mormyrids. The fish fauna includes carp, catfish, characins, lungfish and several endemic familes. The African lungfish *Protopterus* belongs to an ancient family, virtually unchanged since the Palaeozoic Era, and is related to the Neotropical genus *Lepidosiren.*

The insect fauna of the realm is rich and diverse. For instance over 2500 species of butterflies are known and new species are still being discovered. African butterflies belong mostly to common widespread families and genera but mention should be made of the family Acraeidae which is predominantly African and the sub-family of the gorgeous Charaxinae butterflies that reach their greatest diversity in Africa.

2.7 BIOGEOGRAPHICAL DIVISIONS OF THE AFROTROPICAL REALM

There are considerable problems in delineating precise biogeographical boundaries to the Afrotropical realm since the different groups of plants and animals show very different spatial patterns.

Since most species of both plants and animals are, to a large extent, limited to one or a small number of vegetation types, much of the biogeography of the realm can be explained purely on the basis of a vegetation map. Figure 2.6 presents a simplification of the vegetation map of White (1983).

A floristic analysis of many plant families reveals that there are a number of distinct and well recognised phytochoria in Africa, which, independent of vegetation type, contain distinct flora of shared origins. These phytochoria include the main centres of floral endemism, areas of particular floristic impoverishment and areas of transition or a mosaic of floral types. White (1983) has mapped these phytochoria (figure 2.7c) and they are summarised in table 2.1. There is a fairly good correlation between these floristically defined phytochoria and the present distribution of vegetation types. But whereas the present distribution of vegetation reflects the present climatic conditions of the continent, the phytochoria represent ancient cradles of floral evolution and are less biogeographically ephemeral. They therefore form better divisions from a biogeographical viewpoint than vegetation alone. The vegetation types within these units can be used as a subsidiary classification to sub-divide the major units. For this review, we have used White's (1983) UNESCO vegetation map, using the phytochoria boundaries as the basis for biogeographical divisions and the vegetation types as habitat subdivisions within units.

Ideally, biogeographical divisions should be as meaningful for the fauna as the flora and a number of schemes have been proposed for faunal divisions of the realm. Chapin (1923) presented a map (figure 2.7a) for biogeographic units based on bird distribution. His divisions can also relate to vegetation types.

One pragmatic way of dividing the Afrotropical biota (e.g. Moreau 1966) has been to describe western, southern, and eastern Africa separately. This is done as much for geographical and linguistic reasons as from a biological viewpoint; however the western unit includes almost all of Africa's tropical forest and many apparently 'western' species may simply be forest species.

Udvardy (1975) has attempted to construct a compromise map based on vegetation types and some recognised faunal divisions. Unfortunately he did not have available the map of floral phytochoria as a base for his map nor did he have the advantage of the recent publications on bird biogeography. His map (figure 2.7b) has merit but can now certainly be improved upon. His revisions to the map are still not available.

The well documented bird species distribution maps (Hall & Moreau 1970) have enabled more detailed analyses to be made by subsequent* students of African bird geography (Diamond & Hamilton, 1980 ; Crowe & Crowe, 1982).

Diamond and Hamilton (1980) confined their analysis to the distribution of forest birds. Using a fairly sophisticated cluster analysis technique, they conclude that the present distribution of forest birds indicates a history of recent colonisation of newly-formed forests from a number of small discrete Pleistocene refugia. These refugia are still characterised by high levels of species richness, as centres of endemism and as centres of disjunct species distributions. Four lowland areas of high endemism are

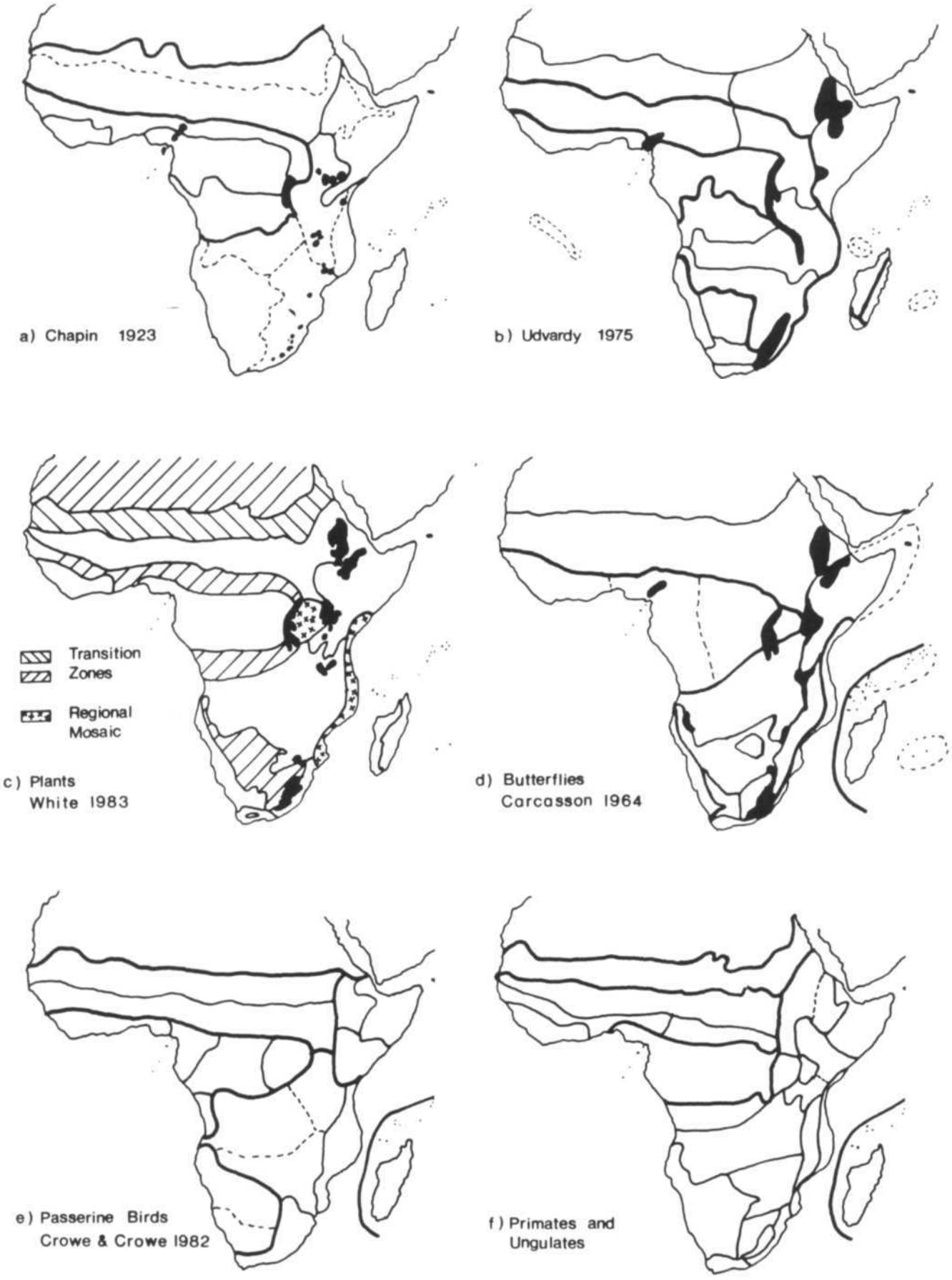


Figure 2.7 *Biogeographical Divisions of Africa*

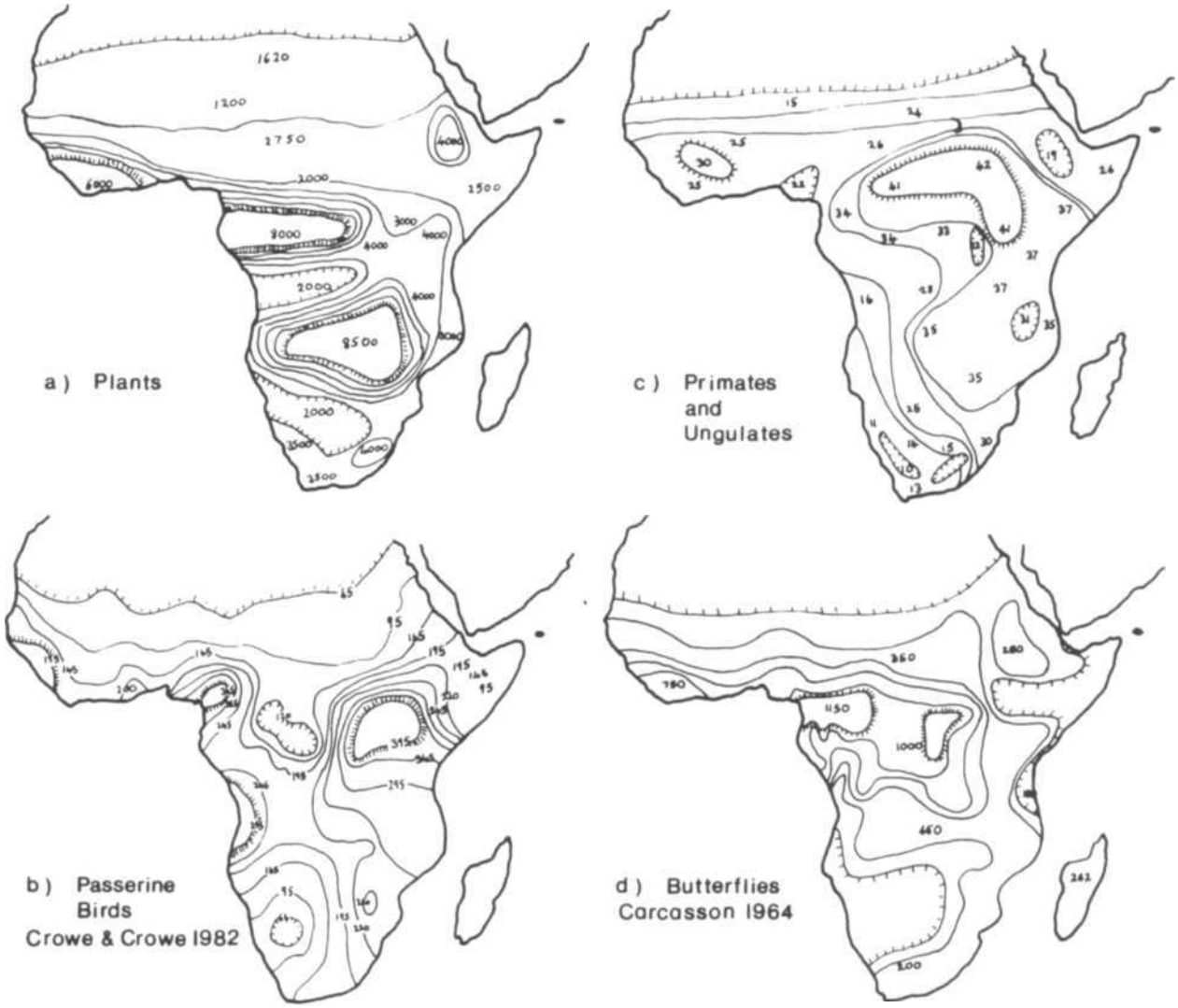


Figure 2.8 *Species Richness of Selected Groups in Africa.*

identified as West Africa (west of the Togo/Dahomey Gap), Cameroon/Gabon, East Zaire and the East African coastal forests.

These findings are largely confirmed by the wider analysis of the whole bird fauna of tropical Africa by Crowe and Crowe (1982), who map the distribution of diversity of both non-passerine (data from Snow, 1978) and passerine birds and identify avifaunal zones through cluster analysis and dendrogram construction. In addition to centres of species richness identified by Diamond and Hamilton, this analysis also reveals the interesting pocket of richness on the west coast in the region of Angola, which the authors suggest must be regarded as another Pleistocene refuge. Since the correlation between non-passerine and passerine birds is close and passerine birds are generally smaller, more numerous and poorer at dispersal, the passerines are taken as a clearer indicator of biogeographic events. Figure 2.9 presents the Crowes' (1982) dendrogram of avifaunal divisions determined for passerine birds, figure 2.7e presents these results in map form and figure 2.8b presents a map of passerine species richness.

The biogeographical divisions of the African butterfly fauna (Carcasson, 1964) are rather similar to those shown by birds (map 2.7d). However, butterflies are much richer in the forested parts of Africa as shown in the species diversity map (2.8d).

Although these faunal groups (passerine birds and butterflies) correlate quite well with the plant phytochoria of White (1983) there are some important differences. Faunal analysis highlights a pocket of bird endemism in Angola, subdivisions of the Guineo-Congolian rainforests, and the distinctiveness of the Karoo and Cape grassland faunas. For the purposes of this review subdivision of the phytochoria by vegetation type is adequate to cover these faunal boundaries but we have decided to subdivide the large and important phytochorion I (Guineo-Congolian) in our evaluation of protected area coverage.

For comparison we have plotted the distribution of African large mammals within these divisions and

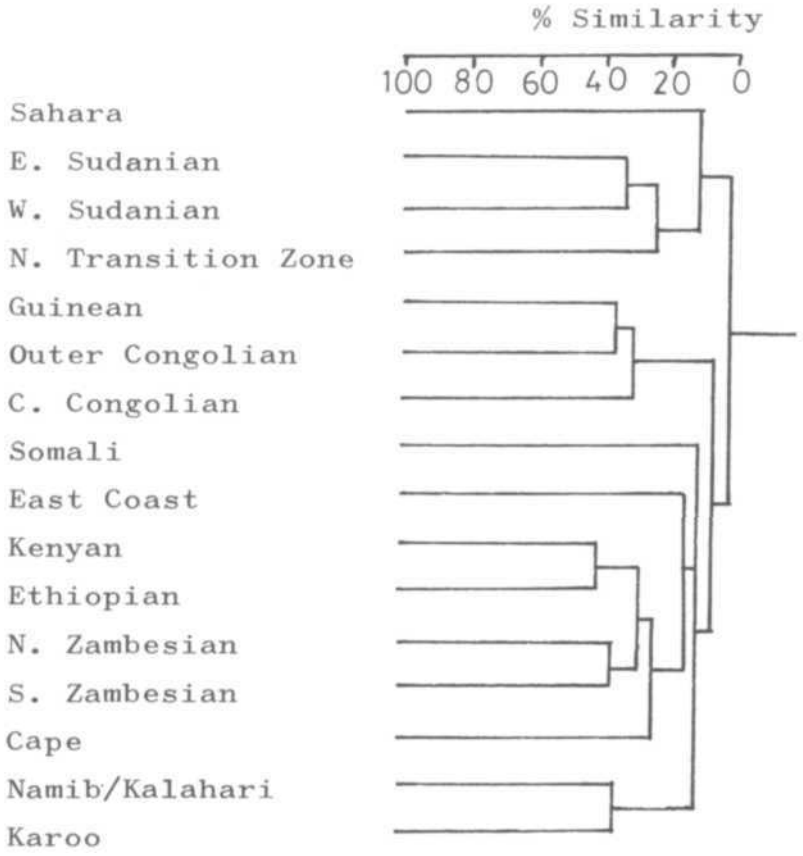


Figure 2.9 *Dendrogram of relationships between passerine bird faunas of different parts of Africa (after Crowe & Crowe 1982).*

produced similar dendrographic analysis to that for birds (figure 2.10). Again there are some interesting differences. For instance the Dahomey Gap and Sahel divisions are more significant for mammals than birds and the whole of eastern and southern Africa are rather undifferentiated for mammals (maps 2.7f and 2.8c).

Table 2.1 lists the biogeographical divisions (phytochoria) used in this review and indicates their respective importance to different groups of plants and animals (birds = passerine families, mammals = ungulates and diurnal primates).

Table 2.1 Biological Importance of Afrotropical Phytochoria

No.	Name	Mammals		Birds		Plants	
		spp.	%endem-ism	spp.	%end.	spp.	%end.
1	Guineo-Congolian	58	45	655	36	8000	80
II	Zambezian	55	4	650	15	8500	54
III	Sudanian	46	2	319	8	2750	33
IV	Somalia-Masai	50	14	345	32	2500	50
V	Cape	14	0	187	4	7000	50
VI	Karoo-Namib	13	0	112	9	3500	50
VIII	Afromontane	50	4	220	65	3000	75
X	Transition I/II	29	0	c.500	0	2000	2
XI	Transition I/III	48	0	c.400	0	2000	2
XII	L.Victoria Mosaic	40	0	505	15	3000	3
XIII	Zanzibar Mosaic	33	0	311	12	3000	33
XIV	Kalahari-Highveld	32	0	172	5	2000	5
XV	Tongaland Mosaic	29	0	226	5	3000	40
XVI	Sahel Transition	25	0	211	4	1200	3
XIX	East Malagasy	17	76	58	57	6100	80
XX	West Malagasy	15	73	40	50	2400	80
XXI	Oceanic Islands	few	0	high	high	C.3000	40

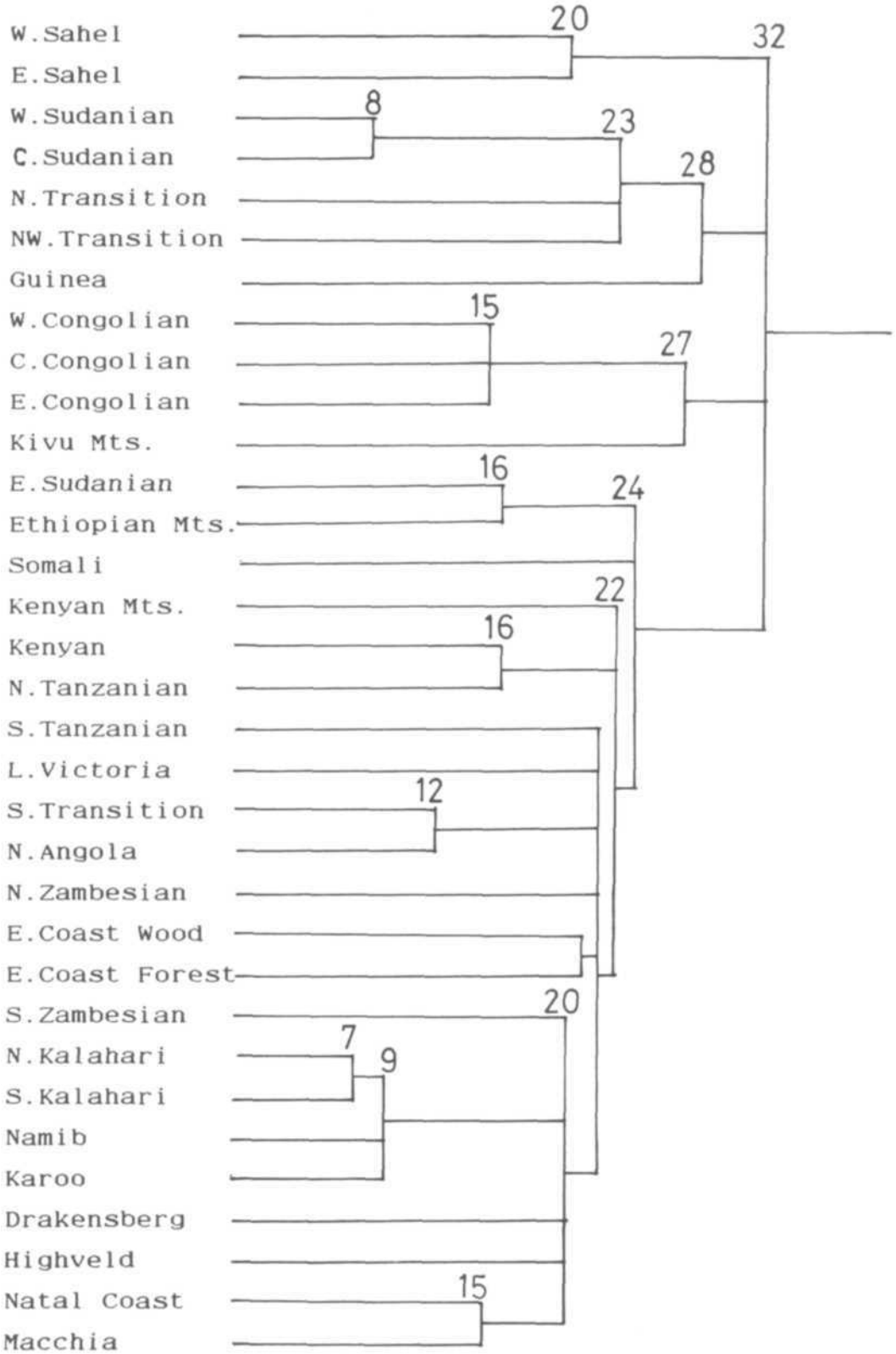


Figure 2.10 *Dendrogram of relationships among selected mammal groups fauna of different biogeographic units and sub-units of the Afrotropical Realm (numbers refer to % divergence).*

2.8 THE HISTORY OF MAN IN AFRICA

Australopithecine fossils from the Lower Pleistocene of southern and eastern Africa are the presumed ancestors of the genus *Homo* to which mankind belongs. The earliest *Homo* (*erectus*) fossils dating from as long ago as 1.5 million years are also found in Africa which can be assumed to be the original home of Man. The earliest remains of *Homo sapiens*, however, are from Europe (c. 250,000 years ago) and it is not clear whether Africa enjoyed a continuous progression of human evolution or was recolonised from the north.

Human influence on the wildlife of Africa has passed through a number of distinct phases:-

1) During the Neolithic Hunter/Gatherer Period (up to about 2000 B.C.) population density was probably rather low but human bands were widespread over most of the continent. There was no extensive agriculture nor keeping of livestock and the main impact on wildlife was through hunting and possibly some burning of vegetation. Some large mammals may have been exterminated and a few others reduced in numbers by these activities.

2) During the Neolithic revolution and Iron-Age period (reaching a peak between 1400 and 1700 A.D.) agriculture and livestock were developed and extended. There was a big build up of human population with focal points of dense stable settlement in the fertile wetter areas. These became centres of political power leading to the formation of many ephemeral kingdoms, each supported by an agricultural base but developing trade in gold and, later, ivory and slaves. Human populations probably reached higher densities than at any time until the mid-colonial period. Bantu peoples spread over much of central and southern Africa. Wildlife was probably considerably reduced and confined to 'boundary wilderness' zones. In the drier areas, pastoralism probably had less effect on wildlife and some species probably benefited by the expansion of savannas by pastoralism.

3) During the period of external invasions by Arabs and later Europeans (between 1600 and 1900 A.D.) the whole continent was decimated by wars, disease and the slave trade. Over 5 million slaves were taken over the Sahara to North Africa, countless more across the Red Sea to Arabia and the East and an estimated 15 million across the Atlantic to America. Many more were killed in the slave trade-inspired wars. Over the same period smallpox, jiggers, venereal disease etc. all took their toll and rinderpest spread among domestic cattle and local wildlife. The human population became reduced and fragmented, probably dropping to its lowest levels in over 2000 years. Most wildlife benefited, except elephants (hunted out of large areas of their range for ivory) and some rinderpest-prone species that quickly recovered. As a result of the fragmentation of human populations and the spread of bush and wildlife, tsetse flies spread and gave rise to outbreaks of nagana and sleeping sickness in the early years of this century (Ford 1971).

4) During the colonial period, (mostly between 1900 and 1960) political stability was achieved and hunting became quite strictly controlled. Some game reserves were established. At the same time human and wildlife populations increased very fast. By the 1930s new lands were being opened up for settlement and the conflict between man and wildlife increased again.

5) In the post-independence period human populations have continued to increase but there has been great political instability and widespread weakness of law enforcement leading to further erosion of economically valuable species. This has been countered to some extent by a significant increase in the amount of land set aside for wildlife as protected areas.

Little of the landscape of Africa outside the closed forests and deserts has not been settled by humans or used by their livestock during this long history. The 'pristine' Africa seen by Europeans around 1900 was in fact an already degraded scene and the continuing 'loss' of wilderness is merely an extension of a pattern that has existed since the Iron Age.

2.9 PATTERNS OF LAND CHANGE

Man has had a long history in Africa and human activities have had a considerable effect on the vegetation of the continent. These influences were probably localised until the Bantu peoples spread from western Africa through much of eastern and southern Africa and the pastoral tribes began herding their cattle across northern Africa.

Cutting forests to open agricultural lands, overgrazing by domestic animals and repeated burning for hunting and to stimulate new growth for grazing have all led to severe degradation of both vegetation and soils over wide areas.

The effects of human activities on the environment have been well documented, for example by De Vos

(1975), Aubreville (1971) and Halwagy (1962). Much of the severe degradation of soil and vegetation in the drier parts of southern Africa can be attributed to the advent of European farmers (Acocks, 1979). Everywhere the rate of land change accelerates as population pressure builds up and more powerful technology is used. For instance the area of tropical forest in Sierra Leone has shrunk from about 70% cover 200 years ago to a mere 4% cover today (Teleki and Baldwin 1981).

More or less unaffected natural habitat in Africa is now confined to the mountainous areas, surviving blocks of intact rainforest, some woodlands, swamps and protected savanna and steppe-lands. Secondary vegetation is found where lands have been abandoned after agriculture, mostly in forested or wooded regions. Much more of Africa is now covered by rangelands—'land carrying natural or semi-natural vegetation which provides habitats suitable for herds of wild or domestic ungulates' (Pratt, Greenway & Gwynne, 1966). These rangelands are all man-affected but vary in their degree of modification from almost original vegetation to severely degraded habitat.

Generally Man's efforts have had the effect of thinning out the vegetation and drying out soils but in some areas overgrazing and overburning have had the opposite effect and led to undesirable thickening of woody plants and loss of good grassland (Walter, 1954; Thomas & Pratt, 1967).

Today large areas have been converted to agricultural and ranch lands where natural vegetation and its associated wildlife have been lost. Major irrigation projects are causing lowering of the water table which may further affect vegetation in some localities.

2.10 SUBSISTENCE HUNTING AND POACHING

Africa has supported hunting man and his ancestors for at least 3 million years. These hominids roamed across the African plains bearing increasingly sophisticated weapons, but not without having an effect on the wildlife on which they preyed. For much of the Pleistocene, Man's very survival must have been in the balance until hunting man made the technological breakthrough that left him the dominant carnivore on the continent– the development of double-edged flake tools. As soon as Man had sharp, hard heads and poisons for his spears and arrows, his impact on wildlife became awesome and he began to reduce and eliminate many species of prey. As these animals were reduced in numbers, so too were their predators, the larger carnivores.

Martin (1966) has shown that waves of extinction, during the Pleistocene, of large, slow-moving, terrestrial mammals coincide, not with particular geological nor climatic events, but with the arrival of Neolithic Man. Thus the great extinctions of North America are far later than the waves of extinction for Africa but earlier than the extinctions on Madagascar, in each case corresponding to the arrival of hunting Man.

Unlike most other carnivores, who suffer from food shortages if they over-utilise their prey base, mankind has never been totally dependent upon animal prey for food. Meat has only been an addition or enrichment to a diet made up predominantly of starchy grains and root tubers. Indeed the advent of raw meat in the diet of Early Man may well have been as much from socio-ritual needs as for nutrition (Rijksen, 1977; MacKinnon, 1978).

Moreover, whereas most carnivores live at much lower densities than their prey species, Man, supported by his starchy diet and able to store food through periods of shortage, was often more numerous than his prey. This made him a particularly dangerous carnivore with no stabilising feed-back to control his hunting levels.

As one would expect, the animals most vulnerable to human hunting have been the large, slow-breeding, generally slow-moving animals. Among the African mammals to disappear since the late Pleistocene were several species of elephants, a giant baboon, the enormous giraffe-like *Libytherium,* several large pigs and bovids and the sabre-toothed tiger *Machairodus.* On Madagascar, Man was probably responsible for the extinction of a variety of larger lemurs such as *Megaladapis* and *Archaeolemur* and the giant flightless bird *Aepyornis.* The more recent extinction of the Mauritius dodo fits the same pattern.

The killing continues. Elephants and rhinos are now being systematically wiped out over wide parts of the realm, even inside protected areas. Kabalega Falls National Park in Uganda has had its elephant population whittled down from 8,000 in 1966 to a mere 160 in just 14 years of poaching. The northern white rhino is all but extinct; only some 17 rhinos survive in the Garamba National Park in Zaire, site of an ongoing WWF project to try to save them. Mountain gorillas in Rwanda continue to be killed in spite of an active conservation project with international backing. Crocodile populations have been drastically reduced almost everywhere. Hunting for bushmeat in West Africa has reduced game to very low levels. The picture is gloomy across the whole continent. Even the game rangers are in danger and suffer losses in

regular gunfights with well-armed poachers. The legal protection of protected areas on paper is meaningless without a fully-equipped and well-motivated guard force and one year of weak management can wipe out 30 years of hard work and adequate protection. Such are the challenges facing the managers of protected areas in Africa today.

2.11 DESERTIFICATION

There have been periods in the Pleistocene when Africa was certainly drier than today. Dead wind-blown sand dunes can be found 300 miles further south than the present limits of moving sand in the Sahara (Grove and Warren, 1968). But throughout human history, the pattern on the continent has been one of ever-increasing aridity, particularly over the northern half of Africa.

Pollen analysis (Hugot et al., 1962) reveals that 5000 years ago, xerophytic Mediterranean scrub and woodlands stretched as far south as the southern borders of the present Sahara Desert. Neolithic artefacts indicate that Early Man could move freely over the region (Monod, 1963). These woodlands were subsequently replaced by African *Acacia* and *Balanites* vegetation which gradually retreated as desertification continued. Today the Sahara supports very little vegetation at all except around water holes, oases and cooler hills and these are drying up.

About 10,000 years ago, at the turn of the last glacial period, the Upper Niger river fed a huge lake west of Timbuktu and only later cut through its sill to drain out along the Lower Niger river to the Atlantic. At this time, Lake Chad was three times larger than Lake Victoria is today and another large lake existed at Adrar Bous in what is now the desert of Tenéré. The climatic conditions at the time were clearly very different from today.

Each year the Sahara and Sahel move further south, causing terrible human hardship and local famine. Partly this relentless spread of desert is a result of climatic change but the situation has been greatly compounded by human misuse of the land. The cutting of the last woods for timber, fuel and charcoal, combined with overgrazing by domestic animals, further aided by tsetse eradication programmes, has pushed the vegetation over critical ecological thresholds which have led to dramatic land degradation, threatening the very survival of wildlife, wild flora and Man himself over a huge area of the continent.

2.12 SUMMARY OVERVIEW

The Afrotropical Realm is not as rich in plant or animal species as either the Neotropical or Indo-Malayan realms but it includes the greatest diversity of families of all the biogeograghical realms. Moreover, the African flora and fauna are completely distinct and very spectacular.

The tropical savanna ecosystem is better developed and more extensive in Africa than anywhere else in the tropics. The great herds of migrating wildebeest and other game are uniquely African sights, and inspiring spectacles. The rich diversity of sympatric ungulates – boldly-marked giraffe and zebra – moving through mixed herds of antelopes, whilst the lion and elephant stand regally watching– these are the images that epitomise 'wildlife' to a vast majority of people today. It is no coincidence that more than half of all wildlife films ever made are of Africa. The African continent is a precious global heritage, deeply embraced in the culture of our species.

Africa is also the cradle of mankind. It was in Africa that the first hominid apes stood up straight and threw their first crude missiles. It was here that sympatric hominids competed for survival and brains won over brawn. The African plains give man a sense of identity and origin. We must preserve and study our origins if we are ever fully to understand ourselves. This means preserving not only the plains that shaped our evolution but also the forest homes of our nearest relatives, the gorillas and chimpanzees.

From a more practical viewpoint, Africa has the widest range of potential domestic animals and the greatest diversity of open country savanna flora from which to select future crops. Man is still an open country animal, dependent on open-country crops and open-country herds. The future of tropical agricultural innovation may lie largely in Africa which is still relatively untapped in terms of domestic species.

The forested parts of Africa contain valuable drugs and edible fruits. Again, we are in danger of losing these resources before we even have time to evaluate their usefulness. Quite often the destruction is so short-sighted and unnecessary that even in the short term it can be shown to be wasteful.

The African mountains serve a vital function in protecting watersheds and water supplies to the lowland users and agriculturists. They also protect some of the most specatcular and interesting fauna and flora –

mountain gorillas, golden moles, giant alpine plants, colourful *Protea* flowers and the beautiful tropical glaciers of Rwenzori, Kilimanjaro and Mt. Kenya.

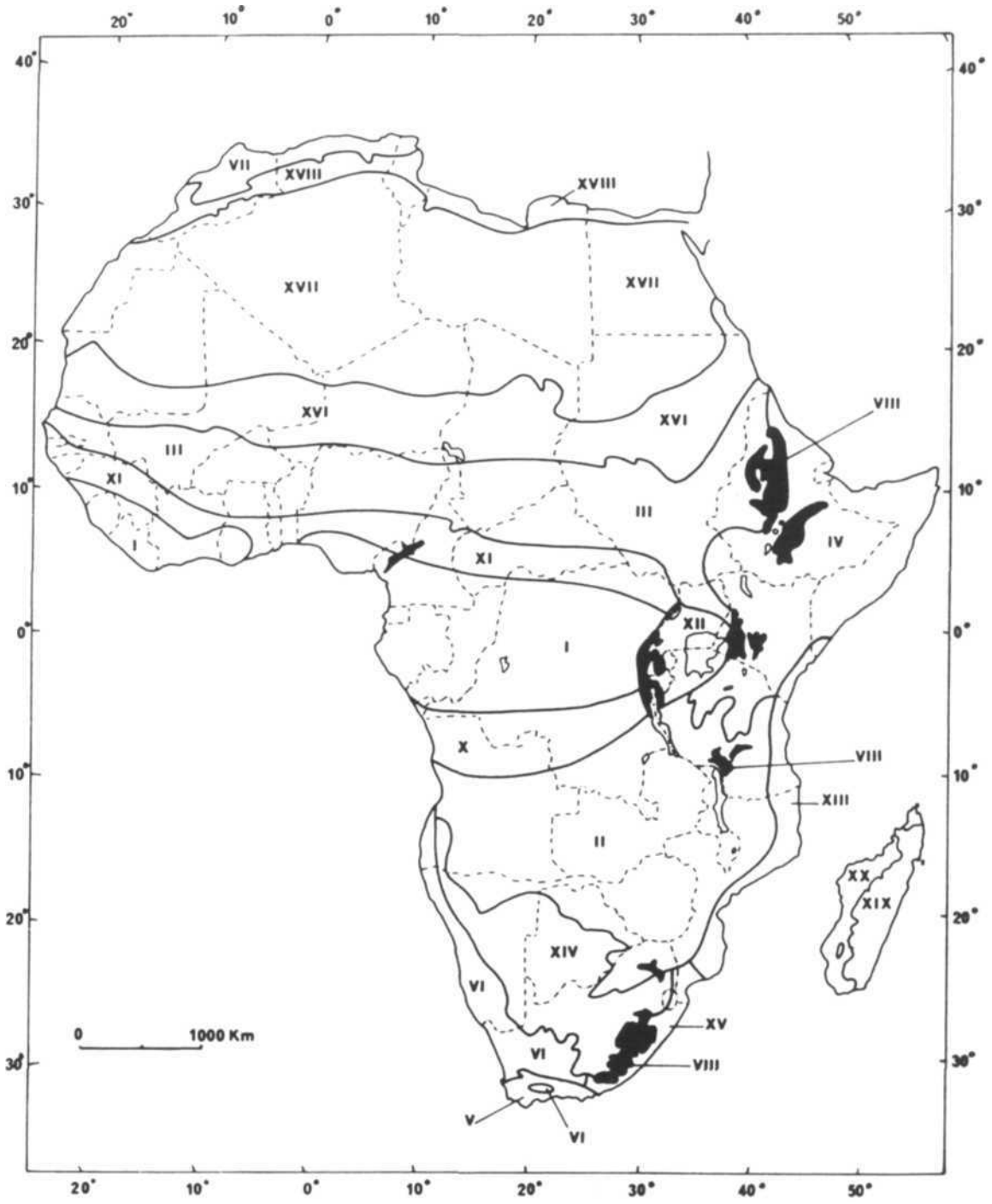
Globally, Africa stands out as *the* 'Wildlife' continent and in terms of biotic richness and diversity, it is on a par with any other area on the planet. Justification for protecting this marvellous natural heritage is very high. Africa has always been regarded as a special priority area for conservation by international agencies such as IUCN, World Wildlife Fund, UNEP, UNESCO and FAO and has in fact received a disproportionate share of international conservation aid. Several hundred conservation projects have been implemented to supplement national efforts in Africa but the conservation picture over much of the continent still looks bleak.

Every year sees the further retreat of wildlife. Wildlands are destroyed and even existing protected areas are invaded by poachers and farmers. The population of Africa grows at a fierce and uncontrolled rate and the situation is made worse by political instability, tribal conflicts and the economic poverty that afflicts the whole region. The problem for the conservationist was well summarised by Lusigi at the Bali Conference in 1982.

'Right across the continent there are still vivid examples of military coups, border disputes, civil confrontations and internal political tensions. All these have affected the atmosphere in which most conservationists work and changed national priorities favour heavy investment into military expenditure. National budgets have consequently shown only small allocations to conservation. . . . Because of political uncertainty in some countries it has been difficult to make plans in the long term and as one director of wildlife conservation puts it 'You just never know what will happen tomorrow'. Under the circumstances, it is quite possible – and this has happened on a few occasions that assistance or support earmarked for conservation finds its way into other unrelated activities.'

It is against this background, a problem for Man as well as for wildlife, that this review of protected area needs in the realm has been instigated. In many ways, the standards of wildlife research and the management of parks and wildlife seen in some African countries are as good or better than anywhere else in the world. But in the current socio-political environment on the continent, and against such a pressure of human expansion, it is clear that current efforts at conservation are not enough. A review of the whole realm is timely. The next decade may be the last chance to get more land for conservation and find a new formula for Man and wildlife to coexist in Africa.

Part Three
COVERAGE BY BIOGEOGRAPHIC UNITS



Map 3.6 *Main Phytochoria of Africa and Madagascar.*
I Guineo-Congolian regional centre of endemism. II. Zambezian regional centre of endemism. III. Sudanian regional centre of endemism. IV. Somalia-Masai regional centre of endemism. V. Cape regional centre of endemism. VI. Karoo-Namib regional centre of endemism. VII. Mediterranean regional centre of endemism. VIII. Afromontane archipelago-like regional centre of endemism, including IX. Afroalpine archipelago-like region of extreme floristic impoverishment (not shown separately). X. Guinea-Congolia/Zambezia regional transition zone. XI Guinea-Congolia/Sudania regional transition zone. XII. Lake Victoria regional mosaic. XIII Zanzibar-Inhambane regional mosaic. XIV. Kalahari-Highveld regional transition zone. XV. Tongaland-Pondoland regional mosaic. XVI. Sahel regional transition zone. XVII Sahara regional transition zone. XVIII. Mediterranean/Sahara regional transition zone. XIX. East Malagasy regional centre of endemism. XX. West Malagasy regional centre of endemism
(Source: White 1983)

Part Three – COVERAGE BY BIOGEOGRAPHIC UNITS

The biogeographic units used in this review correspond to the phytochoria of White (1983)—see map 3.6.

3.1 GUINEO-CONGOLIAN REGIONAL CENTRE OF ENDEMISM (Unit I)

a. Extent of Unit

The unit consists of two distinct parts—the Guinea Rainforest sub-unit which extends for 1,750 kms along the coastal margin of West Africa and has a total area of 420,000 km^2, and the much larger Congolian rainforest unit which occupies the great depression of the Zaire/Lualaba basin from the Atlantic coast to the Great Western Rift (Dorsale du Kivu) and has a total area of 2,380,000 km^2. The two units are separated by the narrow, dry "Dahomey Gap".

b. Administrative Divisions

The Guinea sub-unit falls across five countries :- S.W. Ghana, S. Ivory Coast, the whole of Liberia, most of Sierra Leone and the southern limits of Guinea-Conakry. The Congolian unit comprises a tiny part of Benin, southern Nigeria, southern Cameroon, the whole of Congo, Equatorial Guinea and Gabon, most of Zaire, part of the Cabinda province of Angola and the extreme south of the Central African Republic (CAR).

c. Dominant Vegetation

Maps 3.1 and 3.2 show the dominant vegetation of the unit. Most of the unit is covered in lowland rainforest. The coastal belt of the unit and forest blocks in Cameroon and Gabon and most of the forests of the outer parts of the Zaire/Lualaba basin are evergreen forests. Drier semi-evergreen forests form a narrow fringe around the phytochorion and along the northern edge of the Guinea unit. At the western end of the Guinea unit and in the Equatorial Guinea/S. Cameroon region the forests are a mosaic of evergreen and semi-evergreen types. In the extreme east of the unit the rainforest merges into a transitional type where lowland species mix with Afromontane and endemic species on the lower slopes of the mountain chain which forms the western edge of the Great Rift Valley. Swamp forests grow in areas that are permanently or seasonally inundated with water (often fast flowing) in the old lakebeds and hollows of the Zaire Basin (Cuvette Centrale) and in some of the larger river deltas (especially Niger). Extensive areas that were probably once rainforest have become forest grassland mosaic as a result of former human settlement and shifting cultivation.

d. Distinct Habitat Types

There are a number of distinctive minor vegetation types in the phytochorion.

In the Guinea unit, upland *Parinari excelsa* forests dominate the vegetation above 1000 m, particularly between 1300-1600 m over much of the northern plateau. Distinctive *Lophira* tree savanna occurs on the impoverished soils of Sierra Leone and Liberia and edaphic grasslands are found on hydromorphic soils. There are also areas of coastal park savanna along the sandy coastline. These specialised vegetation types are all comparatively impoverished in total diversity and endemism and are of less conservation importance than the rich mixed forests.

In the Nigeria/Cameroon sub-unit, characteristic stunted vegetation (termed semi-montane forest by Richards, 1952) occurs on granite inselbergs. Elsewhere stunted rupicolous forest is found on rocky hills and other upland areas.

In many parts of the Congolian unit, small areas are dominated by one or more of the following five leguminous trees—*Brachystegia laurentii, Cynometra alexandri, Gilbertiodendron dewevrei, Julbernardia seretii* and *Michelsonia microphylla*. The swamp forests are of several distinct types. A distinct elfin thicket vegetation is

found only on the Belinga Mtns in Gabon. Edaphic grasslands grow on hydromorphic soils. In addition there are several recognisable seral succession stages among the secondary forests of the unit.

e. Current Land Use

The forests of the Guinea unit have been heavily damaged by clearance for agriculture and plantations, logging operations and in some areas (e.g. Mt. Nimba complex) by mining activities. More than half of the original forest cover has been lost and much of the remaining forest is in fact secondary. In Sierra Leone, for instance, it is estimated that less than 4% of the country is now under forest compared with 70% two hundred years ago (Teleki and Baldwin 1981).

Extensive areas of the unit are now planted with rubber, oil palm, cocoa, coffee, kola nuts and ginger. Ground nuts are grown in the north west corner of the unit and Piassava (fibre) is grown in some coastal areas. Rice is cultivated in suitable flat wet areas.

Much of the upland forest has been cleared for its timber and for shifting agriculture, leaving a mosaic of secondary forest and grassland, which has been heavily hunted over and is of little conservation interest.

In the Nigeria/Cameroon sub-unit, many of the Nigerian forests have been cleared and forest remains only in small isolated reserves. In Cameroon the forest clearance has not progressed so fast and quite extensive areas are still under forest cover. Crops are similar to those planted in the Guinea sub-unit.

In Equatorial Guinea, Gabon and Congo, forest clearance has been slower and much of the forest cover is still intact with grassy clearings found only around major population centres and extending from roads.

In the Zaire basin, about 50% of the original forest remains. The transitional forests at the extreme eastern end of the phytochorion are very fertile and have been largely cleared for agriculture and plantations of tea and coffee. The soils in the Cuvette Centrale are far less fertile but have been replaced by extensive rubber, oil palm and coffee plantations. The swamp forests which until recently remained largely undamaged are now being extensively cleared and developed for rice cultivation

f. Biological Richness and Endemism of Unit

The Guineo-Congolian Regional Centre of Endemism is extremely rich in species and has very high levels of endemism. There are an estimated 8000 species of plant of which more than 80% are endemic to the unit.

The unit is by far the richest in Africa for butterflies (see fig 2.8) and also shows very high endemism for this group.

The unit scores as highest in the realm for bird richness (marginally ahead of the large Zambezian unit) with 655 species and subspecies of passerines showing 36% endemism. The unit is also the richest in terms of mammal diversity (based on ungulates and diurnal primates) with 58 species and again very high levels of endemism (45%).

Levels of species richness and endemism are not even over the whole unit. The Guinea sub-unit is less rich than the Cameroon-Gabon or East Congolian sub-units but is rather distinct due to its isolation west of the savanna "Dahomey Gap".

Thus in the Tai forest, for instance, 54% of the 1300 plant species recorded are endemic to the Guinea sub-unit and 16% of these are locally endemic to the Tai region (Guillaumet, 1967). Endemism is less great among birds for which the Dahomey Gap is not much of a barrier. Moreau (1966) lists only 9 bird species as endemic to the Guinea sub-unit. Endemism in mammals is much higher with 8 species (32%) of the 25 ungulate and diurnal primate species being confined to the sub-unit.

The forests between southern Cameroon and Gabon are very rich in species and local endemics and are interpreted as Pleistocene refugia for forest flora and fauna. The forests at the extreme eastern end of the phytochorion are also enriched through the transition with the Afromontane unit and have evolved several locally endemic forms.

The forests of the central part of the unit are relatively impoverished in species and have few endemics at sub-unit level (most of the constituent species are still endemic to the unit as a whole). The Zaire river acts as a barrier to some mammal species, especially primates.

g. Species of Special Commercial Interest

The Guineo-Congolian unit contains a number of wildlife species of economic significance such as elephants (ivory), crocodiles (skins), primates (for biomedical research) and various ungulates and fish locally important as sources of protein.

The forests contain many species of high timber value and high silvicultural potential. For instance the following tree species are recognised as of high value in the Guinea sub-unit :-

Scientific name	Trade name
Entandrophragma utile	Sipo
Entandrophragma angolense	Tiama
Entandrophragma candollei	Kossipo
Entandrophragma cylindricum	Sapelle
Lophira alata	Azobe
Tarietia utilis	Niangam (Cola mahogany)
Aningeria sp.	Aniegre
Mitragyna slipulosa	Abura
Tieghemella heckelii	Makore
Erythrophleum spp.	Tali
Triplochiton scleroxylon	Wawa, Samba, Obeche
Gilbertiodendron preussi	Limbali
Terminalia ivorensis	Framine
Terminalia superba	Limba
Lovoa trichilioides	Dibetou
Khaya anthotheca	Acajou (Red mahogany)
Chlorophora spp.	Iroko
Gaurea cedrata	
Tetraberlinia tubmaniana	
Distemonanthus benthi	
Brachystegia leon	Naga
Mesogordonia sp.	Kotibe-Danta
Nauclea spp.	Kussia opepe
Canarium schweinfurthii	Aiele (White mahogany)
Pipladeniastrum africanum	Dahoma
Mansonia altissima	Bete
Guibourtia ehie	Bubinga, Amazakoue-shedua
Copaeifera salikounda	Etimoe
Afzelia sp.	Doussie
Diospyros sanza-minika	Gboh (Ebony)

By far the most valuable timber species from Gabon is the Okoume *Aucoumea klaineana.* In addition the forests contain many other species of particular value to Man.

Coffea liberica	Liberian coffee	beans
Landolphia spp.	African rubber	latex
Daniella conjugata	Copal	resin
Copaeifera spp.	Copal	resin
Pterocarpus erinaceus	Kino	resin
Daniella thurifera	Sierra Leone frankinsence	resin
Afromomum melgueta	Grains of paradise	spice
Cola nitida	Kola	nuts
Elaeis guineensis	Oil palm	oil nuts
Dioscorea rotundata	Yam	tuber
Ceiba pentandra	Kapok	fibre

h. **Species of Special Biological and Conservation Interest**

The following mammals of the unit are listed as threatened in the Mammal Red Data Book of IUCN:

Cercocebus torquatus	Sooty Mangabey	vulnerable
Cercopilhecus diana	Diana Monkey	vulnerable
Cercopithecus dryas	Dryas Monkey	insuff.known
Cercopithecus erythrogaster	Red-bellied Guenon	vulnerable
Cercopithecus l'hoesti	L'Hoest's Monkey	vulnerable
Allenopithecus nigroviridis	Allen's Swamp Monkey	insuff.known
Cercopithecus erythrotis	Russet-eared Guenon	vulnerable
Papio leucophaeus	Drill	endangered

Papio sphinx	Mandrill	vulnerable
Colobus verus	Olive Colobus	rare
Colobus badius subspp .	Red Colobus	vulnerable
Colobus badiuspennanti	Pennant's Red Colobus	vulnerable
Colobus satanas	Black Colobus	vulnerable
Pan troglodytes	Chimpanzee	vulnerable
Pan paniscus	Pygmy Chimpanzee	vulnerable
Gorilla gorilla	Gorilla	vulnerable
Panthera pardus	Leopard	vulnerable
Loxodonta africana	Elephant	vulnerable
Trichechus senegalensis	Manatee	vulnerable
Choeropsis liberiensis	Pygmy Hippo	vulnerable
Taurotragus derbianusderbianus	Western Giant Eland	endangered
Cephalophus jenlinki	Jentink's Duiker	endangered
Cephalophus zebra	Banded Duiker	indeterminate

The three African Great Apes—chimpanzee, pygmy chimpanzee and gorilla are all found in the unit and are regarded as of very great biological importance for research as Man's nearest living relatives. As yet no adequate populations of pygmy chimpanzees are protected in any protected area.

The following bird species are listed in the Bird Red Data Book of ICBP/IUCN:

Afropavo congolensis	Congo Peacock	special interest
Agelastes meleagrides	White-breasted Guineafowl	endangered
Scotopelia ussheri	Rufous Fishing Owl	rare
Melignomon eisentrauti	Yellow-footed Honeyguide	insuff.known
Campephaga lobata	Yellow Wattled Cuckoo-shrike	vulnerable
Malaconotus gladiator	Green-breasted Bush-shrike	rare
Picathartes gymnocephalus	White-necked Picathartes	vulnerable
Bradypterus grandis	Dja River Warbler	insuff. known
Melaenornis annamarulae	Nimba Flycatcher	indeterminate
Estrilda poliopareia	Anamabra Waxbill	insuff. known
Ploceus batesi	Bates Weaver	rare
Ploceus nigrimentum	Black-chinned Weaver	insuff. known
Ploceus subpersonatus	Loango Slender-billed Weaver	insuff. known
Ploceus aureonucha	Golden-naped Weaver	indeterminate
Malimbus ibadanensis	Ibadan Malimbe	endangered
Malimbus ballmanni	Gola Malimbe	indeterminate

The two endangered species are both very rare. The White-breasted Guineafowl is confined to the shrinking primary rainforests of the Guinea sub-unit and is recorded only from Sapo, Tai and Gola. It is thought to be extinct on Mt. Nimba and elsewhere within its known historical range. The Ibadan Malimbe is known only from a small area of S.W. Nigeria where its habitat is seriously threatened.

The following reptiles of the unit are listed as threatened in the Reptile Red Data Book of IUCN:

Crocodylus niloticus	Nile Crocodile	vulnerable
Crocodylus cataphractus	Slender-snouted Crocodile	insuff.known
Osteolaemus tetraspis	African Dwarf Crocodile	insuff. known

The following Swallowtail Butterflies are listed as threatened in the IUCN Red Data Book:

Papilio antimachus	African Giant Swallowtail	rare
Graphium aurivilliusi		insuff.known
Graphium weberi	Weber's Swallowtail	insuff.known

P. antimachus is rare but widespread, *G. aurivilliusi* is known only from the type specimens from an unkown locality in Congo and *G. weberi* is endemic to Cameroon.

i. Additional Features in Need of Protection

Examples of some of the unit's characteristic physical features such as granite inselbergs, cataracts, etc. should be included in the protected area system.

Various azonal formations such as peaty lakes, river terraces, mangroves, deltas and coastal lagoons should also be included and are given further attention in the wetlands section (chapter 4).

j. Ethnological or Historical Features in Need of Protection

There is a Late Stone-Age archaeological site at Iwo Eleru in Nigeria but otherwise there are few sites of archaeological interest in the unit. There are, however, many interesting tribes (including pygmies) living within the unit with near Stone-Age lifestyles. These forest peoples have valuable knowledge and understanding of the ecology and uses of the tropical forest plants and animals. The survival of some of these cultures could be integrated into the protection of rainforest in the form of Biosphere Reserves or Anthropological Reserves.

k. The Protected Area System of the Unit

Maps 3.1 and 3.2 show the locations of the existing and proposed protected areas of the unit. Table I.1 lists these areas, giving their status, areas of main habitat types, contributory scores and overall importance.

Table I.1 Protected Areas of the Guineo-Congolian Regional Centre of Endemism.

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
CM	Bafia	4	.T.	500–1000	F/G	11a	420	420	3	84	C
CM	Bambuko (part)	8	.T.	1000–4100	F	1a	160	160	3	32	B
CM	Banyang–Mbo	8	.T.	200–500	F	1a	430	430	3	86	C
CM	Bone–Paupa	8	.T.	20–100	F	1a	200	200	3	40	C
CM	Campo	8	.T.	0–50	F	1a	3300	3300	3	660	A
CM	Dibombe Mabobe	8	.T.	50–200	F	1a	180	180	3	36	C
CM	Dja Forest	1	.T.	400–800	F	1a	5000	5000	3	2500	A
CM	Douala Edea	4	.T.	0–15	F	1a	1000	1600	2	800	B
					Mn	77	600				
CM	Doume	8	.T.	c.600	F	2	350	350	3	70	C
CM	Edea Ngambe	8	.T.	50–100	F	1a	600	600	3	120	B
CM	Ejaham	8	.T.	200–500	F	1a	750	750	3	150	B
CM	Keingbe Sud	8	.T.	50–200	F	1a	250	250	3	50	C
CM	Korup	4	.T.	500–1079	F	1a	837	837	2	418	A
CM	L. Barembi	4	.F.	c.100	Aq		20	120	4	24	B
					F	1a	100				
CM	L.Lobeke	4	.T.	1000–1500	F	8	430	430	3	172	C
CM	Mane River	8	.T.	200–500	F	1a	530	530	3	106	C
CM	Nta Ali	8	.T.	200–500	F	1a	330	330	3	66	C
CM	Nyong River	4	.F.	c.600	F	2	200	1200	4	240	B
					F	8	1000				
CM	Nyong Velle Kirebi	8	.T.	50–200	F	1a	1600	1600	3	320	B
CM	Rumpi Hills	8	.T.	500–1764	F	1a	460	460	3	92	C
CM	S. Bakunda	8	.T.	100–300	F	1a	190	190	3	38	C
CM	Takamanda	8	.T.	200–500	F	1a	680	680	3	136	B
CN	Conkouati	4	.T.	c.0	F/G	11a	1000	3000	3	1200	B
					F	2	2000				
CN	Lefini	4	.T.	600–800	F/G	11a	6300	6300	3	2600	B

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km²)	Total area (km²)	Management	Contrib. score	Priority
CN	Lekoli–Pandaka	4	.T.	200–300	F	1a	682	682	3	273	B
CN	Loudima	6	.T.	200–500	F	2	60	60	4	12	C
CN	M'boko	4	.T.	50–100	F	1a	900	900	3	360	B
CN	Mount Fouari	4	.T.	100–400	F/G	11a	100	156	3	78	C
					F	2	56				
CN	Mt Mavoumbou	4	.T.	200–400	F/G	11a	420	420	3	168	C
CN	Nyanga	4	.T.	200–400	F/G	11a	230	230	3	92	C
CN	Nyanga North	4	.T.	150–300	F/G	11a	77	77	3	31	C
CN	Odzala	2	.T.	400–600	F	1a	1266	1266	3	633	B
CN	Tsoulou	4	.T.	50–100	F/G	11a	300	300	3	120	C
CR	Basse Lobaye	8	.T.	400–500	F	2	182	182	3	36	C
CR	Bongo (Zanga)	4	.F.	200–1000	F	2	2000	2870	4	530	B
					F	8	870				
EG	Mt Alen	4	.F.	500–1000	F	3	950	950	4	190	B
GA	Ipassa–Makokou	4	.T.	450–500	F	1a	150	150	2	75	C
GA	Lope–Okanda	4	.T.	200–500	F/G	11a	1000	5000	2	2500	A
					F	1a	4000				
GA	Minkebe	4	.F.	500–1000	F	1a	4000	5000	4	1000	B
					F	8	1000				
GA	Moukalaba	4	.T.	0–100	F	1a	1000	1000	3	400	B
GA	Petit Louango	4	.T.	0–100	F/G	11a	400	800	3	320	B
					F	1a	400				
GA	Sette–Cama	4	.T.	0–100	F/G	11a	4000	7000	3	2800	B
					F	1a	3000				
GA	Wonga Wongue	4	.T.	0–1575	F/G	11a	3580	3580	2	1790	B
GH	Ankasa	4	.T.	0–100	F	2	200	207	3	83	C
GH	Bia	2	.T.	145–230	F	2	70	78	3	39	C
GH	Bia GPR	4	.T.	100–500	F	2	200	228	3	91	C
GH	Bomfobiri	4	.T.	200–500	F	2	70	72	3	29	C
GH	Nini–Suhien	2	.T.	0–100	F	2	100	104	3	54	C
GH	Owebi	4	.T.	200–500	F	2	52	52	3	21	C
GU	Massif du Ziama	8	.T.	500–1387	F	3	1162	1162	3	232	A
GU	Mount Nimba (part)	1	.T.	450–1752	F	3	60	60	2	48	A
IC	Azagny	2	.T.	c.0	Mn	77	10	190	3	95	C
					F	8	120				
IC	Iles d.Erotiles	2	.T.	0–100	Mn	77	10	100	3	50	C
					F	8	70				
IC	Marahoue (part)	2	.T.	90–320	F	2	110	110	3	55	C
IC	Mount Peko	2	.T.	40–1002	F	2	330	330	3	165	C
IC	N'Zo	8	.T.	40–1002	F	3	700	730	3	146	C
IC	Tai	2	.T.	80–623	F	1a	1300	3300	2	2310	A
					F	2	1100				
LB	Cape Mount	1	.F.	0–100	Mn	77	50	50	4	15	C
LB	Cavally	1	.F.	100–200	F/G	11a	200	200	4	60	C
LB	Cestos Sankwen	2	.F.	0–300	F/G	11a	300	1450	4	435	B
					F	1a	300				
LB	Loffa–Mano	2	.F.	200–800	F	3	1000	2300	3	1150	A
LB	Mount Nimba (part)	1	.F.	450–1752	F	3	60	60	4	18	A
LB	Sapo	2	.T.	400–640	F	1a	1000	1307	2	915	A
					F	8	250				
LB	Wonegezi Mts	4	.F.	500–1200	F	3	300	300	4	30	C

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
NI	Game Reserve A	4	.F.	40–1000	F	1a	3100	3100	4	310	A
NI	Game Reserve B	4	.F.	0–500	F	1a	800	800	4	80	A
NI	Gilli Gilli	8	.T.	0–100	F	2	600	800	3	160	B
					F	8	200				
NI	Obudu	4		C.2000	F	1a	720	720	4	144	B
NI	Ohosu	4	.F.	0–100	F	2	1700	1700	4	170	B
NI	Okumu	8	.T.	0–100	F	2	1238	1238	3	248	B
NI	Sapoba	8	.T.	0–100	Mn	77	250	492	3	98	C
					F	8	240				
NI	Stubbs Creek	4	.F.	0–100	F	2	15	100	4	10	C
					Mn	77	85				
NI	Udo Game Complex	8	.T.	0–100	F	1a	54	54	3	11	C
SL	Gola Forest	4	.F.	200–472	F	3	600	750	2	375	A
SL	Kangari Hills	4	.F.	200–500	F/G	11a	100	130	3	52	C
SL	L. Mabesi/Mape	1	.F.	0–100	F	8	50	58	4	17	C
SL	Mamunta Mayoso	4	.T.	100–200	F	8	150	160	2	80	C
SL	Outamba–Kilimi	2	.F.	50–300	F/G	11a	800	980	2	686	B
SL	Sherbro River	4	.F.	0–10	Mn	77	360	360	4	72	B
SL	Tama	4	.F.	200–500	F/G	11a	100	162	3	65	C
SL	Tonkoli	6	.T.	200–1000	F	3	438	438	4	88	B
SL	Western	4	.F.	100–886	F	3	179	179	4	36	B
ZR	Bombo Lumene	4	.T.	650–750	F	2	2400	2400	3	960	C
ZR	Kahuzi Biega (part)	2	.T.	800–3400	F	1a	1500	5000	2	3500	A
					F	4	3500				
ZR	Lomako/Yekokora	4	.F.	200–300	F	9	4000	4000	4	800	A
ZR	Luki Forest	4	.T.	160–350	F	2	330	330	3	132	C
ZR	Maiko	2	.T.	700–1300	F	1a	10000	10830	3	5415	A
					F	4	830				
ZR	Salonga N & S	2	.T.	550–700	F	11a	6500	36560	3	18280	A
					F	1a	20060				
					F	8	4000				
					F	9	6000				
ZR	Yangambi	4	.T.	300–500	F	1a	2000	2500	3	1000	C
					F	8	500				

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table I.2 lists the original area, percentage remaining (indicative of threat), the area protected and area proposed for protection of each of the major vegetation types in the unit.

Table I.2 Protection and Threat of Respective Habitats

Habitat Coverage for Phytochorion I

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
11A	336700	31	24527	7.2	1500	0.4
1A	1117400	48	54095	4.8	9020	0.8
2	623600	43	7018	1.1	3975	0.6
3	166100	29	60	0.0	3527	2.1
4	22200	40	4330	19.5	0	0.0
77	47400	50	620	1.3	495	1.0
8	305000	38	5520	1.8	2700	0.8
9	197100	50	6000	3.0	4000	2.0
Totals	2815500	43	102170	3.6	25217	0.8

The level of threat is fairly evenly spread over all vegetation types. The most threatened appears to be the mosaic of wetter and drier lowland rainforest types and this is the only type not currently included in the protected area system. Transition forest (vegetation type 4) is seriously threatened by slash and burn agriculture and agricultural development but is well represented in the reserve system although protection is not very effective.

m. **Evaluation of Protected Area Importance**

The unit contains many of the richest and most valuable protected areas in the whole realm and those that protect examples of threatened habitats or ecosystems are of particular importance for conservation.

In the Guinea sub-unit, by far the most important reserve is the Tai National Park in Ivory Coast, despite the heavy damage already inflicted on it by loggers, settlers and mining activities. Other areas in this sub-unit given priority A are Sapo National Park in Liberia, the Mt. Nimba Reserves, the Loffa-Mano (Liberia)/Gola Forests (Sierra Leone) complex and the Massif du Ziama in Guinea. The last two areas are proposals only and have no legal protected status yet.

In the rich Nigeria/Cameroon region priority A is given to the Korup National Park, Campo and Dja Reserves in Cameroun and 'A' and 'B' Reserves in Nigeria.

The other priority A areas of the unit are Lope-Okanda Reserve in Gabon, the very large Maiko and Salonga Parks in Zaire (important because of their size but badly damaged and needing considerable boundary revision), the proposed Lomako/Yekokora Reserve in Zaire (best location for pygmy chimpanzees and other Cuvette Centrale wildlife) and the Kahuzi-Biega National Park (especially the large western extension) also in Zaire.

In total these reserves protect about half the plant and animal species of the Realm and the entire unit must be considered of extreme conservation importance.

n. **Evaluation of Protected Area Effectiveness**

Table I.1 includes a crude scoring of management effectiveness of the protected areas of the unit. None of the reserves are considered to be well-managed. Some of the areas in Cameroon, Ghana and Ivory Coast are scored as having moderate management, but most of the unit's protected areas have poor or no effective protection or management.

Where large areas of natural habitat remain and there is still little threat to reserves, as is the case with some of the areas in Gabon and Zaire, this low level of protection is not so serious. But in those parts of the unit where forest is being lost very fast, there is an urgent need to raise standards of protective management. Saving the resource is a more urgent priority than developing tourism or planning other types of use.

o. Assessment of Suitability of Protected Area Status

The gazetted status of most of the protected areas in the unit seems quite suitable to their status if management could be made to reach the standards stated in the objectives of the various categories. There is a need to underline the conservation importance of the various Forest Reserves in the unit, particularly in Cameroon, Gabon, Nigeria and Liberia. These must be developed on a sustained yield basis if large numbers of species are not to be lost.

p. Identification of major gaps in the Protected Area System

The present reserve network includes no areas representing vegetation type 3 (mosaic of wetter and drier lowland rainforests) but several of the proposed reserves will include this habitat type.

With only 3.6 % of the unit protected and another 0.8 % of the area proposed, the entire unit can be said to be underprotected, particularly in view of the richness, high endemism and extreme vulnerability of the rainforest. With about 43 % of the original habitat remaining, there is plenty of room to acquire additional areas and at the outer edges of the unit, where the threat is greatest, there is considerable urgency for conservation. The Guinea sub-unit is very seriously destroyed and it is already too late to establish suitable protected areas over much of its area.

There is still little protection of forest habitats in Congo and Equatorial Guinea and efforts should be made to explore and protect good examples of these local types.

q. Recommendations for Reserve Additions or Extensions

There is a need to increase the area protected for each of the vegetation types in the unit. New reserves are particularly needed in the Cuvette Centrale of Zaire, in Gabon, Congo, Equatorial Guinea, Nigeria and Liberia/Sierra Leone. The following specific recommendations can be made :-

1. Establish the proposed Lomako-Yekokora reserve for the pygmy chimp and other wildlife in Zaire.
2. Declare the Korup Reserve as a National Park in Cameroon.
3. Declare a new reserve in the Loffa-Mano area of Liberia to be linked with a multiple use reserve in the Gola forests of Sierra Leone.
4. Give greater protection to at least part of the Gola Forests in Sierra Leone and link with Loffa-Mano in Liberia as per 3 above.
5. Prepare a master plan for the redesign and development of Salonga National Park in Zaire. The great potential of this park is not being realised due to lack of ground data and inadequate planning. This park was established largely to protect the pygmy chimpanzee but this species is probably absent, or only marginally present, in the reserve.
6. Protected status should be afforded to several of the important Forest Reserves, particularly in West Africa.
7. Several long-standing proposals for the establishment of protected areas in Nigeria and Sierra Leone should be followed up (Ebin 1983, Phillipson 1978).
8. Surveys should be conducted to select and propose a reserve needed in the Minkebe area of Gabon, where, outside the range of *Oukambe* trees, the forests can be expected to be quite different from Lope-Okanda.
9. A reserve should be made in the Nyong river area of Cameroon to protect examples of swamp forest there.
10. Attention should be paid to management and protection of the important Fouta Djalon plateau in Guinea, a site of high importance for plant conservation. This may be achieved by better development of the Massif du Ziama Reserve, which at present has no recognised boundaries.
11. Establish the proposed Zanga (Bongos) Reserve in Central African Republic.
12. Re-establish and extend the protected area network of Equatorial Guinea as outlined in the proposals of Castroviejo et al. (1986), to establish 5 conservation areas, including Mt Alen, on the mainland and two protected areas on Bioko (Fernando Po) which has several endemic subspecies.

r. Additional Conservation Needs

1. Most countries in the unit lack any form of a systems plan for their protected areas and few management plans exist for the major reserves of the unit. Considerable effort must be expended in planning.
2. Better ways must be found to integrate utilisation with protection of rainforest. The present system of harvesting very low timber yields of sizeable trees of a few select species and the laissez-faire policy that allows farmers to destroy the remaining forest for slash and burn agriculture must be stopped. The present

forest destruction is very wasteful. It is essential that proper land-use planning be integrated with forest protection and development.

3. Levels of protection must be improved by further investment in personnel training. Garoua, Cameroon, provides a good course for middle and senior level managers of protected areas, but other countries must develop their own schools for training of rangers and junior guards as Nigeria and CAR have done.

4. Much higher levels of international assistance should be directed at saving the rainforest belt. This has been a neglected area in past conservation efforts in the realm, in spite of the recognised biological richness of rainforest habitats. Because game are difficult to see, forest parks do not have the same appeal to tourists as do the savanna parks; it has always been easier to raise money for large mammals than for rainforests. However, as forest species occur at rather low mean densities, they are particularly vulnerable to habitat destruction.

5. The destruction of the rainforest belt and the consequent reduced rate of transpiration mean that northerly winds carry less moisture to the Sahel region. This must be a contributory factor to the Sahel droughts, a factor which is usually overlooked. Reafforestation of this belt with indigenous tree species should be a high priority for famine prevention programmes.

3.2 ZAMBEZIAN REGIONAL CENTRE OF ENDEMISM (Unit II)

a. Extent of Unit

The unit consists of a large area of southern Africa stretching from the Atlantic coast of Angola almost to the Indian Ocean (see maps 3.3 and 3.4). This large unit has a coastline of only about 320 kms but has a total land area of 3,770,000 km^2.

b. Administrative Divisions

The unit includes the whole of Zambia, Malawi and Zimbabwe, large parts of Angola, southern Tanzania and Mozambique and smaller parts of Zaire (Shaba), Namibia, Botswana and South Africa (Transvaal).

c. Dominant Vegetation

Maps 3.3 and 3.4 show the dominant vegetation of the unit. The Zambezian Region probably has the richest and most diverse flora of all the African phytochoria with a wide range of vegetation types (White 1983). Woodland is the most widespread and most characteristic vegetation of the region and in many places represents the climax vegetation. Elsewhere woodland is secondary or has been profoundly modified by cultivation or fire or coppicing by elephants. Three main types of woodland can be distinguished : miombo woodland, mopane woodland and Zambezian undifferentiated woodland (White 1983). Miombo frequently occurs as scrub woodland at high altitudes and on shallow soils.

d. Distinct Habitat Types

Forest occurs or formerly occurred on deeply drained soils which have adequate moisture in the dry season. The areas of forest have probably always been restricted but are now further reduced by fire and cultivation. Small pockets of dry evergreen forest remain in the wetter northern parts of the unit; dry deciduous and scrub forests occur in areas of lower rainfall.

In the wetter parts of the region, where annual rainfall is above 1000 mm permanent swamp forest occurs around springs at stream sources and patches of swamp and riparian forest occur along watercourses.

In Upper Shaba dry evergreen forest has been extensively replaced by secondary evergreen miombo woodland

Along permanent water courses in the drier parts of the Zambezian region there are well-developed riparian and wooded grasslands.

Various types of thicket occur throughout the Zambezian Region, the most extensive being Itigi thicket. Itigi thicket, and the closely related Jess thicket found further south, usually occur on Cretaceous and Jurassic sediments at the foot of rift escarpments; these thickets are extensive in central Tanzania, south of Lake Tanganyika, Vwaza, Luando valley and Zambezi valley.

The most characteristic Zambezian grasslands occur on seasonally water-logged soils i.e. on flood-plains. There are also extensive areas of secondary grassland but these usually include some trees. *Dambo* grassland is extensive above 1200 m and covers about a fifth of the Central African Plateau. Elsewhere dambo grasslands may occur at lower altitudes (as at Kasungu and Lilongwe at 1000 m) and even as low as 500 m (Majete). Grasslands are also associated with heavy metal and other toxic soils (White 1983).

e. Current Land Use

Most of the unit (c.60%) is used as rangeland but the *Brachystegia* and mopane woodlands can support few cattle. In Botswana and Zimbabwe large tracts are being fenced off for cattle ranching. Quite large areas are managed as protected areas or game management areas or forest production areas. Village farmlands occupy a smaller area as do those parts of the unit, especially in Zambia and Zimbabwe, used for commercial crops such as tobacco.

f. Biological Richness and Endemism of Unit

The Zambezian Region is the largest major phytochorion in the Afrotropical Realm. It probably has the richest and most diversified flora and shows the widest range of vegetation types. The flora includes at least 8500 species of which about 54% are endemic (White, 1983).

The unit is faunally very rich though has lower levels of endemism than the rainforest unit I. Crowe and Crowe (1982) give their passerine bird unit V(8), which is only marginally greater than phytochorion II, a total of 748 species and sub-species of passerine birds with 18% endemism. Our own index of mammal

diversity based on ungulates and primates gives the unit a total of.55 species which is second only to the rainforest unit I in richness. Mammal endemism is lower, however, at only 4%. Carcasson (1964) ranks the unit as of only moderate richness for butterflies with about 450 known species.

g. Species of Special Economic Interest

A number of valuable wildlife species occur in the unit. Some such as elephants, crocodiles, rhinoceros etc. have valuable products of commercial potential. Other species such as leopards, primates etc. command a high price in wildlife trade. Trade in these species is restricted subject to CITES regulations. By far the greatest commercial value of the wildlife of the unit is its potential for tourism through game viewing and hunting safaris. Wildlife also provides some bushmeat to local inhabitants. Wildlife products are used commercially (horn, skin etc.) in the tourist souvenir industry.

Important timber species within the unit and species of silvicultural value include *Pterocarpus angolensis* and *Baikiaea plurijuga* (African Teak).

h. Species of Special Biological and Conservation Interest

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Crocidura maquassiensis	Maquassie Musk Shrew	rare
Colobus badiusgordonorum	Uhehe Red Colobus	endangered
Colobus badiustephrosceles	Uganda Red Colobus	insuff.known
Pan troglodytes	Chimpanzee	vulnerable
Lycaon pictus	Wild Dog	vulnerable
Panthera pardus	Leopard	vulnerable
Acinonyx jubatus	Cheetah	vulnerable
Loxodonta africana	Elephant	vulnerable
Diceros bicornis	Black Rhino	endangered
Alcelaphus lichtensteini	Lichtenstein's Hartebeest	indeterminate
Hippotragus nigervariana	Giant Sable	endangered
Kobus leche	Lechwe	vulnerable
Aepyceros melampuspetersi	Black-faced Impala	endangered

The following bird species are listed in the Bird Red Data Book of ICBP/IUCN:

Egretta vinaceigula	Slaty Egret	indeterminate
Balaeniceps rex	Shoebill	out of danger
Bugeranus carunculatus	Wattled Crane	special interest
Sarothrura ayresi	White-winged Flufftail	indeterminate
Agapornis nigrigenis	Black-cheeked Lovebird	rare
Pogoniulus makawai	White-chested Tinkerbird	indeterminate
Prionops gabela	Gabela Helmet-shrike	indeterminate
Sheppardia gabela	Gabela Akalat	indeterminate
Sheppardia gunningi	East Coast Akalat	rare
Turdus fischeri	Spotted Ground Thrush	rare
Chloropeta gracilirostris	Papyrus Yellow Warbler	rare
Estrilda nigriloris	Black-lored Waxbill	insuff. data
Ploceus ruweti	Lake Lufira Weaver	insuff. data

The following reptile species of the unit are listed as threatened in the Reptile Red Data Book of IUCN:

Chelonia mydas	Green Turtle	endangered
Crocodylus niloticus	Nile Crocodile	vulnerable
Crocodylus cataphractus	African Slender-snouted Crocodile	indeterminate
Malacochersus tornieri	Pancake Tortoise	insuff.known

i. Additional Physical Features in Need of Protection

The unit includes many attractive lakes, mountains and some interesting escarpments and other physical features worthy of preservation. There are some unusual limestone formations with caves in Zimbabwe.

j. Ethnological or Historical Features in Need of Protection

The unit contains several sites of special ethnological or historical value, including the ruins of Great Zimbabwe. There are a number of important archaeological excavations including Early Stone Age Sites at Zombepata, Redcliff, Pomongwe, Gwisho, Makapansgat and Late Stone Age sites at Broken Hill, Kalemba and Kalambo Falls. Flake tools from the Zimbabwean rock shelter sites at Zombepata, Redcliff and Pomongwe have been dated to between 37000 and 42000 years b.p. Broken Hill is important for the find of the skull of an early subspecies of modern man. Pre-Iron Age rock art is found at several sites in Zimbabwe including the Silozwane Cave in the Matopo Hills.

k. The Protected Areas System of the Unit

Maps 3.3 and 3.4 show the location of the existing and proposed network of protected areas in the unit. Table II.1 lists these areas, giving their status and the areas of their main habitat types.

Table II.1 Protected Areas of the Zambezian Regional Centre of Endemism

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
AN	Amboim / Gabela	4	.F.	200–1000	W	25	1000	2000	4	200	A
					W	29c	1000				
AN	Bikuar	2	.T.	1150–1350	F/G	22a	900	7900	4	2370	A
					W	25	6000				
					W	28	1000				
AN	Bufalo	6	.T.	380–1210	W	29c	400	400	4	80	C
AN	Kameia	6	.T.	1059–1158	B/G	47	200	1445	4	289	B
					G	60	1245				
AN	Kisama	2	.T.	0–265	W	29c	9960	9960	3	4980	A
AN	Luando	6	.T.	1040–1455	W	25	8280	8280	4	1656	A
AN	Luiana	6	.T.	970–1024	F/G	22a	8000	8400	4	1680	B
					Aq	64	400				
AN	Mavinga	6	.T.	1052–1228	F/G	22a	1000	5950	4	1190	B
					B/G	47	4950				
AN	Mupa	6	.T.	1130–1340	F/G	22a	2000	6600	3	1980	B
					W	25	2000				
					W	28	2600				
BT	Chobe	2	.T.	c.900	F/G	22a	3000	10870	3	5435	B
					W	28	4000				
					W/B	35a	3000				
					Aq	75	870				
BT	Chobe F. R.	8	.T.	850–1000	W	28	2400	2400	3	480	C
BT	Kasane	8	.T.	500–1000	F/G	22a	600	1200	3	240	B
					W	29	600				
BT	Kazuma	8	.T.	1000–1500	F/G	22a	128	128	3	26	C
BT	Maikaelelo	8	.T.	500–1000	W/B	35a	300	300	3	60	C
BT	Makgadikgadi	4	.T.	c.900	W/B	35a	1000	4140	3	1656	B
					H	76	1140				
					H	PAN	2000				
BT	Moremi	4	.T.	c.900	W	28	300	1800	3	720	A
					H	75	1500				
BT	Nxai Pan	2	.T.	c.900	W/B	35a	2590	2590	3	1295	B
BT	Sibuyu	8	.T.	500–1000	F/G	22a	800	1010	3	202	C
					W/B	35a	210				
MW	Chongoni (part)	8	.T.	1300–2100	W	25	46	46	2	14	C
MW	Dedza Salima Escarp.	8	.T.	800–1800	W	25	326	326	2	98	C

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
MW	Dzalanyama	8	.T.	1150–1713	W	25	989	989	2	297	B
MW	Kaningina (part)	8	.T.	800–1400	W	25	60	60	2	18	C
MW	Kasungu	2	.T.	1000–1340	W	25	2316	2316	1	2084	B
MW	Lake Malawi	2	.T.	200–1140	W	29c	94	94	2	66	A
MW	Lengwe	2	.T.	130–393	W	28	700	887	1	798	C
					W	29c	187				
MW	Liwonde	2	.T.	422–961	W	29c	548	548	1	493	B
MW	Majete	4	.T.	200–500	W	25	260	784	2	392	B
					W	26	264				
					W	28	260				
MW	Malosa Complex	8	.T.	700–2085	W	25	138	555	2	167	B
					W	29c	138				
					H	75	279				
MW	Mangochi	8	.T.	800–1600	W	25	376	376	2	113	C
MW	Matandwe	8	.T.	300–770	W	29c	262	262	3	52	C
MW	Mchinji	8	.T.	1400–1754	W	25	191	191	3	38	C
MW	Misisi	8	.T.	1000–1500	W	25	67	67	2	20	C
MW	Mwabvi	4	.T.	200–1000	W	29c	340	340	3	136	C
MW	Namizimu	8	.T.	700–1800	W	25	870	870	2	261	B
MW	Nkohota–kota (part)	4	.T.	500–1500	W	25	1000	1450	2	725	B
					W	29c	450				
MW	Nyika (part)	2	.T.	1600–2606	W	25	1134	1134	1	1021	A
MW	South Viphya (part)	8	.T.	1000–1954	W	25	277	277	2	83	B
MW	Thambani	8	.T.	700–1453	W	25	50	50	2	15	C
MW	Vtoaza Marsh	4	.T.	1000–1500	W	25	1000	1000	2	500	B
MZ	Banhine	2	.T.	280–1000	W	28	7000	7000	4	2100	B
MZ	Gile	4	.T.	0–200	W	26	2100	2100	4	4020	C
MZ	Gorongosa	2	.T.	200–600	F/G	16	250	3750	4	1125	B
					W	26	3550				
MZ	Niassa	4	.T.	200–1000	W	25	5000	15000	4	3150	B
					W	26	10000				
MZ	Zambezi (part)	8	.T.	c.500	W	29c	6000	6000	4	600	A
MZ	Zinave	2	.T.	50–200	W	26	500	5000	4	1500	B
					W	28	4500				
NM	Caprivi	4	.T.	1000–1500	D	22a	5300	5300	4	1060	C
NM	Etosha	2	.T.	100–1500	W	28	19000	21270	1	19143	A
					H	76	2270				
SA	Blouberg East N.R.	4	.T.	844–1453	W	29d	68	68	1	48	C
SA	Blyde River (part)	4	.T.	676–1831	W	29d	182	182	1	127	C
SA	Borakalalo	4	.T.	1000–1167	W	29d	74	74	1	52	C
SA	Doorndrai Dam	4	.T.	1183–1464	W	29d	72	72	1	50	C
SA	Hans Merenski	4	.T.	434–542	W	28	53	53	1	37	C
SA	Kruger (part)	2	.T.	122–867	W	29d	6547	15092	1	13583	A
					W	28	8505				
SA	Lekgalameetse (part)	4	.T.	800–1853	W	29d	168	168	1	118	C
SA	Loskop Dam	4	.T.	1018–1404	W	29d	148	148	1	104	C
SA	Manyeleti	4	.T.	366–488	W	29d	228	228	1	160	C
SA	Pilanesberg	2	.T.	1050–1675	W	29d	500	500	1	450	C
SA	Serala	4	.T.	795–2050	M	29d	110	110	1	77	B
TZ	Gombe (part)	2	.T.	750–1500	W	25	32	32	2	22	B
TZ	Itigi	4	.F.	1100–1200	B	40	600	600	4	120	B

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km²)	Total area (km²)	Management	Contrib. score	Priority
TZ	Katavi	2	.T.	c.900	S	17	250	2253	3	1126	B
					W	25	1203				
					W/B	35a	800				
TZ	Kizigo (part)	4	.T.	1000–1500	W	26	2000	2000	3	800	B
TZ	Mahale Mountain (pt)	6	.T.	780–2462	W	25	613	613	3	184	B
TZ	Mikumi	2	.T.	c.550	F/G	16a	1700	3230	2	2261	B
					W	26	1530				
TZ	Ruaha (part)	2	.T.	750–1830	W	26	4000	4000	3	2000	A
TZ	Rungwa (part)	4	.T.	1350–2350	W	26	6000	6000	2	3000	B
TZ	Selous (part)	4	.T.	100–1200	F/G	16a	5000	40000	3	16000	A
					W	26	35000				
TZ	Ugalla	6	.T.	c.1400	W	25	2400	5000	3	1500	B
					W	26	2400				
					G	64	200				
TZ	Uwanda	4	.T.	c.1000	W	25	2000	5000	3	2000	B
					W/B	35a	1000				
					H	76	2000				
ZM	Bangweulu	6	.T.	500–1000	W	25	2000	6570	3	1971	A
					Aq	64	570				
					Aq	75	4000				
ZM	Bilili Springs	6	.T.	500–1000	W	25	180	3080	3	924	C
					W	26	2900				
ZM	Blue Lagoon	2	.T.	970–1010	G	64	450	450	4	135	C
ZM	Chambeshi	8	.T.	500–1500	Aq	64	320	620	3	124	C
					Aq	75	300				
ZM	Chibwika-Ntambu	6	.T.	500–1000	W	25	1200	1550	3	465	C
					F	6	350				
ZM	Chisomo	6	.T.	500–1000	W	26	2000	3390	3	1017	C
					W	28	1390				
ZM	Chizera	6	.T.	500–1000	W	25	2280	2280	3	684	C
ZM	Isangano	2	.T.	c.1100	W	21	540	840	4	252	C
					Aq	64	300				
ZM	Kafinda	6	.T.	500–1000	W	25	360	3860	3	1158	B
					Aq	64	3500				
ZM	Kafue	2	.T.	970–1470	W	25	20000	22400	2	15680	A
					F	6	400				
					G	64	2000				
ZM	Kafue Flats	6	.T.	500–1000	F/G	22a	175	5175	3	1553	C
					W	29c	1000				
					Aq	64	4000				
ZM	Kalaso–Mukoso	6	.T.	500–1000	W	25	275	675	3	202	C
					Aq	64	200				
					Aq	75	100				
ZM	Kansonso–Busanga	6	.T.	500–1000	W	25	6000	7780	3	2334	C
					Aq	64	1780				
ZM	Kaputa	6	.T.	500–1500	W	25	1500	3600	3	1080	B
					B	40	1700				
					H	76	400				
ZM	Kasanka	2	.T.	1100–1300	G	64	390	390	2	273	B
ZM	Lavushi Mandu	2	.T.	1100–1800	W	25	1500	1500	4	450	C

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km²)	Total area (km²)	Management	Contrib. score	Priority
ZM	Liuwa Plain	2	.T.	c.1000	G	60	2600	3660	4	1098	A
					G	64	1060				
ZM	Lochinvar	2	.T.	970–1038	W	26	50	410	3	205	C
					W	29c	300				
					G	64	60				
ZM	Lower Zambezi	2	.T.	390–1000	W	26	2070	4140	3	2070	B
					W	28	2070				
ZM	Luambe	2	.T.	500–710	W	26	254	254	2	178	C
ZM	Luano	6	.T.	200–1500	W	26	5000	8930	3	2679	B
					W	28	3930				
ZM	Lukusuzi	2	.T.	800–1240	W	25	800	2720	3	1360	B
					W	26	1920				
ZM	Lukwakwa	6	.T.	500–1000	W	25	450	2540	3	762	C
					F	6	2000				
ZM	Lumimba	6	.T.	500–1000	W	26	1000	4500	3	1350	B
					W	28	3500				
ZM	Lunga Luswishi	6	.T.	200–1500	W	25	13000	13340	3	4002	C
					Aq	64	340				
ZM	Lupande	6	.T.	500–1000	W	26	2340	4840	3	1452	B
					W	28	2500				
ZM	Lusenga Plain	2	.T.	800–1300	W	25	880	880	4	264	C
ZM	Machiya Fungulwe	6	.T.	500–1000	W	25	830	1530	3	459	C
					Aq	64	700				
ZM	Mansa	6	.T.	500–1000	W	25	2070	2070	3	621	B
ZM	Mazabuka	6	.T.	500–1000	Aq	64	254	254	3	76	C
ZM	Mosi–Oa Tanya	2	.T.	833–914	W	26	20	66	3	33	C
					W	28	46				
ZM	Mulobezi	6	.T.	500–1000	F/G	22a	1000	3420	3	1026	C
					W	25	1420				
					W	28	1000				
ZM	Mumbwa	6	.T.	500–1000	W	25	2000	3370	3	1011	C
					W	29c	1000				
					Aq	64	370				
ZM	Munyamadzi	6	.T.	500–1000	W	26	2000	3300	3	990	C
					W	28	1300				
ZM	Musalangu	6	.T.	c.1000	W	26	10850	17350	3	5205	B
					W	28	6500				
ZM	Musele Matebo	6	.T.	500–1000	W	21	1700	3700	3	1110	C
					W	25	1000				
					F	6	1000				
ZM	Mweru Wantipa	2	.T.	900–1400	W	25	2430	3134	3	1567	B
					B	40	300				
					H	76	400				
ZM	Namwala	6	.T.	200–1000	W	25	2800	3600	3	1080	C
					Aq	64	800				
ZM	North Luangwa	2	.T.	500–1100	W	26	2630	4636	2	3245	A
					W	28	2006				
ZM	Nsumbu	2	.T.	800–1250	W	25	1820	2020	3	1010	B
					B	40	200				
ZM	Nyika	2	.T.	1295–2225	W	25	40	80	2	56	B
					W	26	20				
					W	28	20				

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
ZM	Sandwe	6	.T.	500–1000	W	26	1000	1530	3	459	C
					W	28	530				
ZM	Sichifula	6	.T.	500–1000	F/G	22a	1000	3600	3	1080	C
					W	28	2600				
ZM	Sioma–Ngwezi	2	.T.	c.900	F/G	22a	3600	5276	3	2638	C
ZM	South Luangwa	2	.T.	500–1100	W	26	4050	9050	2	6335	A
					W	28	5000				
ZM	Tondwa	6	.T.	500–1000	W	25	440	540	3	162	C
					H	40	100				
ZM	West Lunga	2	.T.	1120–1200	W	25	680	1684	2	1179	B
					F	6	1004				
ZM	West Petauke	6	.T.	200–1000	W	26	3140	4140	3	1242	C
					W	28	1000				
ZM	West Zambezi	6	.T.	200–1000	F/G	22a	8000	38070	3	11421	A
					W	28	4070				
					F	6	6000				
					G	60	12000				
					Aq	64	8000				
ZR	Kundelungu	2	.T.	1200–1700	W	25	4500	7600	3	3800	A
					G	60	3100				
ZR	Upemba	2	.T.	200–1800	W	25	10000	11730	3	5865	B
					G	31	550				
					S	37	550				
					G	60	570				
ZW	Charara	8	.T.	490–1209	W	26	1300	1690	1	1183	B
					W	28	390				
ZW	Chegutu	8	.T.	500–1000	W	26	716	716	4	143	C
ZW	Chete	8	.T.	300–900	W	28	1081	1081	2	540	C
ZW	Chewore	8	.T.	500–1062	W	26	490	3390	1	2373	B
					W	28	2900				
ZW	Chipinga	8	.T.	500–1500	W	26	261	261	4	52	C
ZW	Chirisa	8	.T.	600–1200	W	26	500	1713	1	1199	B
					W	28	1213				
ZW	Chizarira	2	.T.	648–1433	W	26	1250	1910	2	1337	B
					W	28	660				
ZW	Dande	8	.T.	500–1062	W	28	523	523	2	261	C
ZW	Doma	8	.T.	500–1062	W	26	380	764	3	260	B
					W	28	364				
ZW	Gonarezhou	2	.T.	162–578	W	26	53	5053	3	2526	A
					W	28	2500				
					W	29c	2500				
ZW	Hwange	2	.T.	938–1152	F/G	22a	11650	14650	1	13185	B
					W	28	3000				
ZW	Kazuma Pan	2	.T.	900–1200	F/G	22a	153	313	1	282	C
					Aq	28	160				
ZW	Lake Kariba	8	.T.	c.482	A		2830	2830	2	1415	B
ZW	Lake Kyle	8	.T.	c.1200	A		180	180	2	90	B
ZW	Lake Robertson	8	.T.	c.1300	A		81	81	2	40	C
ZW	Mana Pools	2	.T.	500–1062	W	26	696	2196	1	1976	A
					W	28	1500				

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
ZW	Matetsi	8	.T.	C.1000	F/G	22a	920	2920	1	2044	B
					W	28	2000				
ZW	Matobo	2	.T.	1300-1466	W	29c	432	432	1	389	C
ZW	Matusadona	2	.T.	500-1201	W	26	690	1360	1	1224	C
					W	28	670				
ZW	Mushandike	4	.T.	1000-1500	W	26	129	129	1	90	B
ZW	Ngezi	8	.T.	1000-1500	W	28	58	58	2	29	B
ZW	Robert McIlwaine	8	.T.	c.1300	A		520	520	2	260	C
ZW	Sapi	8	.T.	500-1062	W	28	1180	1180	1	826	C
ZW	Sengwa	1	.T.	1000-1500	W	28	373	373	1	373	B
ZW	Tuli	8	.T.	c.695	W	28	416	416	3	160	C
ZW	Umfurundzi	8	.T.	200-1000	W	26	400	760	3	260	C
					W	29c	360				
ZW	Urungwe	8	.T.	500-1062	W	26	870	2870	1	2009	B
					W	28	2000				
ZW	Zambezi	2	.T.	c.1000	F/G	22a	280	564	1	508	C
					W	28	284				

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table II.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table II.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
16	8000	50	250	3.1	0	0.0
16A	14200	50	6700	47.1	0	0.0
16B	2700	50	0	0.0	0	0.0
17	7600	90	250	3.2	0	0.0
2	2400	10	0	0.0	0	0.0
21	34000	25	540	1.5	1700	5.0
22A	247400	51	25803	10.4	21175	8.5
25	1350500	57	58095	4.3	52098	3.8
26	818500	56	83693	10.2	32630	3.9
28	544200	50	75732	13.9	30920	5.6
29C	224100	49	15171	6.7	3400	1.5
29D	144200	59	8097	5.6	0	0.0
31	13600	20	550	4.0	0	0.0
35A	38000	40	8390	22.0	0	0.0
37	8600	30	550	6.3	0	0.0
40	12200	53	500	4.0	2400	19.6
44	7100	30	0	0.0	0	0.0
47	155900	90	0	0.0	5150	3.3
6	36300	40	1404	3.8	9350	25.7
60	96300	71	6270	6.5	13245	13.7
64	76900	80	4260	5.5	21114	27.4
7b	50300	83	2370	4.7	4100	8.1
76	34000	84	5810	17.0	400	1.1
PAN	12100	100	2000	16.5	0	0.0
Totals	3939100	57	306435	7.7	197682	5.0

Overall 7.7% of the unit is included within existing protected areas and another 5% is protected within existing game utilisation areas and forest reserves. Proposed reserves will add another 2600 sq.km to the area protected within the unit. As elsewhere in Africa, many of the parks and protected areas were established to conserve spectacular animals such as elephants and large carnivores or areas with spectacular concentrations of game. Coverage of most major vegetation types is fairly good with several vegetation types having considerably more than 10% of their total protected; generally these are woodland/grassland mosaics. Major omissions are the lack of any protected areas in the small remaining areas of Guineo-Congolian rainforest in Angola (2) and forest patches (16b) and the lack of reserves in the Kalahari *Acacia* bushland (44). Dry evergreen forest, wetter miombo woodland, Zambezian woodlands and Itigi thicket in Tanzania (elsewhere it is well-protected) are all under-represented in the reserve network. Although few swamps are fully protected within national parks and reserves extensive tracts are included within game utilisation areas.

m. Evaluation of Protected Area Importance

The priority A reserves of the unit are Kisama N.P., Angola, Moremi Wildlife Reserve, Botswana, Lake Malawi N.P and Nyika N.P., Malawi, Zambezi Wildlife Utilisation Area, Mozambique, Etosha N.P, Namibia, Kruger N.P., South Africa, Ruaha N.P. and Selous Game Reserve, Tanzania (Selous spans two phytochoria), Bangweulu Game Management Area, Kafue N.P., Liuwa Plain N.P, North Luangwa N.P, South Luangwa N.P , Nsumbu N.P. and West Zambesi Game Management Area, Zambia, Kundelungu N.P., Zaire, Gonarhezou N.P. and the Mana Pools complex in Zimbabwe, which is a World Heritage site.

This unit has many other fine and extensive reserves, including wildlife utilisation areas, which protect large concentrations of game. Of particular importance is the proposed reserve of Amboim/Gabela, Angola.

Ngezi Recreation Park, Zimbabwe (priority B), though very small, is important as it is one of the few protected areas conserving the distinctive serpentine flora of the Great Dyke. Several Game management Areas have also been assigned priority A status for conservation; in most cases this means that they are inadequately protected with their present status.

n. Evaluation of Protected Area Effectiveness

Protection and management of the protected areas of the unit varies from country to country. In Malawi, Namibia, South Africa and Zimbabwe management is generally very good. In Kenya and Tanzania most areas, especially the larger national parks, are fairly well protected and managed but elsewhere management is poor. In both of the Zaire protected areas within the unit, management needs to be improved; as it does for Botswana and Zambian parks. In both Angola and Mozambique protection and management is non-existent in most areas; torn by civil strife these countries have had concerns other then protecting national parks and reserves. In general, the wealthier and/or more stable the country the better the protection and management of national parks and protected areas.

The problems facing the national parks departments in their tasks of protecting reserves and conserving wildlife are similar throughout the unit : increasing pressure for land from surrounding communities, illegal grazing of livestock, collection of firewood, hunting for meat, the disruption of animal migration routes by the erection of fences to exclude game from cattle ranches (especially in Botswana and Zimbabwe). Poaching is a problem in most countries of the unit, particularly for elephant and rhino. To combat all of these problems all countries, except South Africa, need to increase the levels of trained staff, park budgets, equipment and resources available for park management. International cooperation could help to combat the poaching problem.

o. Assessment of Suitability of Protected Area Status

The status of most of the protected areas of the unit is suitable for their management objectives if they could be effectively protected and managed. Many are among the best-managed and protected areas in the Realm. Special attention should be paid to Game Managament Areas whose primary objective is exploitation of wildlife. Several of these areas, including Matetsi (Zimbabwe), West Zambesi and Bangweulu (Zambia) and the Zambezi Wildlife Utilisation Area (Mozambique) harbour important wildlife communities. In all game utilisation areas effective controls are needed to ensure that the wildlife is not over-exploited.

p. Identification of Major Gaps in the Protected Area System

Most of the major habitat types of the unit are included within the protected area systems of the unit with

particularly good coverage of the coastal mosaic, other woodland/grassland mosaics, miombo and mopane woodlands and the halophytic vegetation of the alkaline pans.

Major biomes which are under-represented or inadequately protected within the existing reserve system include:
relict patches of forest
Itigi thicket in Tanzania
swamps and floodplains
freshwater and alkaline lakes
seashore and marine habitats on the west coast
serpentine soil vegetation of the Great Dyke, Zimbabwe.

q. **Recommendations for Reserve Additions or Extensions**

Overall the percentage of land included within the existing reserve systems of the unit is good. Historically, however, protected areas were established to protect areas of wildlife concentration and there was no attempt to ensure that national parks systems gave adequate coverage to all ecosystems represented within the countries of the unit. As a consequence there are extensive areas protected in those habitats where large game is particularly rich and visible while other biotic communities are not protected at all. To make the protected areas network of the unit more representative conservation areas should be established as follows.

1. Establish a game or forest reserve to protect an area of Itigi thicket in central Tanzania. This habitat is subject to clearing for agriculture (Lamprey 1974). The floristically similar Itigi-type thicket in Zambia is fully protected in the Nsumbu and Mweru-Wantipu national parks.

2. Flood plain types such as Kafue, Zambesi and Bengweulu are very important wetlands in Zambia but only Kafue has national park status. The other two are designated as game management areas in recognition of the fact that they, and especially Bengweulu, are heavily utilised by fishermen. If the status of these wetlands becomes threatened by developments and drainage programmes then it may be worthwhile reconsidering their status and giving the areas greater protection.

3. Establish game reserves to protect the flood plains of Buhoro, Kilombero, Wembere, Malagarasi and Lake Rukwa , Tanzania (Lamprey 1974). At present these areas are unprotected or only partially protected (Rukwa) with the result that their wild mammal populations are subject to uncontrolled illegal hunting.

4. Establish game reserves to protect the freshwater swamps of Ugalla, Bahi and Kagera, Tanzania (Lamprey 1974).

5. With few exceptions the open water of most freshwater lakes is excluded from parks and reserves, even though adjoining land may have park status. Park boundaries should be extended out into the open waters of the lakes to protect at least part of the freshwater habitat and the wildlife it supports. For example, the boundaries of Nsumbu N.P, Zambia, should be extended into Lake Tanganyika.

6. Extend the Nyamaneche Sanctuary and Sebakwe Recreational Park in Zimbabwe as proposed to protect more of the distinct serpentine vegetation found on the Great Dyke.

7. Establish a game or forest reserve to protect a substantial area of the *Parinari* forests in Zimbabwe.

8. Five biotic communities are not yet represented in the protected area network of Malawi (Clarke and Bell 1986):
semi-evergreen forest;
closed canopy woodlands on wetter uplands;
open-canopy woodlands of fertile areas;
woodlands of fertile areas;
saline lakes.

Examples of these habitats should be given protection either by the establishment of nature reserves, a new category for Malawi, or by extending the current system of forest reserves and improving their management. The latter solution would be easier as some of these habitats are already included within Malawi's extensive system of forest reserves.

9. Give protection to the alkaline lakes of the unit including:
Lakes Natron, Eyasi, Balangida and Balangida Lelu, Tanzania, which are important flamingo habitat.

10. In Mozambique extend the Gorongosa N.P. to include Mt Gorongosa and important wildlife habitat to the north of present park boundaries, and extend Niassa G.R. to include Lugenda valley.

11. Establish reserves to protect the remaining lowland rainforest within the unit (Angola, Zaire).

r. **Additional Conservation Needs.**

1. The first priority for the unit, as elsewhere in Africa, must be to devise national conservation strategies and to develop landuse plans taking into account the needs of rural communities living adjacent to national parks and other protected areas . It is essential to reduce conflict between local interests and conservation interests since the problems and costs of conservation are proportional to the extent of this conflict.

2. Improve protection and management in those reserves which score less than 2 for management effectiveness (see table II.1). At present Mozambique and Angola have no effective management in most reserves; immediate steps should be taken to implement administration and management of reserves as soon as the political situation allows. Parks in these countries lack personnel, budgets, infrastructure and resources. Management should be improved in the protected areas of Botswana, Tanzania, Zambia and Zaire; this will involve increasing the levels of trained staff, budgets and resources. South Africa, Zimbabwe, Malawi and Namibia already have some of the best managed reserves in the whole of Africa. However Malawi at least is in a critical state financially and urgently requires extra funding for its parks and protected areas.

3. Improve levels of training for parks staff especially in Botswana, Zaire, Zambia, Mozambique and Angola by in-service training, training as a component of foreign-funded technical assistance programmes and by sending staff to the schools of wildlife management at Garoua, Cameroon and Mweka, Tanzania.

4. Poaching is a major problem throughout the unit, particularly poaching of elephant and rhino. More anti-poaching units should be established, especially in Tanzania, Zaire, Zambia, Botswana, Angola and Mozambique, and should be fully equipped with vehicles, radios and firearms. Staff should be trained in maintenance and use of this equipment. Whenever possible the countries of the unit should consult and collaborate in operations to catch poachers and to stop cross-border poaching and trade in poached trophies. Simultaneously public education campaigns should be increased to make local communities more aware of the value of wildlife and hostile to poachers and their illegal activities. At the same time programmes should be developed for rational use of wildlife resources outside protected areas—particularly relevant to Angola, Botswana, Tanzania, Malawi, Mozambique and Zaire.

5. In Tanzania, Malawi, Zambia, Zimbabwe, Botswana, and South Africa tourist facilities are already well-developed in many parks and protected areas; in the last three countries tourism based on the national park system is a substantial revenue earner. Facilities for visitors should be established in parks in Namibia, Zaire, Angola and Mozambique as appropriate and where the political situation allows. It is important to provide for domestic visitors as well as overseas tourists and provide cheap accommodation, transport and admission fees for local nationals, subsidised if necessary.

6. Monitor the effects on wildlife of artificial drainage of lakes and wetlands; this is especially relevant to Botswana and Zambia.

7. Monitor the effects on wildlife of veterinary fences in Botswana and Zimbabwe which are blocking traditional migration and watering routes and seek ways to reduce their impact on wildlife. As foot and mouth disesase is controlled by vaccination programmes these fences should be removed, if possible.

8. Considerable international assistance should be mobilised to strengthen the capabilities of the national authorities in the poorer countries of the region to assist them with identifying, establishing and managing protected areas, and with training personnel. Angola and Mozambique are priority areas for action when the political situation allows. Technical assistance should be continued to Tanzania and Zambia. South Africa and Zimbabwe have excellent parks systems and highly skilled personnel; they should be encouraged to share their expertise by participating in staff exchange and training schemes with other national parks authorities.

3.3 THE SUDANIAN REGIONAL CENTRE OF ENDEMISM (Unit III)

a. Extent of Unit

The unit consists of a narrow band of land 500 to 750 kms wide, stretching across northern Africa from Senegal eastwards as far as the foothills of the Ethiopian Highlands. The unit has a total surface area of about 3,731,000 km^2.

b. Administrative Divisions

The unit extends across northern Africa overlapping a number of countries: Senegal, Gambia, the northern tip of Guinea, Mali, Mauritania, Burkina Faso, Ivory Coast, Ghana, Togo, Benin, Nigeria, Niger, Cameroon, Chad, Cenral African Republic, Sudan, Ethiopia, Uganda and a small part of Zaire.

c. Dominant Vegetation

Maps 3.1 and 3.2 show the dominant vegetation of the unit. Of the surviving stands of vegetation the most numerous and characteristic are various types of woodland. It has been suggested that before the area became densely settled dry forest was the original climax vegetation over extensive areas. Apart from a small amount of swamp forest and riparian forest and some outliers of Guineo-Congolian forest in the south there is virtually no forest left (White 1983).

In most places where cultivation is possible the natural vegetation has been profoundly modified. In less densely populated areas much of the land is bush fallow woodland in various stages of regeneration after cultivation. Around population centres where cultivation is more intensive valuable trees are protected and the landscape is wooded farmland.

d. Distinct Habitat Types

Some undisturbed dense dry forest still exists between Bria and Ndele in Central African Republic, (an area of low human population); there is also much dense gallery forest north of Ndele. Some interesting relics of dry evergreen forest also persist on the sandstone plateaux of western Mali.

Most of the Sudanian region lies below 1000 m but the higher Jos and Mandara plateaux support distinctive plant communities.

In some areas, especially the valleys of the larger rivers and sites of Pleistocene lakes, the prevalent vegetation is edaphic grassland and wooded grassland; the latter is often associated with aquatic and semi-aquatic vegetation. Small patches of grassland occur on seasonally waterlogged soils at the heads of some tributary streams, on shallow soils on ironstone and other rocky outcrops.

There is very little bushland and thicket in the Sudanian Region (White 1983).

e. Current Land Use

Much of the Sudanian region is densely settled and cultivated. In the less densely populated areas land is cultivated then allowed to lie fallow and return to bush. At the end of the fallow period the land is cleared by burning. Around the large towns cultivation is permanent or semi-permanent for several kilometres.

Principal crops of the unit are the staples such as millet, sorghum, maize and yams. Cash crops include groundnuts (Nigeria, Sudan and Senegal are major producers) and small areas of tobacco and cotton. Most agriculture is dry-land farming except in the Nile valley where irrigation has been long practised; elsewhere irrigation is only economically viable where there is an assured overseas market for crops such as cotton or where a low-cost scheme is available to local farmers.

Pastoralism is also important in the unit especially in the north; cattle, sheep and goats are raised for their meat and skins. Supplementary livestock farming (mainly of goats and chickens) is also practised by settled agriculturalists with the advantage that small domestic livestock can be converted to food or cash as necessity demands. Communities with access to lakes and all-season rivers also rely on fish as a major source of protein. Fishing has been encouraged by the creation of artificial lakes such as Lake Volta in Ghana and Lake Kainji in Nigeria.

f. Biological Richness and Endemism of Unit

The unit is biologically very impoverished. There are possibly no more than 2750 species of plants but about one third of these are endemic (White 1983). There are no endemic plant families and the few endemic genera include *Butyrospermum, Haematostaphis* and *Pseudocedrela,* all of which are monotypic.

Faunally the region is fairly rich in mammals (46 species of ungulates and diurnal primates) and birds (319 species of passerine birds). Many mammals are here at the northernmost limit of their distribution. In both mammals and birds endemism is low, only 2% for mammals and 8% for birds.

g. **Species of Special Economic Interest**

Several plant species of commercial value are native to the unit including :-

Landolphia spp	African rubber	latex
Acacia Senegal	Gum arabic	resin
Daniella ogea	Copal	resin
Urena lobata	Aramena	fibres for sacking
Cola nitida	Kola nuts	stimulant drug
Bombax petandrum	Silk Cotton	kapok
Butyrospermum parkii	Shea butter	fat
Borassus aethiopicum	African fan palm	fruit, thatch

Important African food crops native to the region and probably domesticated there include:

Pennisetum americanum	Pearl millet	Cereal
Sorghum bicolor	Sorghum	Cereal
Eleusine coracana	Finger millet	Cereal
Dioscorea rotundata	Yam	Root
Oryza glaberrima	African rice	Cereal
Digitaria exilis	Fonio	Cereal
Digitaria iburua	Black fonio	Cereal
Voandzeia spp .	Groundnuts	
Kerstingiella spp .	Groundnuts	

Bushmeat is a very important part of the national economies of Senegal, Sudan, Togo, Ghana, Nigeria and Ivory Coast, especially in the north. In Ghana, for instance, 75% of the population depends largely on traditional sources of protein from wildlife, including mammals, birds, fish, insects, and snails (Sale 1981).

h. **Species of Special Biological and Conservation Interest**

The following mammal species are currently listed as threatened in the Mammal Red Data Book of IUCN :

Lycaon pictus	Hunting Dog	vulnerable
Panthera pardus	Leopard	vulnerable
Acinonyx jubatus	Cheetah	vulnerable
Loxodonta africana	Elephant	vulnerable
Trichechus senegalensis	Manatee	vulnerable
Diceros bicornis	Black Rhino	vulnerable
Taurotragus derbianus derbianus	Western Giant Eland	endangered
Alcelaphus buselaphustora	Tora hartebeest	endangered

The northern white rhino is now presumed extinct in the unit.

The following bird species are listed in the Bird Red Data Book of ICBP/IUCN.

Balaeniceps rex	Shoebill	of special concern
Prinia fiuviatilis	River Prinia	insuff. known

The following reptiles of the unit are listed as threatened in the IUCN Red Data Book:

Chelonia mydas	Green Turtle	endangered
Lepidochelys olivacea	Olive Ridley	endangered
Dermochelys coriacea	Leatherback Turtle	endangered
Caretta caretta	Loggerhead Turtle	vulnerable
Crocodylus niloticus	Nile Crocodile	vulnerable
Crocodylus cataphractus	African Slender-snouted Crocodile	indeterminate
Osteolaemus tetraspis	African Dwarf Crocodile	indeterminate

i. Additional Physical Features in Need of Protection

Freshwater swamps, rivers and waterways are generally underprotected throughout the unit.

j. Ethnological or Historical Features in Need of Protection

The unit contains a number of sites of ethnological and historical interest. Late Stone Age sites are found at Esh Shaeinah, Kadero and Early Khartoum in Sudan. There is evidence of the earliest Iron Age settlements in West Africa at Nok on the Jos Plateau and important sites at Daima, south-west of Lake Chad, show that neolithic herders acquired iron in the first centuries A.D. Other important archaeological sites include the burial site of Igbo-Ukwa in eastern Nigeria and Ife (by Yoruba tradition the place of the world's creation).

From the 12th to the 17th centuries trans-Saharan trade between North Africa and the peoples of West Africa created wealth which led to the establishment of several important kingdoms and empires holding dominion over the largely agricultural societies. Cultural traditions and artefacts from this period still remain in West Africa.

k. The Protected Areas System of the Unit

Maps 3.1 and 3.2 show the location of the existing and proposed network of protected areas in the unit. Table III. 1 lists these areas, giving their status and the areas of their main habitat types.

Table III.1 Protected Areas of the Sudanian Regional Centre of Endemism

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
BF	"W"	2	.T.	230–373	W	29a	2350	2350	3	1175	A
BF	Arli	4	.T.	100–500	W	29a	760	760	3	152	C
BF	Bontioli	4	.T.	100–500	W	27	63	127	4	25	C
					W	29a	64				
BF	Deux Bale	8	.T.	250–310	W	29a	280	560	3	112	C
					W	30	280				
BF	Dida	8	.T.	200–500	W	27	800	800	3	160	B
BF	Kourtiagou	6	.T.	100–500	W	29a	510	510	4	102	B
BF	Komoe Leraba	2	.F.	200–500	W	27	1450	1450	4	840	B
BF	Nabere	8	.T.	200–500	W	29a	365	365	4	37	C
BF	Pam	6	.T.	100–300	W	29a	3535	3535	3	1060	B
BF	PO	2	.T.	200–400	W	29a	1494	1494	3	747	B
BF	Singou	4	.T.	0–200	W	29a	1928	1928	4	386	B
BN	"W"	2	.T.	230–373	W	29a	5680	5680	3	2840	A
BN	Atakora	8	.T.	100–500	W	29a	1750	1750	3	350	C
BN	Boucle d. Pendjari	2	.T.	0–200	W	29a	2755	2755	2	1928	B
BN	Djona	8	.T.	100–500	W	29a	2250	2250	3	450	C
BN	Pendjari H. R.	8	.T.	100–500	W	27	500	2000	3	400	B
					W	29a	1500				
CH	Aboutelfan	6	.T.	500–1508	W	29a	1100	1100	3	330	C
CH	Bahr Salamat	6	.T.	250–500	W	29a	15000	20600	4	4120	A
					W/G	63	5600				
CH	Binder Lere	6	.T.	280–500	W	29a	1350	1350	4	270	C
CH	Manda	2	.T.	200–500	W	29a	1140	1140	3	570	B
CH	Mandelia	6	.T.	250–500	W/G	63	1380	1380	3	414	C
CH	Siniaka Minja	6	.T.	500–1613	W	29a	4260	4260	4	852	B
CH	Zakouma	6	.T.	200–500	W	29a	3000	3000	4	600	C
CM	Benoue	2	.T.	400–1000	W	27	1750	1750	2	1225	B
CM	Bouba Njidah	2	.T.	350–900	W	27	200	2200	2	1540	B
					W	29a	2000				
CM	Faro	2	.T.	620–975	W	27	3300	3300	2	2310	A

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km²)	Total area (km²)	Management	Contrib. score	Priority
CM	Waza	2	.T.	300–500	W	29a	800	1700	2	1190	A
					W/G	63	900				
CR	Andre Felix	6	.T.	500–900	W	27	1700	1700	4	340	B
CR	Aouk–Aoukale	4	.T.	200–500	W	29a	3300	3300	4	660	C
CR	Avakaba	8	.T.	350–450	W	27	1750	1750	4	175	C
CR	Bamingui–Bangoran	2	.T.	350–450	W	27	10700	10700	4	3210	A
CR	Gribingui–Bamingui	4	.T.	350–450	W	27	4380	4380	4	876	B
CR	Koukouru–Baingui	4	.T.	350–450	W	27	1100	1100	4	220	C
CR	Manova–Gounda–St.Fl.	2	.T.	400–800	W	27	15000	17400	4	5220	A
					W	29a	2400				
CR	Nana Banya	6	.T.	200–1000	W	27	2300	2300	4	460	B
CR	Ouandija–Vakaja	4	.T.	200–500	W	27	1300	1300	4	260	C
CR	Vassako–Bolo	1	.T.	350–450	W	27	860	860	4	258	B
CR	Yata–Ngaya	6	.T.	500–900	W	27	4200	4200	4	840	B
CR	Zemongo	6	.T.	500–1000	W	27	10100	10100	4	2020	A
ET	Chire	4	.T.	600–1500	W	29b	2000	2000	4	400	B
ET	Gambella	2	.F.	200–1000	W	29b	1500	2000	4	400	B
					W/B	35b	500				
ET	Mago (part)	2	.T.	500–1000	W	29b	400	400	3	200	B
ET	Omo (part)	2	.T.	500–2000	W	29b	1250	1250	3	625	A
ET	Tarna (part)	4	.T.	600–1000	W	29b	1500	1500	4	300	B
GH	Gbele	8	.T.	200–500	W	27	324	324	3	65	C
GH	Mole	2	.T.	100–500	W	27	4921	4921	3	2460	B
IC	Comoe (part)	2	.T.	119–658	W	27	9500	9500	2	6650	A
IC	Ouarigue	8	.T.	100–500	W	27	800	800	3	160	B
ML	Badinko	4	.T.	200–500	W	29a	1930	1930	4	390	B
ML	Banifing Baoule	4	.T.	100–200	W	29a	130	130	3	52	C
ML	Bossofola	4	.T.	200–500	W	29a	120	120	3	48	C
ML	Boucle du Baoule	2	.T.	c.300	W	29a	3500	3500	3	2450	A
ML	Elephant	4	.T.	200–500	W	29a	14000	15000	4	3000	A
					Aq	64	1000				
ML	Faya	4	.T.	100–500	W	29a	800	800	4	160	C
ML	Fina	4	.T.	200–500	W	29a	1360	1360	4	272	C
ML	Kenie Baoule	4	.T.	0–200	W	29a	675	675	4	135	C
ML	Kongossambougu	4	.T.	200–500	W	29a	920	920	4	184	C
ML	Nafadji	4	.T.	100–200	W	29a	430	430	3	172	C
ML	Sounsan	4	.T.	200–500	W	29a	376	376	4	75	C
ML	Talikourou	4	.T.	100–200	W	29a	139	139	3	56	C
NG	"W"	2	.T.	230–373	W	29a	2200	2200	4	660	A
NG	Tamou	4	.T.	206–277	W	29a	760	760	3	304	B
NI	Chingurmi–Duguma	8	.T.	200–1000	W	29a	354	354	3	71	C
NI	Falgore	8	.T.	100–1500	W	27	920	920	3	184	C
NI	Kamuku	8	.T.	200–1000	W	27	1128	1128	3	226	C
NI	Kwiambana	8	.T.	400–800	W	27	2614	2614	3	523	B
NI	Lake Kainji	2	.T.	120–339	W	27	5341	5341	3	2670	B
NI	Lame–Bura	4	.F.	500–1000	W	29a	2060	2060	4	206	C
NI	Old Oyo	8	.T.	200–500	W	27	400	400	3	80	C
NI	Opara (part)	8	.T.	100–500	W	27	2950	2950	3	590	B
NI	Pandam	8	.T.	200–500	W	30	225	225	3	45	C
NI	Sambisa	8	.T.	200–1000	W	29a	517	517	3	103	C
NI	Upper Ogun	4	.T.	100–500	W	27	1100	1100	3	440	C
NI	Yankari	4	.T.	200–500	W	30	2240	2240	3	896	B

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
SD	Ashana	6	.T.	500–1000	W	27	900	900	4	180	C
SD	Badingilo	4	.F.	200–500	W	27	500	8400	4	840	B
					W/G	62	1300				
					W/G	35b	1600				
					Aq	64	4000				
					G	61	1000				
SD	Bona (part)	2	.F.	400–1100	W/G	11a	600	18200	4	5460	B
					W	29b	3000				
					W/B	35b	13600				
					G	61	1000				
SD	Boro	4	.F.	500–1200	W	27	1500	1500	4	150	B
SD	Chelkou	6	.T.	600–1000	W	27	5500	5500	4	1100	B
SD	Dinder	2	.T.	700–800	W	29b	1400	8900	4	2670	A
					W/B	35b	7500				
SD	Dinder (prop. ext.)	4	.F.	700–800	W/B	35b	4000	8000	4	1600	A
					W/G	62	4000				
SD	Juba	6	.T.	500–1000	W	27	200	200	3	60	C
SD	Kidepo (part)	6	.T.	1000–2000	W	29a	1050	1050	3	315	B
SD	Meshra	4	.F.	200–500	W	27	2000	4500	4	450	B
					G	61	1500				
					Aq	64	1000				
SD	Nimule	2	.T.	650–700	W	27	410	410	3	205	C
SD	Numatina	6	.T.	500–1000	W	27	2100	2100	4	420	B
SD	Radom	2	.T.	c.450	W	27	12510	12510	3	6255	B
SD	Rahad	6	.T.	500–1000	W	29b	2000	3500	4	700	C
					W/B	35b	1500				
SD	Shambe	6	.T.	200–500	W	27	160	620	4	124	A
					G	61	300				
					Aq	64	160				
SD	Shainbe Ext.	4	.F.	200–600	W	27	1500	15000	4	1500	A
					G	61	9000				
					Aq	64	4500				
SD	Southern	6	.T.	800–1000	W	27	23000	23000	4	4600	A
SD	Zeraf	6	.T.	200–500	G	61	3700	9700	3	2910	B
					W/G	62	2000				
					Aq	64	4000				
SN	Ferlo Sud	4	.T.	C.100+	W	29a	6337	6337	3	2535	B
SN	Niokolo–Koba	2	.T.	16–311	W	29a	7500	7500	2	5250	A
TG	Fazao–Malfakassa	2	.T.	100–800	W	27	1920	1920	3	960	B
TG	Fosse aux Lions	4	.T.	200–500	W	29a	90	90	3	36	C
TG	Reran	2	.T.	100–140	W	27	1291	1291	3	645	B
TG	Keran	4	.T.	100–140	W	27	505	505	3	101	C
UG	Ajai	4	.T.	700–1000	W	29a	158	158	3	63	C
UG	Bugungu (part)	4	.T.	600–1300	W	29a	400	400	3	160	C
UG	Kidepo Valley (part)	2	.T.	900–2750	W	29a	1200	1200	2	840	B
UG	Mount Kei (part)	4	.T.	500–1000	W	27	289	289	3	116	B
UG	Murchison Falls (pt)	2	.T.	500–1292	W	29a	840	840	2	588	A
UG	Pian–Upe (part)	6	.T.	1000–3068	W	29a	214	214	4	43	C
UG	Toro (part)	4	.T.	690–750	W	29a	275	275	3	110	C
UG	Zoka Forest	6	.T.	200–500	W	29a	207	207	3	62	C

1. Analysis of Habitat Coverage versus Habitat Threat

Table III.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table III.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
11A	1500	5	0	0.0	600	40.0
27	1207900	35	76440	6.3	59660	4.9
29A	1594000	23	68811	4.3	32286	2.0
29B	141300	12	6550	4.6	6500	4.6
30	36900	29	2240	6.0	0	0.0
32	6200	30	0	0.0	0	0.0
33	6600	22	0	0.0	0	0.0
35B	89400	30	7500	8.3	21200	23.7
61	149800	29	0	0.0	16500	11.0
62	191700	20	0	0.0	7300	3.8
63	78300	21	900	1.1	6980	8.9
64	61800	56	1000	1.6	13660	22.1
Totals	3565400	27	163441	4.5	164686	4.6

These figures indicate that the coverage of most vegetation types is far from adequate. There is no coverage at all of the distinctive plant communities associated with the higher altitude Jos and Mandara plateaux; these mixed woodland/grassland mosaics are also not represented in the protected area networks of adjoining phytochoria. Nor is there at present any coverage of edaphic grasslands in the upper Nile basin though extensive areas of these are proposed for protection.

Because the unit has had a long history of human settlement, permanent and shifting cultivation and livestock grazing most habitat types are already severely reduced. This is especially true for woodlands. Although extensive areas of swamp occur in the unit they are threatened by developments such as drainage and irrigation schemes (such as the Jonglei Canal in southern Sudan) and oil exploration.

m. Evaluation of Protected Area Importance

The priority protected areas of the unit are "W" national park, a transnational park overlapping the borders of Burkina Faso, Benin and Niger; the large Bahr Salamat Faunal Reserve which surrounds Zakouma N.P. , Chad; Faro and Waza national parks, Cameroon; Bamingui–Bangoran N.P., Manovo-Gounda-St.Floris and Zemongo Faunal Reserve, Central African Republic; Omo N.P., Ethiopia; Comoe N.P. Ivory Coast; Boucle du Baoule N.P. and Elephant Reserve, Mali; Dinder N.P., Southern N.P. and Shambe Game Reserve, Sudan; Niokola-Koba N.P., Senegal and Murchison Falls N.P., Uganda.

Other priority A areas representing the best examples of their ecosystems within the unit are the proposed Komoe-Leraba N.P., Burkina Faso, and the proposed extensions for Dinder and Shambe, Sudan.

Together these parks cover a wide range of the habitat types found throughout the unit and represent the different animal and plant communities found as one moves from west to east across North Africa. Each of these protected areas is considered to be the best of its type either in quality and variety of habitat or diversity of plant and animal species; several also support spectacular concentrations of wildlife.

n. Evaluation of Protected Area Effectiveness

Standards of protection and management of the national parks and protected areas vary from country to country within the unit . In Cameroon, and in individual reserves elsewhere, management is fairly good but overall throughout the unit protection and management is far from adequate with no management at all in many reserves (see table III.2). The situation in Burkina Faso, Central African Republic, Mali and Sudan is particularly serious; virtually no resources have been assigned to protected area management and many of the reserves exist only on paper and lack properly defined boundaries.

For the protected area network of the unit to be effective there must be an immediate increase in conservation efforts which will not only require outside funding but will require many national

governments to acknowledge and appreciate the value and necessity of conserving their wildlife resources as valuable national assets. Almost all reserves within the unit require an immediate increase in the levels of trained staff, funding, equipment and other resources. Very few protected areas have any administration or infrastructure. As a first step it is essential that all reserves are properly gazetted with well defined boundaries.

o. Assessment of Suitability of Protected Area Status

The status of many of the protected areas of the unit is inadequate for their proposed management objectives and for providing effective protection for the wildlife and habitats they are supposed to conserve. For instance several of the areas described as national parks and faunal reserves in Burkina Faso, Chad, and Sudan can at best be assigned to IUCN category 6. Serious attention must be paid to improving management of these reserves to exercise greater control over activities allowed within their boundaries and give greater protection to the ecosystems they were established to protect.

Elsewhere throughout the unit the status of the reserves would be satisfactory if protection and management could be improved. Particular attention needs to be focused on forest reserves, especially in Nigeria, Burkina Faso, Benin and Ghana. These reserves were established primarily for timber exploitation; in fact these existing forest areas are important refuges for wildlife within a landscape that has already been much changed by the agricultural activities of Man. Whenever possible the status of these forest reserves should be upgraded to nature reserve to provide greater protection for the important plant and animal communities they contain. By acknowledging the high conservation value of these remaining forests, conservation authorities can bring pressure to bear on national forestry departments to give greater protection to these reserves and to manage them to minimise disturbance to wildlife.

p. Identification of Major Gaps in the Protected Area System

Overall only 4.5% of the unit is included within protected areas and most of this is woodland and woodland/grassland transitions. A further 4.6% of the unit is proposed as conservation areas or lies within reserves of category 6 or 8, often managed as hunting reserves. Swamps will be well-protected if the current proposed areas are included within the reserve network. Habitats which are inadequately represented within the current system include edaphic grasslands (but large areas of these fall within the proposed reserves) and specialised plant communities. Useful additions to the reserve system would include some protection for the remaining small areas of lowland rainforest and the higher altitude vegetation on the Jos and Mandara plateaux.

q. Recommendations for Reserve Additions or Extensions

1. Extend the Dinder national park, Sudan, as proposed by 800,000 ha to include large areas of edaphic grasslands.

2. Extend Shambe Game Reserve, Sudan, by 1,500,000 ha, as proposed, to increase protection of important swamp and edaphic grasslands. This extension will safeguard part of the Sudd swamps, feedwaters of the Nile, an important area for wildlife

3. Gazette and develop the proposed Komoe-Leraba N.P., Burkina Faso, a woodland area with important wildlife concentrations.

4. Gazette and develop the proposed Gambella N.P., Ethiopia, an important area of woodlands and grasslands.

5. Gazette, establish and develop the proposed protected areas of Boma, Badingilo, and Boro, Sudan (see Hillman 1985b).

6. Gazette and develop the proposed reserve of Lame-Bura, Nigeria, a woodland area.

7. Extend the protected area system of Nigeria by upgrading the status and increasing protection of many of the present forest reserves, currently exploited for timber.

8. Take appropriate action to protect as conservation areas important wetlands within the region including swamps, floodplains, and freshwater lakes. The Sudd swamps will be partly protected within the proposed Shambe extension if this can be adequately protected and managed.

r. Additional Conservation Needs.

1. Most countries of the unit have identified networks of protected areas but in many cases these exist only on paper. This is especially true in Chad, Central African Republic and Mali. Sudan and Ethiopia have proposed extensive reserve systems but now need to legally gazette these areas. It is essential that these countries continue active implementation of their parks programmes, improving park protection, management and staffing levels, with international aid as available.

2. Poaching is a major problem throughout the region, particularly poaching of elephant and rhino. More anti-poaching units should be established with fully trained personnel well-equipped with vehicles, radios and firearms. At present poachers from Sudan are operating in neighbouring countries. There needs to be closer cooperation and collaboration between the countries of the unit to mount joint anti-poaching operations and to stop cross-border poaching raids.

3. Surveys should be made throughout the region to identify wetlands and lakes especially important for waterbirds and other fauna e.g crocodiles and manatees.

4. Continue international support for the Wildlife College, Garoua, Cameroon. Increase support for the Nigerian school and encourage it to offer training to English-speaking wildlife personnel from outside Nigeria as well as to nationals.

5. Acknowledge the importance of bushmeat as a source of protein in the national economies of the countries of the region. Develop programmes for the wise and rational utilisation of this important resource, e.g. game ranching.

6. Inventory the use of wild resources and their importance in national economies for food and other uses (see Sale, 1981). Develop conservation education programmes to make the general public and government decision-makers more aware of the economic value of these resources and the need to establish conservation areas to protect the resource base.

7. Monitor the effects of aid programmes to improve irrigation of agricultural land within the unit, e.g. the Jonglei Canal scheme in Sudan. Note the effects of encouraging permanent settlements around boreholes in the Sahel etc. Lobby large international organistaions, such as World Bank, to take note of environmental considerations when they finance such schemes.

8. Considerable international assistance should be mobilised to assist the countries of the unit in strengthening their national park authorities and establishing and managing protected areas. International assistance is required in the form of technical assistance, funding and provision of equipment and training. Even where agencies are concentrating on management of individual reserves international experts should be briefed to monitor the situation throughout the whole national network of the country and to suggest extensions and improvements as appropriate.

3.4 SOMALIA-MASAI REGIONAL CENTRE OF ENDEMISM (Unit IV)

a. Extent of Unit

The unit consists of a large area of eastern Africa and the southwestern tip of Arabia, including the island of Socotra. It has a total north-south length of 3000 kms (see map 3.3) and a coastline length of c.7000 kms. The area of the unit (African mainland and Socotra only) is 1,873,000 sq.km.

b. Administrative Divisions

The unit overlaps seven African countries, including the whole of Djibouti, almost all of Somalia, eastern and southern Ethiopia (except the mountains), the southeastern corner of Sudan, northeastern corner of Uganda (Karamoja), most of Kenya except the coastal belt, and the dry lowlands of north and central Tanzania. In addition the unit contains the island of Socotra (South Yemen) and the coastal hills of Saudi Arabia, Yemen and South Yemen (see map 3.3).

c. Dominant Vegetation

Map 3.3 shows the dominant vegetation of the unit. Most of the unit is naturally clothed in deciduous bushland and thickets dominated by the *Acacia-Commiphora* association. The coastal regions of the unit and parts of northern Kenya are very dry and support only semi-desert grassland and shrubland. Hilly terrain in the southwest of the unit supports moister vegetation, predominantly a mosaic of original evergreen bushland and secondary *Acacia* wooded grassland. Several major mountain areas punctuate the unit but are dealt with in phytochorion VIII.

d. Distinct Habitat Types

Small areas of distinct edaphic vegetation occur such as the edaphic grasslands on the volcanoes of N. Tanzania, the halophytic vegetation associated with alkaline rift lakes and the Bahi swamp (Tanzania), and the semi-aquatic communities of the Lotagipi swamp (Uganda).

On Socotra the vegetation of the coastal plains consists mainly of semi-desert dwarf shrubland and grassland. The vegetation of the limestone plateau is more variable with interesting shrubland and thicket communities, including many endemic species.

e. Current Land Use

Most of the unit is extremely barren with very low agricultural potential. As a result it supports a low population density. The area is used primarily as pastoral rangelands by a number of tribal groups, though quite a large proportion is protected for wildlife. Overgrazing, overcutting of trees and bush and the recent years of drought have caused severe degradation of much of the rangeland of the unit, particularly in the north.

Much of the land associated with the Great Rift Valley and the volcanoes of East Africa is extremely rich in minerals and consequently fertile. In hilly areas with moister climate, areas with irrigation potential and areas benefiting from the bimodal rainfall pattern, there is excellent farmland, pasture and high quality rangeland. The latter supports some of the highest densities of wildlife in Africa.

f. Biological Richness and Endemism of Unit

Botanically the unit is of moderate richness with a total of about 2500 species of flowering plants and rather high endemism of c. 50 % (White, 1983). The island of Socotra (South Yemen) is an important site of local endemism with the following plant genera known only from the island : *Angkalanthus, Ballochia, Dendrosicyos,Haya,Lachnocapsa,Lochia,Mitolepsis,Nirarathamnos,Placopoda,Socotranthus,* and *Trichocalyx* (11 genera). 215 species are believed to be endemic to the island with more than 130 of these threatened. The greatest floral diversity occurs on the limestone plateau in the north of the island.

Faunally, the unit is of great importance. The rich habitat mosaic of forest to desert, mountains and Rift Lakes all allow for a great diversity of birds. Ornithologists are amazed at the diversity of species that can be seen in East Africa and the world record for spotting the most bird species in 24 hours (over 400 species) was made in this unit.

Butterflies and mammals show only moderate richness, but the high quality of grazing due to mineral richness and bimodal rainfall leads to spectacular densities of big game in some areas.

g. Species of Special Economic Value

The unit contains several plant species of commercial interest. Odera (1984) lists 34 commercially important trees for Kenya, mostly from the montane (Afromontane unit VIII) areas but some extending

into this unit. In addition the following valuable species occur :-

Landolphia sp.	African rubber	latex
Acacia Senegal	Gum arabic	resin
Tachylobium verrucosum	Copal	resin
Avena sativa	Oats	grain
Trilicum sp.	Wheat	grain
Citrullus colocynthis	Colocynth	purgative
Aloe spp.	Aloe	glucocides
Adansonia sp.	Baobab	medicines
Phoenix dactylifera	Dates	fruit

A number of valuable wildlife species occur in the unit. Some such as elephants, crocodiles, rhinoceros etc. have valuable products of commercial potential. Other species such as some primates are important for biomedical research. But by far the greatest commercial value of the wildlife of the unit is its potential for tourism through game viewing. Wildlife also provides some bushmeat to local inhabitants. Wildlife products (horn, skin etc.) are used commercially in the tourist souvenir industry.

h. **Species of Special Biological and Conservation Interest**

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Allenopithecus nigroviridis	Blackish Green Guenon	insuff.known
Lycaon pictus	Wild Dog	vulnerable
Panthera pardus	Leopard	vulnerable
Acinonyx jubatus	Cheetah	vulnerable
Loxodonta africana	Elephant	vulnerable
Diceros bicornis	Black Rhino	endangered
Alcelaphus buselaphusswaynei	Swayne's Hartebeest	endangered
Damaliscus hunteri	Hunter's Hartebeest	rare
Ammodorcas clarkei	Dibatag	vulnerable
Dorcatragus megalotis	Beira Antelope	vulnerable
Gazella dorcaspelzelni	Pelzeln's Gazelle	endangered
Gazella gazella	Mountain Gazelle	vulnerable
Gazella spekei	Speke's Gazelle	indeterminate

The only full species at present classified as endangered is the black rhino whose population numbers have dropped dramatically throughout Africa due to increased poaching.

The following bird species are listed as threatened in the Bird Red Data Book of ICBP/IUCN:

Geronticus eremita	Northern Bald Ibis	endangered
Turdoides hindei	Hinde's Pied Babbler	vulnerable
Heteromirafra archeri	Somali Long-clawed Lark	indeterminate
Heteromirafra sidamoensis	Sidamo Long-clawed Lark	indeterminate
Columba oliviae	Somali Pigeon	rare
Hirundo megaensis	White-tailed Swallow	rare
Acanthis johannis	Warsangli Linnet	rare
Zavattariornisstresemanni	Ethiopian Bush Crow	rare
Mirafra ashi	Ash's Lark	insufficient data
Mirafra degodiensis	Degodi Lark	insufficient data
Apalis karamojae	Karamoja Apalis	insufficient data
Balaeniceps rex	Shoebill	of special concern
Bugeranus carunculatus	Wattled Crane	of special concern
Serinus flavigula	Yellow-throated Serin	of special concern

The only endangered species is the Northern Bald Ibis which is a visitor to the unit from its breeding

grounds in Turkey. This population appears to be heading for extinction, leaving only one other declining population in North Africa.
The following reptile species of the unit are listed as threatened in the Reptile Red Data Book of IUCN:

Chelonia mydas	Green Turtle	endangered
Eretmochelys imbricata	Hawksbill Turtle	endangered
Crocodylus niloticus	Nile Crocodile	vulnerable
Malacochersus tornieri	Pancake Tortoise	insuff. known

i. Additional Physical Features in Need of Protection

The Somalia-Masai unit contains some spectacular scenery. Some of the most spectacular geological structures are associated with the Great Rift Valley, including escarpments, rock pillars, and freshwater and soda lakes. Other interesting geological phenomena include the many small and large volcanoes, hot water spouts and lava flows. Additional features of interest are the many kopje hills characteristic of much of the semi-desert terrain, and the desert habitat of the Danakil Depression .

j. Ethnological or Historical Features in Need of Protection

The unit contains some of the most important archaeological research sites in the whole of Africa, particularly those associated with the hominid remains so important for tracing the evolution of Man. There are many important Early and Late Stone Age sites along the Rift Valley. Some of the more famous finds of early hominid remains have been made at Olduvai Gorge (Tanzania), Olorgesailie and Lake Turkana (formerly Rudolf) in Kenya; the Laetoli beds of Tanzania have yielded fifteen new hominid species as well as the famous Laetoli footprints (Leakey 1984). The controversial 'Lucy' finds come from Hadar in Ethiopia. Late Stone Age sites in the unit include Lowasera, Lothagam, Nasera and Narosura. Possibly the earliest *Homo sapiens* remains yet recovered in Africa come from the Omo River valley in southern Ethiopia. At Kisese and Kolo (Tanzania) there are wonderful rock paintings created by Late Stone Age men.

In addition there are several more recent sites of cultural importance; Maasai graves, sacred forest patches etc. and sites where ancient cultural traditions are still maintained but may be in danger of being lost (e.g. Rendille tribe of N. Kenya).

k. The Protected Areas System of the Unit

Map 3.3. shows the location of the existing and proposed network of protected areas in the unit. Table IV.1 lists these areas giving their status and the areas of their main habitat types.

Table IV.1 Protected Areas of The Somalia-Masai Regional Centre of Endemism

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
DJ	Day	2	.T.	c.1500	SD	54b	30	30	4	9	A
ET	Abiatta–Shalla (pt)	1	.T.	1500–4000	B	42	400	400	4	264	B
ET	Awash	2	.T.	850–2005	B	42	720	720	3	360	B
ET	Chew Bahar	4	.T.	500–3000	B	42	2800	3000	4	600	B
					SD	54b	200				
ET	Gewane	4	.T.	500–1000	SD	54b	2500	2500	3	1000	B
ET	Harrar (part)	4	.T.	100–1200	B	42	4500	4500	3	1800	B
ET	Mago (part)	2	.T.	500–1000	B	42	1100	1100	3	550	B
ET	Mille Sardo	4	.T.	500–1000	SD	54b	10000	10000	4	2000	A
ET	Nechisar	2	.T.	1200–1400	B	42	700	700	3	350	C
ET	Omo (part)	2	.T.	500–2000	B	42	1215	1215	3	607	A
ET	Tama (part)	4	.T.	600–1000	B	42	1500	1500	4	300	B

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
ET	Yangudi Rassa	2	.T.	500–600	SD	54b	2000	2000	3	1000	B
ET	Yavello (part)	4	.T.	1500–3500	B	42	2000	2000	4	400	B
KY	Amboseli	2	.T.	1000–1155	B	42	102	392	2	274	B
					H	76	190				
KY	Bisanadi	6	.T.	320–660	B	42	606	606	3	182	C
KY	Buffalo Springs	2	.T.	900–1000	B	42	300	339	2	237	B
					G	45	39				
KY	Hells Gate	2	.T.	c.2777	B/G	45	680	680	1	612	C
KY	Kora	6	.T.	250–440	B	42	1787	1788	1	1073	B
KY	Lake Bogoria	2	.T.	1000–1600	B/G	45	107	107	2	75	B
KY	Lake Nakuru	2	.T.	1753–2073	A		71	200	1	180	A
					B/G	45	129				
KY	Losai	6	.T.	650–1750	B	42	1807	1807	4	361	C
KY	Maasai Mara	2	.T.	1500–2170	B/G	45	1510	1510	2	1057	A
KY	Marsabit (part)	2	.T.	420–1700	B	42	600	1400	2	980	B
					G	45	800				
KY	Meru	2	.T.	366–941	B	42	870	870	1	783	B
KY	Mwea	6	.T.	1000–1100	B	42	20	68	3	20	C
					B/G	45	48				
KY	Nairobi	2	.T.	1533–1760	B/G	45	117	117	1	105	B
KY	Nasolot	6	.T.	750–1500	B	42	925	925	3	278	C
KY	Ngai Ndethya	6	.T.	650–750	B	42	212	212	3	64	C
KY	North Kitui	6	.T.	428–675	B	42	745	745	3	224	C
KY	Rahole	6	.T.	250–1000	B	42	1270	1270	3	381	C
KY	S.Turkana	6	.T.	900–2270	B	42	800	1091	3	327	B
					B/G	45	291				
KY	Samburu	6	.T.	200–1000	B	42	165	165	2	83	B
KY	Shaba	6	.T.	700–1500	B	42	239	239	2	120	C
KY	Sibiloi	2	.T.	0–200	SD	54b	1570	1570	2	1099	B
KY	South Kitui	6	.T.	400–675	B	42	1833	1833	3	550	B
KY	Tsavo (part)	2	.T.	229–2438	B	42	20400	20400	2	14280	A
SD	Boma (part)	2	.F.	400–1100	B	42	4600	4600	4	1380	B
SM	Arbowerow	4	.F.	0–100	B	42	1500	1500	4	300	C
SM	Awdhegle–Gandershe	2	.F.	0–200	B	42	800	800	4	240	C
SM	Boja Swamps	4	.F.	0–100	B	42	1100	1100	4	220	C
SM	Daalo Forest (part)	2		0–1000	B	42	800	1630	4	489	A
					SD	54b	800				
					Mn	77	30				
SM	El Hammure	4		100–500	B	42	4000	4000	4	800	B
SM	Gezira	2	.F.	0–200	B	42	50	50	4	15	C
SM	Haradere–Awale Arug.	4	.F.	0–200	SD	54b	2500	2500	4	500	B
SM	Harqan–Dalandoole	4	.F.	500–1000	B	42	8000	8000	4	1600	B
SM	Hobyo	2	.F.	100–200	SD	54b	2500	2500	4	750	B
SM	Jowhar Warshek	2	.F.	100–200	B	42	2200	2200	4	660	B
SM	Lack Dere	2	.F.	0–200	B	42	4000	5000	4	1500	B
SM	Lag Badana	2	.T.	0–100	B	42	1000	1340	3	670	A
					Mn	77	340				
SM	Las Anod TalehChebet	4	.F.	200–1000	B	42	2000	8000	4	1600	A
					SD	54b	6000				
SM	Zeila	4	.F.	0–200	SD	54b	4000	4000	4	800	B
TZ	Kizigo (part)	4	.T.	1000–1500	B	42	2000	2000	3	800	B
TZ	Lake Manyara	2	.T.	960–1828	G	59	320	320	2	224	B

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
TZ	Maswa	4	.T.	1000–1500	B	42	2200	2200	2	1100	B
TZ	Mkomazi (part)	6	.T.	630–1630	B	42	700	700	2	350	B
TZ	Ngorongoro (part)	8	.T.	1500–3000	B	42	4000	6280	2	1884	B
					G	59	2280				
TZ	Ruaha (part)	2	.T.	750–1830	S	42	8950	8950	3	4475	A
TZ	Rungwa (part)	4	.T.	1350–2350	B	42	3000	3000	2	1500	B
TZ	Serengeti	2	.T.	920–1850	B	42	11263	14763	1	13287	A
					G	59	3500				
TZ	Taranagire	2	.T.	1100–1500	B	42	2600	2600	3	1300	B
TZ	Umba	4	.T.	1000–1500	B	42	1500	1500	3	600	C
UG	Bokora Corridor	4	.T.	1000–2100	B	42	2056	2056	3	822	B
UG	Matheniko	6	.T.	1200–1600	B	42	1600	1600	3	480	C
UG	Pian–Upe (part)	6	.T.	1000–3068	B	42	2000	2000	4	400	C

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table IV.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type within the unit.

Table IV.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
16B	300	23	0	0.0	0	0.0
42	1456300	51	72256	4.9	43759	3.0
45	73100	41	3382	4.6	339	0.4
54B	413000	56	16300	3.9	15800	3.8
59	17700	60	3820	21.5	0	0.0
64	7000	50	0	0.0	0	0.0
67	6000	100	0	0.0	0	0.0
68B	5200	75	0	0.0	0	0.0
71	5200	70	0	0.0	0	0.0
76	4200	80	190	4.5	0	0.0
77	2100	30	340	16.1	30	1.4
Totals	1990100	52	96288	4.8	59928	3.0

These figures indicate that the coverage of all vegetation types except 59 (edaphic grasslands on volcanic soils) and mangroves is far from adequate. The lack of any coverage of semi-aquatic and desert habitats is particularly serious, especially as these biomes are under-represented in the protected area systems elsewhere in the Afrotropical Realm.

As the human population expands there will be increasing pressure on land resources. Already large areas of bushland, thicket and semidesert vegetation have been degraded due to overgrazing by domestic livestock. Half of the original swamplands and large tracts of other vegetation types have been cleared for agriculture, even where the land is not particularly fertile; this leads to increasing soil erosion and environmental degradation, particularly in the north of the unit. Forests have been particularly vulnerable so that only relict patches remain within the unit – yet these support some of the most interesting and species-rich biological communities.

m. Evaluation of Protected Area Importance

The priority reserves of the unit are Day N.P. (Djibouti) which includes relict forests, Mille Sardo Wild Ass Reserve (Ethiopia) which protects semidesert habitat , Omo N.P (Ethiopia), Lake Nakuru, Maasai Mara and Tsavo national parks (Kenya), Lag Badana N.P. (Somalia) and the Ruaha and Serengeti national parks (Tanzania). Several of these are large parks protecting the eastern Africa savanna with its great densities of wildlife and amazing animal migrations. Lake Nakuru is an alkaline lake important as flamingo and waterbird habitat.

Other priority A areas for conservation action are the proposed Daalo Forest N.P. and proposed reserve of Las Anod Taleh/Chebet (Somalia) which will protect semidesert habitat and some of Somalia's unique desert fauna. There is little information on the existing state of Somalia's wildlife and protected areas but the country is suffering from increasing environmental degradation and it is essential that conservation measures are implemented now to protect Somalia's wildlife.

Many of the other protected areas of eastern Africa have spectacular wildlife concentrations. Although they are important in a regional context they have not been designated as areas of top priority for conservation action because they are already well-managed or duplicate habitat types represented elsewhere.

n. Evaluation of Protected Area Effectiveness

Protection and management of the national parks of eastern Africa vary from country to country. In Kenya and Tanzania where national parks form the basis of an important tourism industry many of the larger parks at least are fairly well-managed. In both countries, however, the parks system is threatened by increasing pressure on land and poaching of wildlife; both parks departments need to increase numbers of trained staff, funding and equipment.

In the other countries of the unit levels of management and protection effectiveness are generally low. Uganda, Sudan and Ethiopia have all suffered from recent civil wars and long periods of political unrest. In Djibouti and Somalia reserves exist only on paper and it may already be too late to establish an effective protected area system. All of these countries require further conservation action with increased manpower, funding, transport , equipment and resources for parks and protected areas. Administration and infrastructure of parks also must be improved (see country recommendations).

o. Assessment of Suitability of Protected Area Status

The status of most areas is suitable to their management objectives if they could be effectively protected and managed. Special attention should be paid to forest reserves which are important not just as producers of forest products but as watersheds and refuges for many species of wildlife. In general forests are poorly protected within the unit. Although many forests are designated as forest reserves this does not afford them adequate protection. Many forest species, particularly trees and birds, occur at very low densities so that forest endemics are particularly vulnerable and endangered by habitat destruction. As a matter of priority more forest areas should be given full reserve status with no exploitation allowed there.

p. Identification of Major Gaps in the Protected Area System

Most of the major habitat types of the unit are included in the protected area system with savanna ecosystems particularly well-represented in many major national parks and reserves. Although there is little mangrove within the unit 16% of mangrove stands are included within the existing protected area network.

Major biomes which are under-represented or inadequately protected in the existing reserve system include:

Forests
Deserts
Swamps
Seashore and marine areas
Freshwater and alkaline lakes.

Within these biomes greater protection should be given to relict areas of forest of high biological importance, to the alkaline lakes of the Rift Valley and to protecting at least some areas of the open water of important freshwater lakes.

Much of the desert vegetation has been degraded but it is probable that the vegetation could recover in some areas if given adequate protection.

The island of Socotra has a unique flora with high levels of endemism yet the island has no reserves. The limestone plateau in the north of the island is of especial richness.

q. Recommendations for Reserve Additions and Extensions

1. Establish a representative system of protected areas in Somalia; the paper by Simonetta and Simonetta (1983) outlines some proposals. Top priority should be given to establishment of the proposed Daalo Forest N.P. and the Las Anod Taleh/ Chebet reserve. Since Somalia seems to have no viable protected area system at present the selection and establishment of reserves may require further surveys to identify relatively undisturbed habitats and areas of wildlife concentrations.

2. Take immediate measures to protect as conservation areas the alkaline lakes of Ethiopia, Kenya and Tanzania which collectively form the breeding and feeding habitats of greater and lesser flamingoes and are also critical habitats for other waterbirds. The following alkaline lakes are not yet protected by national park or reserve status:

Ethiopia: Lakes Zwai, Langano, Awasa, Abaya, Chamo; Abaya and Chamo could be included in Nechisar N.P.

Kenya : Lakes Baringo, Magadi;

Tanzania: Lakes Natron, Eyasi, Balangida, Balangida Lelu.

Lake Natron is the only breeding site for lesser flamingoes in eastern Africa.

3. Take appropriate action to protect at least some of the open water of the major freshwater lakes of eastern Africa, including Lake Victoria, Lake Tanzania and the freshwater lakes of the Rift Valley. Extend the boundaries of national parks bordering lakes at least 500 m out into the open water to include some of the open water within the protected area.

4. Establish reserves to give full protection to areas of relict forest which are presently inadequately protected as forest reserves even though these are areas of biological richness and important bird and wildlife habitats.

5. Establish coastal and marine reserves on the Red Sea coast in accordance with recommendations outlined by Salm and Chong Seng (UNEP 1984). The proposed Dahlak Marine N.P. in the Red Sea, off the coast of Ethiopia, is a valuable area.

6. Very few extensive swamps in eastern Africa are protected in parks or reserves. In Kenya the Lorian and Lotikiri swamps need protection, in Tanzania Wembere, Malagarasi, Ugalla, Kilombero, Bahi and Kagera swamps.

8. Upgrade the status of important areas of forest from forest reserve to nature or game reserve to give more adequate protection to important wildlife. These outliers (relicts of formerly far more extensive blocks of eastern forest which are quite distinct from the lowland forests of West Africa) are important as they harbour several endemic birds and tree species. Areas deserving conservation action include the Kakamega Forest (Kenya).

r. Additional Conservation Needs

1. Immediate action must be taken to identify and establish suitable conservation areas in Somalia and Djibouti. Both countries have severe environmental problems, extensive degradation of natural habitats and no effective protection nor management of existing protected areas.

2. Sudan and Ethiopia have already identified and proposed extensive systems of protected areas and Ethiopia, in particular, has made real efforts and achievements in conservation with very few resources. Both countries now need to gazette their protected areas and to continue and maintain active implementation of their parks programmes and system plans.

3. Throughout the unit there is a need to establish more conservation areas to protect wetlands and lakes, especially important for waterbirds and other fauna e.g. crocodiles. Particular attention should be paid to alkaline lakes and freshwater swamps.

4. Poaching is a major problem throughout the region, particularly poaching of elephant and rhino. More anti-poaching units should be established and fully equipped with vehicles, radios and firearms etc. Poachers from Sudan cross into other countries of the region and considerable amounts of poached ivory leave Africa via Sudan; there will need to be greater cooperation between Sudan and other countries of the unit to stop this cross-border poaching and trade in poached trophies.

5. As elsehwere in Africa, conservation education programmes should be established in all countries of the unit to increase public awareness of the importance of protected areas and value of wildlife. Since Kenya and Tanzania already have considerable expertise in this field they could advise other countries in the region.

6. Mweka Wildlife College, Tanzania, has a fine record for training parks managers and staff from throughout Africa. Those countries of the unit with newly established or expanding parks departments would particularly benefit from sending personnel to Mweka for wildlife management training. It would also be useful if Mweka could include refresher courses for senior parks staff within its curriculum.

7. Encourage tourism development of parks within the unit; again the other countries of the unit could benefit from the expertise of Kenya and Tanzania, especially Kenya. There should be interchange of ideas on park management between countries through regional meetings and study tours.

8. Considerable international assistance should be mobilised to strengthen the capabilities of the national authorities in identifying, establishing, protecting and managing protected areas. International aid should be sought in the form of technical assistance, funding, equipment and training of personnel. Kenya, Tanzania and Uganda are already receiving considerable technical assistance which should be continued and international assistance to the other countries of the unit should be increased.

3.5 THE CAPE REGIONAL CENTRE OF ENDEMISM (Unit V)

a. Extent of Unit

The region covers the south-western and southern part of the Cape Province of South Africa between 32^0 and 35°S and 18° and 27° E . Most of the unit lies below 1000 m and surrounds large enclaves of Karoo and Afromontane vegetation on the mountain ranges (units VI and VIII). The easternmost area of Cape vegetation is separated from the main block by the bushlands of the Sundays River valley. Outliers of this vegetation type also occur on the highlands above Van Rhynsdorp and the summit of the Kamiesberg. The total area of this biogeographic unit is 71,000 sq.km.

b. Administrative Divisions

The unit falls entirely within Cape Province, Republic of South Africa (see map 3.4).

c. Dominant Vegetation

Map 3.4 shows the dominant vegetation of the unit, *fynbos,* which most characteristically occurs in the form of sclerophyllous shrubland, 1–3 m tall with a few scattered taller trees and *Protea* bushes. The original vegetation may have included many species of tropical and karroid affinity but today large parts of the Cape lowlands, where not cultivated, are now occupied by secondary shrubland dominated by the 'rhenosterbos' *Elytropappus rhinocerotis* . The dominant vegetation of the coastal plain is coastal fynbos with patches of bushland and thicket (White 1983).

d. Distinct Habitat Types

Mountain streams in many parts of the Cape Region are fringed with riparian thicket and scrub forest dominated by a mixture of Cape endemics and Afromontane species.

Most stands of fynbos contain many species and single-species dominance does not occur except locally. *Protea* bushes and other tall plants in bushy fynbos may form dense impenetrable thickets if protected from fire but most fynbos species cannot regenerate under such conditions. It is now widely believed that fynbos evolved in relation to recurrent natural fires and that fire is necessary for its healthy maintenance. Mountain fynbos communities are less species rich and are often structurally distinct from the lowland fynbos vegetation .

e. Current Land Use

Much of the Cape lowlands have been cleared for cultivation and intensively farmed. Arable farming is highly mechanised. The principal crop is wheat but in the Mediterranean-type climate cash crops such as citrus and other fruits, grapes and tobacco are also grown. South Africa is a major food exporter to the rest of Africa and overseas.

Over 16% of the unit is already included within national parks and protected areas. Although early white settlers cleared much of the natural bush and decimated the wildlife, in South Africa today conservation areas are considered an appropriate form of alternative land-use and are well-protected and managed.

f. Biological Richness and Endemism of Unit

The southern cape of Africa has a remarkable flora, very different from, and much richer than, any other area of comparable size in Africa. The unit has an estimated 8500 vascular species (about 7000 species of flowering plants (White, 1983) of which about 68% are endemic (Droop 1985). There are seven endemic plant families: Bruniaceae, Geissolomataceae, Grubbiaceae, Penaeceae, Roridulaceae, Retziaceae and Stilbaceae. About 210 genera are endemic to the Cape Region and a further 70 genera have their greatest concentration of species there. Other characteristic plant families of the region are Ericaceae, Proteaceae, Restionaceae and Rutaceae-Diosmeae (White 1983).

g. Species of Special Economic Interest

Much of the unit's wildlife was extensively hunted in the past for food and elephant ivory. Some species such as elephant and crocodile were hunted locally to extinction. Today wildlife makes a substantial input into the South African economy with tourism to national parks and protected areas earning considerable revenue from domestic and international visitors.

Several native plants of the unit are also of some economic value, including wild yams and grain sorghum, *Sorghum caffrorum.* Numerous native plants are valued for their ornamental value, e.g. members

of the families Proteaceae, Ericaceae, Redaceae, Liliaceae and Restionaceae, and have been exported and cultivated overseas.

The South African Clawed Toad, *Xenopus Laevis,* is well known throughout the world because of its use in biology classes and past use for pregnancy testing.

h. Species of Special Biological and Conservation Interest

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Chrysopalax trevelyani	Giant Golden Mole	endangered
Bunolagus monticularis	Riverine Rabbit	endangered
Panthera pardus	Leopard	vulnerable
Equus zebrazebra	Cape Mountain Zebra	endangered
Loxodonta africana	Elephant	vulnerable
Damaliscus dorcasdorcas	Bontebok	vulnerable

Two mammals once found in the unit, the quagga *Equus quagga* and the bluebuck *Hippotragus leucophaeus,* are now extinct. Elephants have been reintroduced to the unit and both elephant and leopard are rare here. The riverine rabbit is regarded as endangered. The bontebok *Damaliscus dorcas dorcas,* which is endemic to the unit, is listed as vulnerable but is protected in several reserves.

The South African Red Data Books give more detailed data on the distribution and status of both large and small mammals within the unit (Skinner et al. 1977, Meester 1976).

The following bird species are listed as threatened in the Bird Red Data Book of ICBP/IUCN:

Gyps coprotheres	Cape Vulture	rare
Spheniscus demersus	Jackass Penguin	of special concern

The South African Red Data Book for Birds (Brooke 1984) gives more detailed information on the distribution and status of bird species within the unit. For the whole of the Republic of South Africa it lists 5 species as endangered, 17 as vulnerable and 42 species as rare in South Africa.

The following species, both endemic to the unit, are listed as threatened in the IUCN Amphibia/Reptilia Red Data Book;

Psammobates geometricus	Geometric Tortoise	vulnerable
Xenopus gilli	Cape Clawed Toad	vulnerable

i. Additional Physical Features in Need of Protection

The unit has some spectacular highland scenery much of which is already included within the protected area system of South Africa. Additional physical features requiring protection include coastal sand dunes, which are vulnerable to misuse by fast growing human population pressures and demands for recreation, development etc. Coastal dunes are of considerable economic importance because of their buffer role, sand and heavy mineral resources and the high costs of stablising mobile dune areas. A comprehensive list of proposed dune conservation areas for the unit is given by Tinley (1985).

j. Ethnological or Historical Features in Need of Protection

The unit includes many sites of historical and ethnological interest. Among the most fascinating are the archaeological excavations of Stone Age sites at Montagu Cave, Die Kelders, Klasies River Mouth and Boomplas Wilton. The cave complex at Klasies River Mouth is of particular interest because of the faunal remains preserved with a long sequence of Middle Stone Age industries that ended some 38,000 years ago. These remains show that Early Man was hunting eland, young giant buffalo, seals and penguins, and collecting shellfish. Finds from Montagu Cave demonstrate the range of stone industries manufactured during the Middle Stone Age.

k. The Protected Areas System of the Unit

Map 3.4 shows the location of the existing and proposed network of protected areas in the unit. Table V.1 lists these areas, giving their protected status and the areas of their main habitat types.

Table V.1 Protected Areas of the Cape Regional Centre of Endemism

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
SA	Anysberg/Klein (pt)	4	.T.	670–2325	B	50	294	294	1	206	C
SA	Cape of Good Hope	4	.T.	0–366	B	50	77	77	1	54	C
SA	De Hoop	4	.T.	611–1000	B	50	178	178	1	125	A
SA	Gamka Mtn (part)	4	.T.	300–1000	B	50	66	66	1	46	C
SA	Gamkapoort (part)	4	.T.	430–1280	B	50	24	24	1	17	C
SA	Groendal Wildn. (pt)	4	.T.	90–1180	B	50	200	200	1	140	C
SA	Groot East Swart(pt)	4	.T.	650–3085	B	50	968	968	1	678	B
SA	Groot Winterhoek	4	.T.	200–2077	B	50	812	812	1	568	B
SA	Hawequas	4	.T.	100–1995	B	50	1159	1159	1	811	B
SA	Hottentots Holland M	4	.T.	0–1589	B	50	849	849	1	594	A
SA	Kammanassie	4	.T.	700–1965	B	50	455	455	1	318	C
SA	Kouga/Baviaanskl(pt)	4	.T.	400–1758	B	50	861	861	1	603	B
SA	Langeberg East (pt)	4	.T.	61–1637	B	50	642	642	1	449	B
SA	Langeberg West (pt)	4	.T.	122–1654	B	50	694	694	1	486	B
SA	Matroosberg	4	.T.	400–2249	B	50	953	953	1	667	B
SA	Otterford	4	.T.	100–1106	B	50	115	115	1	81	C
SA	Outeniqua (part)	4	.T.	400–1521	B	50	951	951	1	666	B
SA	Riviersonderend (pt)	4	.T.	200–1654	B	50	626	626	1	438	B
SA	Rooiberg (part)	4	.T.	600–1490	B	50	127	127	1	89	C
SA	Sederberg	4	.T.	213–2027	B	50	1264	1264	1	885	B
SA	Storms River (part)	4	.T.	275–1232	B	50	47	47	1	33	C
SA	Suurberg	4	.T.	250–970	B	50	211	211	1	148	C
SA	Tsitsikamma Mts (pt)	4	.T.	1300–1675	B	50	720	720	1	504	B
SA	Walker Bay	4	.T.	0–40	B	50	71	71	1	50	C

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table V.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table V.3 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
50	71000	40	12364	17.4	0	0.0
Totals	71000	40	12364	17.4	0	0.0

Only a single unit representing the Cape vegetation appears on the map and 17.4% of this vegetation type is already included within protected areas. Cape vegetation can be differentiated into mountain fynbos and lowland fynbos. Lowland fynbos with its unparalleled richness and distinctiveness of species is under-represented in the protected area network. Huntley (in litt.) calculates that only 318 sq.km of lowland fynbos is protected or 0.4% of the original area of this habitat type. Lowland fynbos has already suffered considerable destruction and degradation (only 20% of the original area remaining) whereas mountain fynbos has been little disturbed and almost a fifth of the original area of this vegetation type is included within protected areas (Huntley, in litt.)

m. Evaluation of Protected Area Importance

With certain notable exceptions, such as Hawequas and Sederberg, most of the reserves of this unit are small but well-managed and together they give good protection to mountain fynbos. Since lowland fynbos is so under-represented in the total protected area system (only 2.6% of protected habitat) those areas including lowland fynbos are of top conservation priority .

All reserves in South Africa are well-managed but their contribution to conservation would be enhanced if some areas could be enlarged. This is especially true of lowland fynbos areas; top priority should be given to identifying and protecting relatively undisturbed examples of this habitat, either by creating new reserves or extending existing ones.

We have not included reserves of less than 5000 ha in this analysis since we believe such small reserves are not viable in the longterm but some smaller reserves are important areas protecting lowland fynbos.

n. Evaluation of Protected Area Effectiveness

Levels of protection and management in South African reserves are very high and all reserves in this phytochorion have been scored as having good management. The greatest management problems are the small size of many areas and grazing and cultivation on the park borders which may cause disturbances of the natural habitat. Exotic woody plant invaders such as *Acacia* present a major threat to the fynbos ecosystem and veld fires started on adjacent farmland are a major problem, sometimes compounded by unsatisfactory boundary alignments. In general management problems are those associated with small size of reserves.

o. Assessment Of Protected Area Status

The status of all the areas considered in this unit is that of managed nature reserve (category 4), which is appropriate for their management objectives. As yet there is only one national park in this unit. Creation of more national parks, specifically to protect lowland fynbos, would be useful additions to the unit, providing that visitor use was well-controlled and not in itself a threat to the habitat.

p. Identification of Major Gaps in the Protected Area System

Mountain fynbos is well-represented within the extensive protected area network of the unit but lowland fynbos is inadequately protected. This habitat occurs in the lowland areas most favoured for agriculture but, if practicable, more protected areas of as large a size as possible should be established to protect this unique and species-rich habitat. A detailed analysis of conservation priorities for the lowland fynbos provides an action plan for this biotically unique region (Jarman 1986).

q. Recommendations for Reserve Additions and Extensions

1. Implement the recommendations of the lowland fynbos action plan (Jarman 1986).

r. Additional Conservation Needs

1. Extend conservation education programmes to increase public awareness of the uniqueness of the very special flora of the unit and to increase public support for the protected area system.

2. Monitor the effect of drainage of marshland on rare amphibians, especially the Cape clawed toad *Xenopus gilli*, microfrogs *Microbatrachella capensis*, rain frogs *Breviceps* spp., the Cape caco *Cacosternum namaquense* and the banded stream frog *Rana montana*, all of which are very local in distribution (Simmonds 1985).

3. Take appropriate conservation action to protect the last remaining local populations of endemic amphibians and the geometric tortoise confined to the fynbos habitat.

4. Implement the conservation action proposed by Tinley (1985) to protect sand dunes and their endemic and/or specialized plant and animal species.

3.6 KAROO-NAMIB REGIONAL CENTRE OF ENDEMISM (Unit VI)

a. Extent of Unit

This region occupies the central, northern and north-western parts of the Cape Province immediately to the north of the Cape floristic region (unit V) but also has important enclaves within the latter. The unit extends northwards as a narrow band along the coastal plain and the escarpment of the interior plateau through Namibia into SW Angola to about u°S. The area of the unit is 661,000 sq.km.

b. Administrative Divisions

The unit overlaps three countries extending from central Cape Province, Republic of South Africa, northwards as a narrow band along the entire length of Namibia into SW Angola (see map 3.4).

c. Dominant Vegetation

Map 3.4 shows the dominant vegetation of the unit. The unit can be divided into two vegetational zones: the semi-desert vegetation of the Karoo and the desert vegetation of the Namib. Except along the larger watercourses, which support a fringe of scrub forest, bushland or thicket, almost the whole area is covered with shrubland, with shrubs less, and often much less, than 2 m tall. Over extensive areas the landscape is dotted with larger woody plants: arborescent succulents, non-succulent bushes or bushy trees. These taller plants rarely exceed 5 m in height and are mainly confined to 'broken veld', usually rocky places where the water supply is increased by run-off from surrounding slopes.

d. Distinct Habitat Types

The Namib desert runs the whole length of Namibia and continues north into Angola as the desert of Moçamedes; most of the area receives less than 100 mm rainfall each year. In the north there are extensive areas of sand dunes with very sparse vegetation. North of Swakopmund gravel desert occupies most of the outer parts of the Central Namib; over half the surface is covered with a stony pavement covered with colourful foliose and crustose lichens. Apart from ground-water areas, rocks provide the only habitats where perennials can survive. The plains of the Inner Namib are covered after rain by annual grasses with a few succulents. The transition zone between the Inner and Outer Namib Desert is a characteristic habitat for *Welwitschia bainesii,* one of the most remarkable plants in the world. *Welwitschia* is not confined to the Namib-Mocamedes desert nor the Karoo-Namib Region but also extends into the Karoo-Namib/ Zambesia transition zone.

e. Current Land Use

Rainfall in the Namib Desert is less than 100 mm a year and elsewhere it rarely exceeds 250 mm; permanent watercourses do not exist and drainage is ephemeral. These desert and semidesert conditions make the area unsuitable for agriculture and cattle ranching. In the past these desert regions were probably roamed by Bushmen following a hunter/gatherer lifestyle and by Hottentot pastoralists who herded their livestock from place to place, seeking out grazing. The Topnaar Hottentots still live in the Namib/Naukluft national park, grazing their cattle and goats along the vegetation of the Kiuseb river bed.

Mining activities have caused considerable disturbance in some parts of the unit. Diamonds are mined in the Namib desert and copper mines have changed the face of the environment in the Walvis Bay area. In the southern Karoo cattle and sheep are ranched.

f. Biological Richness and Endemism of Unit

Botanically, the unit is rich with a total of about 3500 species of flowering plants of which more than half are endemic. There is one endemic family represented by *Welwitschia bainesii* found in both the Namib and Moçamedes deserts. Other characteristic plant families include Asclepiadaceae and Aizoaceae.

Faunally the Karoo-Namib area is rather impoverished in species with few mammals and birds compared with the richer units of the realm and low levels of species endemism. Nevertheless the unit includes some interesting desert fauna.

g. Species of Special Economic Interest

The wildlife of the unit was an important resource for traditional hunter/gatherers following a nomadic lifestyle. Today this wildlife is valuable as an attraction drawing both domestic and foreign tourists to visit

national parks and protected areas. Wildlife-based tourism is an important revenue earner in South Africa.

Several plants of the unit are of economic importance, many as food plants for tribal peoples and as grazing for livestock. Native species of economic interest include:

Digilaria decumbens	Pongola Grass	pasture
Eragrostis curvula	Weeping Love Grass	pasture
Sorghum caffrorum	Grain Sorghum	cereal
Gossypium triphyllum	Wild Cotton	fibre
Dioscorea sylvatica	Wild Yam	drug

h. Species of Special Biological and Conservation Interest

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Chrysopalax trevelyani	Giant Golden Mole	endangered
Lycaon pictus	Wild Dog	vulnerable
Hyaena brunnea	Brown hyaena	vulnerable
Panthera pardus	Leopard	vulnerable
Acinonyx jubatus	Cheetah	vulnerable
Loxodonta africana	Elephant	vulnerable
Equus zebra	Mountain zebra	endangered
Equus zebrahartmannae	Hartmann's Mountain Zebra	vulnerable
Ceratotherium simum	White Rhino	out of danger
Diceros bicornis	Black Rhino	endangered

The elephant is very rare within the unit but the situation for rhinos is good as a result of active management programmes.

The South African Red Data Books give more detailed information for the distributions and status of large and small mammals (Skinner, Fairall and Bothma 1977, Meester 1976). Thus species such as the serval, not considered threatened over their whole range, are listed as rare for this unit.

The following bird species of the unit are listed as possibly threatened in the Bird Red Data Book of ICBP/IUCN:

Gyps coprotheres	Cape Vulture	rare
Spheniscus demersus	Jackass Penguin	of special concern
Sterna balaenarum	Damara Tern	rare

The South African Red Data Book for Birds (Brooke 1984) gives more detailed information on the distribution and status of the birds of the unit.

The following reptile species which nest on the sandy beaches of the unit are listed as threatened in the Reptile Red Data Book of IUCN:

Chelonia mydas	Green Turtle	endangered
Caretta caretta	Loggerhead Turtle	vulnerable

i. Additional Physical Features in Need of Protection

Coastal sand dunes along the unit's coastline require greater protection. Sand dunes are important because of their buffer effect to coastal wave action, as sources of sand and heavy minerals and as distinct ecosystems, providing habitat for endemic and/or specialised plants and animals. They are particularly vulnerable to development and recreational use. Tinley (1985) has identified sand dune areas that should be protected within the unit.

j. Ethnological or Historical Features in Need of Protection

The unit contains some interesting archaeological sites such as the Late Stone Age site of Apollo 11 in southern Namibia, where rock paintings can be dated back to 40,000 years ago.

k. **The Protected Areas System of the Unit**

Map 3.4. shows the location of the existing and proposed network of protected areas in the unit. Table VI.1 lists these areas, giving their status and the areas of their main habitat types.

Table VI.1 Protected Areas of the Karoo-Namib Regional Centre of Endemism

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
AN	Iona	6	.T.	0–2040	SD	51	10000	15150	4	3030	A
					D	74	5150				
AN	Mocamedes	4	.T.	0–750	SD	51	2000	4450	3	1780	C
					D	74	2450				
NM	Cape Cross	4	.T.	0–200	D	74	60	60	1	24	C
NM	Fish R. Canyon	4	.T.	200–1000	D	74	461	461	1	323	C
NM	Hardap	4	.T.	1000–1500	SD	51	250	250	1	175	C
NM	Namib/Naukluft	2	.T.	0–2000	SD	51	24010	24010	1	21609	A
NM	National West Coast	8	.T.	0–500	D	74	6000	6000	1	2400	C
NM	Skeleton Coast	2	.T.	0–500	D	74	16390	16390	1	14751	B
SA	Anysberg/Klein (pt)	4	.T.	670–2325	D	51	294	294	1	206	C
SA	Augrabies Falls	2	.T.	503–704	SD	51	94	94	1	85	C
SA	Gamka Mtn (part)	4	.T.	300–1000	D	51	28	28	1	20	C
SA	Gainkapoort (part)	4	.T.	430–1280	D	51	56	56	1	39	C
SA	Groot East Swart(pt)	4	.T.	650–2085	D	51	242	242	1	169	B
SA	Hester Malan	4	.T.	884–1354	SD	51	66	66	1	46	A
SA	Karoo	2	.T.	740–1710	SD	51	108	270	1	243	A
					B/G	57a	162				
SA	Kouga/Baviaanskl(pt)	4	.T.	400–1758	D	51	861	861	1	603	B
SA	Langeberg East (pt)	4	.T.	61–1637	D	51	71	71	1	50	B
SA	Langeberg West (pt)	4	.T.	122–1654	D	51	77	77	1	54	B
SA	Outeniqua (part)	4	.T.	400–1521	D	51	634	634	1	444	B
SA	Riviersonderend (pt)	4	.T.	200–1654	D	51	69	69	1	48	B
SA	Rooiberg (part)	4	.T.	600–1490	D	51	127	127	1	89	C

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table VI.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table VI.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
44	4900	40	0	0.0	0	0.0
51	327200	48	30987	9.4	11000	3.3
52	48600	60	0	0.0	0	0.0
53	138800	30	0	0.0	0	0.0
57A	12900	40	162	1.2	0	0.0
74	160200	99	17361	10.8	4150	2.5
Totals	692600	57	48510	7.0	15150	2.1

These figures indicate that protection of all habitat types other than bushy Karoo-Namib shrubland (51) is far from adequate. However, *Acacia* wooded grassland (44) is well-protected in the adjoining phytochorion XIV. Succulent Karoo and dwarf Karoo shrubland are not represented in any protected areas of larger than 5000 ha. This is a serious omission, especially as these two very rich and distinctive biotic communities have already been much reduced in extent. Only 30% of the original area of dwarf Karoo shrubland still remains. Montane Karoo grassy shrubland has also suffered considerable habitat deterioration as a result of livestock grazing.

m. Evaluation of Protected Area Importance

The Namib Desert is an area of great biological importance with its specialised desert flora and fauna. More than 10% of the total desert area is included within the protected area system and the large desert parks of Iona N.P. (Angola) and the Namib/Naukluft N.P. (Namibia) are scored as highest priority for ecosystem conservation.

Other important reserves within the unit are the Karoo N.P. and Hester Malan Reserve (South Africa) which both protect the semidesert vegetation of the Karoo-Namib shrubland.

n. Evaluation of Protected Area Effectiveness

Levels of protection and management of the two desert parks of Angola are poor with no protection at all in Iona N.P. However these two reserves are protected to a certain extent by their vastness, isolation from population centres and the inhospitableness of the environment.

Protection and management of parks and reserves in Namibia and South Africa are good. Though well-managed most of the South African reserves are small, but together they protect a large sample of the Karoo Namib semidesert shrubland. Their conservation value would, however, be enhanced if they could be enlarged. The Namib/Naukluft N.P. of Namibia is both large and well-managed and as such makes the greatest conservation contribution and is the most important park in the region.

o. Assessment of Suitability of Protected Area Status

The status of most areas is suitable to their management objectives, particularly if the Angolan parks can be more effectively managed.

p. Identification of Major Gaps in the Protected Area System

Major omissions from the protected area system of the unit are the lack of any large reserves protecting examples of either succulent Karoo or dwarf Karoo bushland. These are particularly rich and distinctive habitat types. It may not be possible, because of pressure from other forms of landuse, to establish more protected areas within this biome but if there are suitable undisturbed areas immediate measures should be taken to conserve them.

q. Recommendations for Reserve Additions and Extensions

4.6% of the total area of the unit is included within the protected area system. Many of the reserves in South Africa though well-managed are small; their conservation value would be enhanced if they could be enlarged.

1. Immediate priority should be given to identifying suitable areas of undisturbed habitat of adequate size to protect representative samples of succulent Karoo and dwarf Karoo bushland, distinctive ecosystems unique to this phytochorion.
2. Give greater protection to coastal sand dunes and sandy beaches by protecting conservation areas identified by Tinley (1985).

r. Additional Conservation Needs

1. Improve protection and management of protected areas in Angola by increasing numbers of trained staff, budgets, equipment and other resources. Improve administration and infrastructure of Angolan parks and improve training of parks personnel.

2. Control mining concessions to reduce their impact on the parks of the Namib Desert.

3. Considerable international assistance should be mobilised to strengthen the capability of the Angolan authorities to establish and protect an adequate reserve system. Cooperation between the three countries of the unit would benefit the conservation situation though this is unlikely in the present political climate.

3.7 THE AFROMONTANE REGIONAL CENTRE OF ENDEMISM (Unit VIII)

a. Extent of Unit

Although most African mountains are small and widely separated, floristically they share many common characters and even plant species. The African mountains can be likened to an archipelago of 'islands'- the largest archipelago in the world. Their flora is markedly different from that of the surrounding lowlands. Because of this White (1983) regards the African mountains as a Regional Centre of Endemism which is comparable to the great lowland regional centres of endemism such as the Cape and Guineo-Congolian regions .

The Afromontane Region extends over a considerable distance from the Loma Mountains and Tingi Hills in Sierra Leone eastwards to the Ahl Mescat Mountains in Somalia and from the Red Sea Hills in the Sudan Republic southwards to the Cape Peninsula (see maps 3.1 to 3.4). The West African mountains west of Cameroon and the highlands of Angola have been included in the region, even though the Afromontane species occurring there are diluted by the presence of many lowland species.

In the tropics most Afromontane plant communities are found only above 2000 m but where the climate is more oceanic, as in the West Usambara Mountains of Tanzania, they can occur as low as 1200 m. Further south in the temperate Cape Region exclaves of montane forest occur at even lower altitudes (White 1983). The total area of mountains and highlands included within the region is 715,000 km^2.

b. Administrative Divisions

The highlands of the Afromontane region lie in several African countries : Sierra Leone, Guinea, Liberia and Ivory Coast in West Africa; Nigeria, Cameroon, Sudan, Ethiopia, Yemen, Kenya, Uganda, Tanzania, Rwanda, Burundi, Zaire, Malawi, Zimbabwe, Mozambique, Swaziland, Republic of South Africa, Lesotho and the highlands of Angola.

c. Dominant Vegetation

On any particular mountain there is usually a very wide range of vegetation types but the collective flora of the 'archipelago' shows a remarkable continuity and uniformity (White 1983). In accordance with White's vegetation map all areas with vegetation types 19a or 19b (Afromontane forests, *Hagenia* woodlands, bamboo and evergreen bushland) and altimontane vegetation types 65 and 66 (Afromontane thickets, grasslands and alpine communities) have been classified as part of the Afromontane arcipelago.

On most mountains the lowermost vegetation is forest, below which the original vegetation is a transition zone connecting the Afromontane and lowland phytochoria; almost everywhere, however, this transition zone has been destroyed by fire and cultivation. On most African mountains vegetation decreases in stature from the lower slopes to the summit and three broad belts – forest, Ericaceous and Afroalpine can be recognised for the high mountains of East Africa. In the Cape Region, Afromontane vegetation, represented only by forest, is no longer associated with the higher parts of the mountains but is found only on the lower slopes.

d. Distinct Habitat Types

Afromontane rainforest is found on the wetter slopes of most of the higher mountains from southern Ethiopia to Malawi; it occurs mostly between 1200 and 2500 m. This evergreen forest is similar to certain types of Guineo-Congolian lowland rainforest except for the occurrence of tree ferns and conifers.

At higher altitudes rainforest is usually replaced by Afromontane forest of mixed composition and lower height. After fire this forest is sometimes replaced by almost pure stands of *Juniperus procera* (East Africa from Red Sea Hills in Sudan, Eritrea and Arabia to Nyika Plateau in Malawi), *Widdringtonia cupressoides* (eastern Africa from Table Mountain northwards to Mt Mulanje) or *Hagenia abyssinica,* found on most of the higher mountains between Ethiopia and the Nyika Plateau of Malawi. *Hagenia* forms almost pure stands 9–15 m tall in a narrow zone between taller types of montane forest and the shrublands of the Ericaceous belt.

Stands of bamboo occur on most of the high mountains of East Africa from Ethiopia to the Southern Highlands of Tanzania and also on some of the other African mountains. Bamboo appears to grow most vigorously and to form continuous stands on deep volcanic soils on gentle slopes where the rainfall exceeds 1250 mm a year (White 1983). The largest areas are on the Aberdare Range (65,000 ha), Mau Range (51,000 ha) and Mt Kenya (39,000 ha).

Evergreen bushland and thicket occur on most of the higher African mountains and characteristically occupy a large part of the Ericaceous belt. Ericaceous bushland (including species of Ericaceae) is

normally between 3 and 13 m tall but burns readily and has been replaced extensively by secondary grasslands. Tall elfin thicket (3-7 m high) occurs on some of the eastern mountains too low to support an Ericaceous belt but with summits permanently enshrouded by mist.

Today grassland is the most widespread vegetation type on the African mountains, especially the drier ones. Although some of this vegetation is a result of natural fires, most Afromontane grasslands have originated or been greatly extended by human activity. Secondary montane grassland is sometimes invaded by small fire-resistant trees such as *Protea.*

The Afroalpine vegetation of the highest peaks of tropical Africa (e.g. Rwenzori, Virunga Volcanoes, Elgon, Aberdare, Mt Kenya, Kilimanjaro and Mt Meru) is very different from that occurring at lower altitudes. It is characterised by Giant Senecios, Giant Lobelias, shrubby Alchemillas and other plants of remarkable life-form (White 1983).

e. **Current Land Use**

Extensive areas of the lower slopes of many of the African mountains have been cleared by felling and burning to make way for agricultural lands. Burning has caused much of the natural vegetation to be replaced by secondary grasslands. Elsewhere vegetation has been cleared to make way for plantations of tea, coffee and pyrethrum.

f. **Biological Richness and Endemism of Unit**

Botanically the Afromontane region is very rich with at least 4000 plant species of which about 3000 are endemic (White 1983). About one fifth of the tree genera are endemic. (In the Afroalpine belt, on peaks reaching more than 3800 m, the total flora is small, about 280 species, with no endemic genera and few species that do not also occur in the Ericaceous and forest belts.)

Florally the Afromontane Region can be divided into seven regional subunits: West African, Ethiopian, Kivu-Rwenzori, Imatongs-Usumbara, Uluguru-Mulanje, Chimanamani Hills, and Drakensberg Mountains and the tree flora is much richer in the east (White 1983b). Similarly Carcasson (1964) found that the butterfly faunas of the eastern highland blocks were richer in species; he identifies the Kivu-Rwenzori highlands as particularly rich for butterflies. These highlands include some of the most extensive blocks of highland forest, have been part of a large interpluvial forest refuge and are surrounded by lowland forest; this combination of factors has helped to evolve what is probably the richest montane fauna in Africa with many endemic species of butterflies.

The Afromontane Region is fairly rich in species for mammals but most of these are also lowland forms so endemism is low. The mountains are not as rich in bird species as the rich lowland rainforests, vast savanna units or the transitional zones but endemism is high among mountain birds, about 25% for passerines. Endemism is particularly high among those animal groups that are poor dispersers e.g. amphibians and invertebrates. The relict highland forests of Tanzania are particularly rich, showing high levels of endemism among some invertebrate, amphibian and reptilian groups (Rodgers and Homewood 1982, Stoltze 1981.)For instance the East Usambara Mountains constitute what is probably one of the richest biological communities in Africa in terms of species number and endemism with the percentage of endemic taxa varying from 2% in mammals to 95% for millipedes (Rodgers and Homewood 1982).

g. **Species of Special Economic Interest**

Montane forests provide many valuable timber trees. Odera (1984) lists 34 commercially important trees for Kenya, mostly from the montane areas.

The Ethiopian highlands were an early centre for food production and several of the crops still grown in the region were probably domesticated from indigenous plants including:

Eleusine coracana	Finger millet	cereal
Eragrostis tef	Tef	cereal
Musa ensete	Ensete banana	root crop, fruit
Coffea arabica	Coffee	beverage
Guizotia abyssinica	noog	oil seed

h. **Species of Special Biological and Conservation Interest**

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Gorilla gorillaberingei	Mountain Gorilla	endangered
Canis simensis	Simien Fox	endangered
Panthera pardus	Leopard	vulnerable
Loxodonta africana	African Elephant	vulnerable
Diceros bicornis	Black Rhinoceros	endangered
Tragelaphus buxtoni	Mountain Nyala	vulnerable
Cephalophus spadix	Abbot's Duiker	insuff.known

The endangered Simien fox and mountain nyala occur only on the mountain plateaux of Ethiopia, where they are protected in the Bale Mountains N.P. The mountain gorilla, confined to the high mountains north and east of Lake Kivu (the volcanoes of E. Zaire and W. Rwanda) and S.W Uganda, is now believed to be reduced to a population of less than 500 animals.

The following bird species are listed as threatened in the Bird Red Data Book of ICBP/IUCN :

Geronticus calvus	Southern Bald Ibis	rare
Gyps coprotheres	Cape Vulture	rare
Francolinus caerunensis	Mount Cameroon Francolin	rare
Francolinus swierstrai	Swierstra's Francolin	indeterminate
Sarothrura ayresi	White-winged Flufftail	indeterminate
Tauraco bannermani	Bannerman's Turaco	endangered
Tauraco ruspolii	Prince Ruspoli's Turaco	rare
Bubo vosseleri	Usambara Eagle Owl	rare
Phodilus prigoginei	Itombwe Owl	indeterminate
Glaucidium albertinum	Albertine Owlet	rare
Schoutedenapus schoutedeni	Schouteden's Swift	indeterminate
Pseudocolyptomena graueri	African Green Broadbill	rare
Heteromirafra ruddi	South African Long-clawed Lark	indeterminate
Spizocorys fringillaris	Botha's Lark	indeterminate
Chlorocichla prigoginei	Prigogine's Greenbul	vulnerable
Prionops gabela	Gabela Helmet-Shrike	indeterminate
Malaconotus alius	Uluguru Bush-shrike	rare
Malaconotus kupeensis	Mount Kupe Bush-shrike	indeterminate
Malaconotus monteiri	Monteiro's Bush-shrike	indeterminate
Swynnertonia swynnertoni	Swynnerton's Forest Robin	rare
Sheppardia gabela	Gabela Akalat	indeterminate
Modulatrix orostruthus	Dappled Mountain Robin	rare
Dryocichloides montanus	Usambara Ground Robin	rare
Dryocichloides lowei	Iringa Ground Robin	rare
Alethe choloensis	Thyolo Alethe	endangered
Turdus helleri	Taita Thrush	endangered
Turdus oberlaenderi	Forest Ground Thrush	rare
Lioptilus gilberti	White-throated Mountain Babbler	rare
Bradypterus graueri	Grauer's Swamp Warbler	vulnerable
Apalis argentea	Kungwe Apalis	rare
Apalis kaboboensis	Kabobo Apalis	rare
Apalis moreau	Long-billed Apalis	rare
Bathmocercus winifredae	Mrs Moreau's Warbler	rare
Macrosphenus pulitzeri	Pulitzer's Longbill	indeterminate
Muscicapa lendu	Chapin's Flycatcher	rare
Platysleira laticincta	Banded Wattle-eye	endangered
Anlhreples rubritorques	Banded Green Sunbird	rare
Nectarinia rufipennis	Rufous-winged Sunbird	rare
Mectarinia prigoginei	Marungu Sunbird	endangered

Nectarinia rockefelleri	Rockefeller's Sunbird	rare
Serinus ankoberensis	Ankober Serin	rare
Ploceus bannerman	Bannerman's Weaver	vulnerable
Ploceus nicolli	Tanzanian Mountain Weaver	rare

Five of the bird species of the unit are considered endangered: Bannerman's Turaco, Thyolo Alethe, Taita Thrush, Banded Wattle-eye and the Marungu Sunbird. Bannerman's Turaco and the Banded Wattle-eye are restricted to the Bamenda-Banso Highlands in western Cameroon and will probably become extinct unless forest on Mt Oku is preserved (Collar and Stuart 1985). The Thyolo Alethe is confined to the remaining very small patches of highland forest in southern Malawi and adjacent Mozambique and is threatened by forest clearance, as is the Taita Thrush confined to the last forest patches on the Taita Hills, Kenya. The Marungu Sunbird is known only from riparian patches of forest in the Marungu Highlands of south-eastern Zaire. Seven species listed as indeterminate are seriously threatened and may be endangered: White-winged flufftail (Ethiopian highlands, South Africa, Zambia and Zimbabwe), Itombwe Owl and Schouteden's Swift (Itombwe Mountains of E. Zaire), South African Long-clawed Lark and Botha's Lark (high altitude grasslands in South Africa), Mount Kupe Bush-shrike (Mount Kupe, Cameroon) and Monteiro's Bush-shrike (the escarpment of western Angola and Mt Cameroon).

The IUCN Red Data Book for Threatened Swallowtails lists the following threatened butterflies for the unit:

Papilio leucotaenia	Cream-banded Swallowtail	vulnerable
Papilio sjoestedti	Kilimanjaro Swallowtail	rare
Papilio desmonditeita	Taita Blue-banded Swallowtail	endangered

i. Additional Physical Features in Need of Protection

The Rwenzori Mountains, the fabled Mountains of the Moon, are totally unprotected in Uganda except for areas of montane forest which are included within forest reserves where timber production is the primary management objective. Four-fifths of this spectacular mountain range lie within Uganda; the Zaire part of the range is already protected within the Virunga National Park, a World Heritage Site. The Rwenzoris are an area of outstanding beauty including peaks over 5000 m high, and spectacular glaciers and icefields. Apart from being of great scenic beauty, the mountains are the main watershed supplying the headwaters of the Nile.

j. Ethnological or Historical Features in Need of Protection

The Ethiopian Highlands are of particular ethnological and historical significance with many sites of archaeological interest. At Gobedra there are rock shelters used by Stone Age Man. Ruins of temples and other buildings on the Eritrean escarpment at Coloe and Matara show early Arab influence and reflect the long trading association between Ethiopia and southern Arabia, an association that began several hundred years B.C. The area is also rich in ruins of churches and monasteries that date back to the 5th and 6th centuries A.D. and reflect the history of early Christianity in Ethiopia.

k. The Protected Areas System of the Unit

Maps 3.1 to 3.4 show the location of the existing and proposed network of protected areas in the unit. Table VIII.1 lists these areas, giving their status and the areas of their main habitat types.

Table VIII.1 Protected Areas of the Afromontane Regional Centre of Endemism

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
AN	Bandeira	4	.F.	1500–2200	M	19a	700	700	4	70	B
AN	Humbe/Bailundu	4	.F.	1500–2620	M	19a	800	800	4	80	A
BR	Kibira	2	.T.	1500–3000	M	19a	379	379	3	190	C
CM	Bambuko (part)	8	.T.	1000–4100	M	19a	100	100	3	20	B

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
CM	Lake Oku	4	.F.	1000-3008	M	19a	100	100	4	20	B
ET	Awash West	4	.T.	850-2005	M	19a	1200	2500	3	1000	B
					G	38	1000				
					M	65	300				
ET	Bale Mountains	2	.T.	1700-4500	M	19a	500	2200	2	1540	A
					M	65	1700				
ET	Bale/WR	4	.T.	2500-3500	M	19a	1500	2000	3	400	A
					M	65	500				
ET	Harrar (part)	4	.T.	1200-1500	G	38	1500	1500	3	600	B
ET	Nakfa	4	.T.	1500-3000	G	38	3000	3000	4	600	B
ET	Omo (part)	2	.T.	500-2000	G	17	1000	1000	3	500	A
ET	Simen Mountain	2	.T.	3500-4500	M	19a	125	225	3	112	A
					M	65	100				
ET	Yavello (part)	4	.T.	1500-3500	G	38	1000	1000	4	200	B
GU	Mount Nimba (part)	1	.T.	450-1752	M	19a	70	70	2	56	A
IC	Mount Nimba	1	.T.	450-1752	M	19a	50	50	3	25	A
KY	Aberdare	2	.T.	1829-3964	M	19a	612	766	2	536	B
					M	65	150				
KY	Marsabit (part)	2	.T.	420-1700	M	19a	608	608	2	426	B
KY	Mount Elgon	2	.T.	2336-4321	M	19a	169	169	2	118	B
KY	Mount Kenya	2	.T.	1600-5199	M	19a	50	588	2	412	A
					M	65	538				
KY	Taita Hills	6	.T.	500-914	M	19a	113	113	2	56	B
KY	Tsavo (part)	2	.T.	229-2438	M	19a	420	420	2	294	A
LB	Mount Nimba (part)	1	.F.	450-1752	M	19a	70	70	4	21	A
LE	Sehlabathebe	4	.T.	2200-2600	M	66	68	68	2	34	C
MW	Chimaliro	8	.T.	1200-1800	M	19a	121	121	2	51	C
MW	Cnongoni (part)	8	.T.	1300-2100	M	19a	80	80	2	24	C
MW	Kaningina (part)	8	.T.	800-1400	M	19a	90	90	2	27	C
MW	Matipa Complex	8	.T.	1200-1900	M	19a	26	26	2	8	C
MW	Mount Mulanje	8	.T.	1000-3002	M	19a	330	552	2	166	A
					M	65	222				
MW	Nkohota-kota (part)	4	.T.	500-1500	M	19a	352	352	2	176	B
MW	Nyika (part)	2	.T.	1600-2606	M	19a	2000	2000	1	1800	A
MW	South Viphya (part)	8	.T.	1000-1954	M	19a	1100	1100	2	330	B
MW	Thyolo/Chiradzulu	4	.F.	1000-1773	M	19a	1000	1000	4	200	A
NI	Gashaka/Gumti	8	.T.	200-1000	M	19a	2000	6670	3	1334	B
RW	Volcanoes	2	.T.	2400-4507	M	65	130	130	2	91	B
SA	Blyde River (part)	4	.T.	676-1831	M	19a	45	45	1	32	C
SA	Drakensberg SF	4	.T.	1350-3377	M	19a	1710	1900	1	1330	A
					M	66	190				
SA	Giants Castle	4	.T.	1380-3451	M	19a	208	346	1	242	C
					M	66	138				
SA	Golden Gate	2	.T.	1892-2770	M	19a	62	62	1	56	C
SA	Knysna	4	.T.	0-1000	M	19a	442	442	1	309	C
SA	Lekgalameetse (part)	4	.T.	800-1853	M	19a	13	13	1	9	C
SA	Ntedenka Wilderness	4	.T.	500-1200	M	19a	52	52	1	36	C
SA	Pirie Forest	4	.T.	540-1300	M	19a	52	52	1	36	C
SA	Royal Natal	2	.T.	1300-3282	M	19a	70	70	1	63	C
SA	Rugged Glen	4	.T.	1300-3282	M	66	19	19	1	13	C
SA	Serala	4	.T.	795-2050	M	19a	110	110	1	77	B
SA	Storms River (part)	4	.T.	275-1232	M	19a	90	90	1	63	C

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
SA	Tsitsikaimna	4	.T.	0–1000	M	19a	156	156	1	109	A
SA	Tsitsikamma Mts (pt)	4	.T.	1300–1675	M	19a	80	80	1	56	B
SA	Weza	4	.T.	960–2268	M	19a	90	90	1	63	C
SA	Woodbush/DeHoek	4	.T.	1200–1834	M	19a	66	66	1	46	C
SD	Imatong	4	.F.	1500–3187	M	19a	1000	1000	4	100	A
SD	Jebel Marra	4	.F.	1500–3082	M	19b	1500	1500	4	150	B
SD	Kidepo (part)	6	.T.	1000–2000	M	19a	350	350	3	105	B
SL	Loma Mts	4	.F.	200–1000	M	19a	200	200	3	80	A
SM	Daalo Forest (part)	2	.F.	0–1000	M	19a	80	880	4	264	A
					G	38	800				
SM	Gaan Libaax	2	.F.	200–1000	M	19a	200	500	4	150	C
					G	38	300				
SW	Malalotja	4	.T.	615–1828	M	19a	180	180	1	126	B
TZ	Arusha	2	.T.	1525–4565	M	19a	137	137	2	96	C
TZ	Gombe (part)	2	.T.	750–1500	M	19a	20	20	2	14	B
TZ	Kilimanjaro	2	.T.	1830–5895	M	19a	350	758	2	531	A
					M	65	400				
TZ	Kipengere Mts	4	.F.	1500–2958	M	19a	5000	5000	4	1250	B
TZ	Mahale Mountain (pt)	6	.T.	780–2462	M	19a	1000	1000	3	300	B
TZ	Mkomazi (part)	6	.T.	630–1630	M	19a	300	300	2	150	B
TZ	Ngorongoro (part)	8	.T.	1500–3000	M	19a	2000	2000	2	600	B
TZ	Uluguru Mtns	8	.T.	1400–2138	M	19a	1000	1000	3	200	A
TZ	Usambaras	8	.T.	1000–2286	M	19a	6213	6213	3	1243	A
TZ	Uzungwa Forest	2	.F.	300–2800	M	19a	1000	1000	3	500	A
UG	Bwindi Forest	6	.T.	1400–2400	M	19a	310	310	3	62	B
UG	Kidepo Valley (part)	2	.T.	900–2750	M	19a	144	144	2	101	B
UG	Kigezi	4	.T.	1050	M	19a	330	330	4	66	C
UG	Mgahinga	8	.T.	2500–4127	M	65	25	25	3	5	B
UG	Pian–Upe (part)	6	.T.	1000–3068	M	19a	100	100	4	20	C
UG	Rwenzori	8	.T.	2000–5109	M	19a	200	450	3	90	A
					M	65	250				
ZR	Kahuzi Biega (part)	2	.T.	800–3400	M	19a	1000	1000	2	700	A
ZR	Marungu Mts	4	.F.	1000–2500	M	19a	2000	2000	4	400	A
ZR	Uvira Mts	4	.F.	1500–3300	M	19a	1500	1500	4	250	B
ZR	Virunga (part)	2	.T.	798–5119	M	19a	4000	4000	2	2800	A
ZW	Chimanimani	2	.T.	2000–2400	M	19a	171	171	2	120	A
ZW	Inyanga/Mtarazi	2	.T.	880–2592	M	19a	314	314	1	283	B

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table VIII.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Overall 4.5% of this unit is included within protected areas. Since mountains, especially the isolated mountain blocks of Africa, are individually areas of great biological interest and centres of speciation and endemism we should aim to protect at least 10% of all montane habitats. The figures in table VIII.2 indicate that coverage of all vegetation types, except tropical altimontane vegetation, is inadequate. Immediate priority should be given to protecting greater areas of montane forest throughout Africa, but especially in the species-rich eastern highlands, and also to increasing the protected area of altimontane vegetation in South Africa.

In spite of the fact that clearing montane vegetation and particularly montane forests may lead to serious erosion and environmental degradation already more than 37% of the unit's original vegetation has gone. This is particularly serious as most clearance is of forests on lower mountain slopes which have

been felled for timber and to make way for agriculture and plantations. It is these forests which not only protect the watershed but harbour the majority of the plant and animal species found in mountain regions.

Table VIII.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
17	12700	20	1000	7.8	0	0.0
19A	499500	38	17927	3.5	15473	3.0
19B	1700	80	0	0.0	1500	88.2
29B	3800	10	0	0.0	0	0.0
38	91100	21	6500	7.1	1100	1.2
65	28900	75	3818	13.2	0	0.0
66	9300	82	415	4.4	0	0.0
Totals	647000	37	29660	4.5	18073	2.7

m. Evaluation of protected area importance

Although the mountain blocks of Africa share many vegetation characteristics and even some plant species in common, they can be likened to an archipelago of 'islands' of montane vegetation separated by a 'sea' of quite different lowland forests. This isolation has led to evolution of plant and animal species uniquely adapted only to individual mountain blocks. In general the higher and/or more isolated the mountains the more distinct its fauna. The African mountains show high levels of endemism in many animal groups—especially birds, amphibians and butterflies—in the same way that oceanic islands have evolved their own unique fauna. Accordingly many of the African mountains are of high biological interest and conservation importance because of their high levels of species endemism and unique floral and faunal composition. The relict forests of the eastern mountains of the Kivu-Rwenzori region and Tanzania are particularly rich in plant and animal species and show high levels of endemism in several animal groups.

Protected areas of particular importance totally or partly contained within the unit include the Bale and Simen Mountains, the Bale Wildlife Reserve and Omo N.P. (Ethiopia), Mount Nimba (a transnational reserve spanning Guinea, Ivory Coast and Liberia), Mount Kenya N.P. and the Aberdare N.P. (Kenya), Mount Mulanje Forest Reserve, and Nyika N.P. (Malawi), Drakensberg State Forest (South Africa), Kilimanjaro N.P., the Uluguru and Usambara Mountains (Tanzania), Rwenzori Forest (Uganda), Kahuzi-Biega N.P. and Virunga N.P. (Zaire) and the Chimanimani N.P. (Zimbabwe).

Other mountain areas of top conservation priority within the unit include the proposed reserves of Humbe/Bailundu (Angola), Mount Nimba (Liberia), the Thyolo/Chiradzulu Forest (Malawi), the Imatong Mountains and Jebel Marra (Sudan), Loma Mountains (Sierra Leone), Daalo Forest (Somalia), proposed Uzungwa Forest N.P. (Tanzania), the Taita Hills (Kenya) and the Marungu Mountains (Zaire).

n. Evaluation of Protected Area Effectiveness

Protection and management of the mountain national parks and reserves vary from country to country. The effective management of each reserve is shown in table VIII.1. In general protection of montane habitats, especially montane forests, needs to be improved. These areas are valuable not just as refuges for wildlife or to protect valuable timber but the forests often protect watersheds and thereby regulate the water regime and fertility of surrounding lowlands.

Special attention should be focused on the mountain forest reserves. In many of the eastern and southern African countries much of the forest estate is included within forest reserves. These are subject to both legal and illegal logging and other disturbances and are not adequately protected for their importance in protecting unique biotic communities or species that are inadequately protected elsewhere. Many endemics, particularly forest birds and forest tree species, occur at very low densities and are therefore extremely vulnerable and seriously endangered by any habitat destruction. The low conservation status of most forest reserves and the lack of detailed knowledge on the distribution, status and biology of endemic species means that present conservation efforts are haphazard and often inadequate.

Wherever possible some of these forest reserves should be upgraded to full reserve status with no removal of timber allowed and other exploitation permitted only on a limited and controlled basis. Emphasis of the biological importance of forest reserves will encourage Forestry Departments to afford these areas greater protection than at present.

o. Assessment of Protected Area Status

The status of most designated reserves and national parks is appropriate to their management objectives if they could be effectively protected and managed. However, greater protection should be afforded to montane forests which are under-represented and inadequately protected within the unit. Many forest areas are designated as forest reserves, i.e. reserves for exploitation of forest; these areas are subject to increasing encroachment and disturbance as human populations increase and expand and natural resources decrease. More strict reserves should be established within the existing mountain forest estate and better protection should be given to all forest reserves in acknowledgement of their importance in protecting watersheds and wildlife.

p. Identification of Major Gaps in the Protected Area System

Major gaps in the existing reserve system are the absence of any protected areas in several of the Afromontane subunits e.g. Angola, South Malawi and Jebel Marra with its distinctive Sahelomontane vegetation; however extensive areas have been proposed to protect this latter habitat type. Afromontane forests are under-represented in the reserve network throughout Africa, and particularly in central and western Africa.

q. Recommendations for Reserve Additions and Extensions

1. Establish a national park or strict reserve to protect the Rwenzori mountains of Uganda, an area of spectacular scenery and unique flora and fauna. Part of the mountain forest is presently protected as forest reserve but this status does not afford adequate protection. The Zaire part of the mountain range already has national park and World Heritage Site status.

2. Establish and develop the proposed Mount Nimba Reserve, Liberia, as a strict nature reserve. Mt Nimba was a Pleistocene refugium for plants and is an area of high species diversity and local endemism. Biologically it is one of the most important mountains in West Africa. The Mount Nimba reserve spans three countries and is an important transnational reserve; Ivory Coast and Guinea have already given their parts of the reserve full protection status. The mountain has been designated one of CNPPA's Greatest Natural Areas but is under threat from iron ore mining .

3. Establish the proposed Loma Mountain Reserve in Sierra Leone to protect the mountain forests. This 2000 m mountain is flanked by floristically rich lowland forest and capped with submontane grassland with a rich and interesting herbaceous flora, showing floristic affinities with neighbouring peaks in the Fouta Djallon and Mt Nimba. It is an important site for plant endemism.

4. Establish and develop the proposed reserve on the Ziama Massif, part of the High Plateau of Fouta Djallon, Guinea, a highland area of exceptional botanical interest with very high levels of plant species diversity. At present this proposed reserve has no defined boundaries.

5. At 4100 m Mount Cameroon is the highest mountain in West Africa. It was an important Pleistocene refugium and has an estimated 45 endemic plant species as well as several endemic birds. It is not feasible to protect the entire Mt. Cameroon area but it would be useful to upgrade the status of the Bambauk Forest Reserve and to establish a protected area to the south to include the peak of Little Mt Cameroon, Etinde. The mountain is a major water catchment area.

6. Establish the proposed Mt Oku and Mt Kupe reserves in Cameroon, identified as sites of special importance for threatened and endemic birds by ICBP.

7. Establish the proposed reserves in the Marungu Mountains and Uvira mountains, Zaire. These highlands are part of the Haute Katanga, one of Africa's prime centres of endemism with over 300 endemic plants (Droop, 1985).

8. Establish a reserve or national park to give more adequate protection to Mount Mulanje, Malawi, at present protected only as a forest reserve. This isolated highland plateau shows floral affinities with other areas of the Afromontane archipelago but has several endemic plants and animals. Many of its plant species, such as the famous Mulanje cedar, are South African in their affinities and here at the northernmost limit of their distributions.

9. Establish a managed nature reserve to protect the Thyolo/Chiradzulu montane forests in Malawi, part

of Malawi's diminishing forest estate and an important biotic community. Part of this 100,000 ha forest is already gazetted as forest reserve but this status does not afford adequate protection. ICBP have identified Thyolo and Chiradzulu forests as two of the African forests most important for conserving threatened forest birds (Collar and Stuart, in prep.)

10. Apart from the recent volcanic mountains of Kilimanjaro and Meru, the mountains of Tanzania are very old and their forests have been isolated for a long time. As a result they show high levels of species diversity and endemism. They are also important water catchments. Two main forest blocks, the Usambara Mountains and the Uzungwa Forest, have been identified by the Threatened Plants Unit of IUCN as sites of special importance.

a: Establish a reserve or national park to conserve the Usambara Mountains, an area of exceptional forest diversity with at least 50 endemic plant species and high levels of endemism in several animal groups including birds, frogs and some invertebrates. This area currently has the status of forest reserve but this does not afford adequate protection to the forest and its wildlife and as human population levels have risen the forest has been destroyed so that only patches now remain.

b: Establish a reserve or national park to conserve the relict forests of the Uluguru mountains, blocks of isolated montane forest which support a unique biotic community showing high species endemism. Like the Usambaras this area is designated as a forest reserve but needs stronger protection to conserve its unique flora and fauna.

c: Establish the proposed national park of 100,000 ha to conserve the Uzungwa Forest, an important area of montane forest with high levels of species diversity and endemism. This mountain, with its continuum of forest from lowland to Afromontane forest up to 2500 m, is far less disturbed than the Usambaras.

11. Establish a reserve (or extend the boundaries of Tsavo N.P.) to protect the Taita Hills, a specatcular mountain massif lying to the south of Tsavo West National Park and not included within the park boundaries. The remaining montane forests of the Taita Hills are critical habitats for several endemic species including the endangered Taita Thrush and the Taita Blue-banded Swallowtail butterfly. In spite of its name the existing Taita Hills Game Sanctuary does *not* include the Taita Hills.

12. Designate the Imatong Mountains, Sudan, as a managed nature reserve (category 4) of 20000 ha. This is one of the few remaining areas of wet montane forest in Sudan and presently designated for development. ICBP have identified it as important for birds. As the highest mountains in Sudan the Imatongs form a link between the western mountains of the Great Rift Valley and the highlands of Ethiopia. The Imatongs harbour almost half of Sudan's plant species and are important for several endemic birds. The Imatongs already have extensive tea plantations and the remaining forests are further threatened by a proposed forestry scheme to exploit the indigenous timber and replant with exotic softwoods and hardwoods.

13. Establish a reserve to protect the Jebel Marra massif, an important montane ecosystem surrounded by semi-arid lands. Jebel Marra has already suffered some environmental degradation but harbours several important animals and plants.

14. Gazette the already established Bale Mountain N.P., Ethiopia, created to conserve the largest area of Afro-alpine habitat in Africa and to protect the water catchments of three of Ethiopia's main rivers. The park protects more than half of Ethiopia's endemic mammals (11 species) and birds (14 species) and includes such rare mammals as the endemic mountain nyala, Simien fox and giant mole rat. Conservation efforts are already underway to develop the park.

15. Establish the proposed Daalo Forest and Gaan Libaax reserves in Somalia.

16. Establish a managed nature reserve to protect the Humbe/Bailundu mountains (Mt Moco) in Angola, an area of plant and bird endemism and species richness.

17. Establish a managed nature reserve to protect Mt Bandeira, Angola. This is part of the Huilla Plateau, Angola, the district in Angola with the highest level of plant species endemism. Angola is particularly important for plant endemism, showing the second highest levels, after Zaire, for the whole of Africa.

18. Reconsider plans to extend protection of the Chimanimani range by establishing a protected area in Mozambique, adjoining Chimanimani N.P.

r. Additional Conservation Needs

1. Stop agricultural encroachment and forest clearance on upper mountain slopes. Such habitat loss leads to soil erosion and environmental degradation. Simultaneously develop and extend conservation education programmes to increase public awareness of the necessity for conserving mountain forests because of their vital role in protecting watersheds.

2. Control visitor use of mountain habitats to protect these particularly vulnerable habitats from environmental degradation. High-altitude environments take a particularly long time to recover.
3. Encourage Forestry Departments to take a more active role in conserving and protecting montane forests and controlling their exploitation to minimise damage to these unique ecosystems and their wildlife.
4. Encourage surveys and research to identify areas of special biological interest and uniqueness. The low conservation status of mountain forest reserves and the lack of knowledge about the distribution, status and biology of endemic species hamper conservation efforts. Mountain forests are particularly vulnerable to disturbance and as these habitats are cleared many plant and animal populations are reduced to levels at which they are no longer viable.

3.8 THE GUINEA-CONGOLIA/ZAMBEZIA REGIONAL TRANSITION ZONE (Unit X)

a. Extent of Unit

The transition zone which separates the Guineo-Congolian and Zambezian Regions extends from the Atlantic Ocean to the high ground flanking the northern end of Lake Tanganyika. Most of the transition zone forms part of the dissected plateau which extends south from the Zaire basin to the Zambezi-Zaire watershed. It covers a total area of 705,000 sq.km with a maximum width of nearly 500 km.

b. Administrative Divisions

The unit extends from the Cabinda enclave of Angola eastwards through the Zaire Basin of Zaire to Lake Tanganyika and southwards into Angola (see map 3.2).

c. Dominant Vegetation

Map 3.2 shows the dominant vegetation of the unit. The floras of the Guineo-Congolian and Zambezian Regions are quite distinct but in the transition zone of unit X impoverished examples of both floras interdigitate or occur in mosaic and locally intermingle (White, 1983). Most of the transition zone is occupied today by secondary grassland and wooded grassland dominated almost exclusively by Zambezian species, which have become more abundant following destruction of the original vegetation. In general the Zambezian element of the flora becomes more abundant towards the south.

d. Distinct Habitat Types

On the arid coastal plain at the western end of the unit the vegetation is predominantly Zambezian but this rapidly gives way to humid, *Dembos* 'cloud' forests on the escarpment of the interior plateau. These *Dembos* forests in Angola are the most extensive of the surviving forests of the unit. Floristically poor miombo woodland occurs in the southern part of the region.

The prevalent vegetation of the coastal belt is grassland and wooded grassland, most of it probably secondary. Baobabs which are absent further inland are common here. At the mouth of the Zaire river there are 250 sq.km of swamp forest on the landward side of the mangrove (White 1983).

e. Current Land Use

Although the unit has only moderate population density, it has a long history of agricultural activity, particularly along the coastal belt and in the eastern part of the region. Much of the unit is occupied by secondary grassland and wooded grassland, which has replaced original woodlands destroyed to clear agricultural lands or cut for timber and fuel. Principal crops include cassava, yams, maize and bananas grown as staples. There are also extensive lands planted with cash crops such as oil palm, groundnuts and cotton.

f. Biological Richness and Endemism of Unit

Botanically, the unit is relatively impoverished. Excluding marginal intruders there are probably no more than 2000 plant species, very few of which are endemic. (White, 1983). Faunally the unit is of low conservation value. It supports rather few mammals (only 29 species of ungulates and diurnal primates) and no endemics. As a transition zone with a variety of different habitats it supports a rich avifauna of about 500 bird species but none are endemic to the unit.

g. Species of Special Economic Interest

The rainforests of the unit include some valuable timber trees. Other plant species are important in local economies as food, fibre, medicines, dyes and building materials. Mangrove swamps protect spawning and nursery grounds for fish and prawns. Species of special economic value include:

Adansonia digitata	Baobab	medicinal bark
Landolphia spp.	African rubber	latex
Acacia Senegal	Gum arabic	resin

Bushmeat is an important item in local diets in both Zaire and Angola. Fishing, especially along inland waterways, provides a major source of protein to local communities. The wildlife of the unit has some potential, though as yet unexploited value, as an attraction for wildlife-based tourism serving both domestic and overseas visitors. Crocodiles have potential for captive breeding and farming to produce meat and skins for domestic and overseas markets.

h. **Species of Special Biological and Conservation Interest**

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Colobus badius foai	Foa red colobus	insuff.known
Pan troglodytes	Chimpanzee	vulnerable
Lycaon pictus	Wild dog	vulnerable
Panthera pardus	Leopard	vulnerable
Acinonyx jubatus	Cheetah	vulnerable
Loxodonla africana	Elephant	vulnerable

The following bird species of the unit are listed as threatened in the Bird Red Data Book of ICBP/IUCN:

Cossypha heinrichi	White-headed Robin-Chat	indeterminate
Ploceus nigrimentum	Black-chinned Weaver	indeterminate

The following reptiles occurring in the unit are listed as threatened in the Reptile Red Data Book of IUCN:

Chelonia mydas	Green Turtle	endangered
Lepidochelys olivacea	Olive Ridley	endangered
Dermochelys coriacea	Leatherback Turtle	endangered
Crocodylus niloticus	Nile Crocodile	vulnerable
Crocodylus cataphractus	African Slender-snouted Crocodile	indeterminate

i. **Additional Physical Features in Need of Protection**

Riverine habitats and wetlands throughout the unit are important to both wildlife and human communities, yet are seriously under-protected. Sandy coastal beaches where sea turtles nest also require protection.

j. **Ethnological or Historical Features in Need of Protection**

The unit has a few sites of ethnological and historical interest. Archaeological excavations at Mufo have revealed remains of Early Stone Age Man. There are several Iron-Age sites in the unit and excavations around Lake Kisale have revealed twelfth century graves of people adorned with copper, iron and ivory jewellery. Artefacts also remain of the fourteenth and fifteenth century Lunda, Mbundu and Kongo kingdoms in the Zaire basin, whose wealth was based on trade in metals and timber, and of early Portuguese merchantmen who came to trade in slaves.

k. **The Protected Areas System of the Unit**

Map 3.2 shows the location of the existing and proposed network of protected areas in the unit. Table X.1 lists these areas giving their status and the areas of their main habitat types.

Table X.1 Protected Areas of the Guinea-Congolia/Zambezia Regional Transitional Zone.

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
AN	Kangandala	4	.T.	1040–1157	W	21	600	600	2	300	A
ZR	Shaba	4	.T.	500–1000	F/G	11a	2000	2000	3	800	B

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table X.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table X.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
11A	385600	44	2000	0.5	0	0.0
14	56400	58	0	0.0	0	0.0
15	3200	40	0	0.0	0	0.0
2	42200	30	0	0.0	0	0.0
21	82200	67	600	0.7	0	0.0
25	18800	30	0	0.0	0	0.0
29C	27800	40	0	0.0	0	0.0
31	56600	30	0	0.0	0	0.0
37	4300	30	0	0.0	0	0.0
60	84400	84	0	0.0	0	0.0
77	4700	50	0	0.0	0	0.0
Totals	766200	49	2600	0.3	0	0.0

Only 0.3% of the region is included within protected areas. There is inadequate coverage of all vegetation types with no representation at all of most major habitat types within the only two protected areas larger than 5000 ha which occur in the region. At first this seems very serious for conservation, especially since large areas of some vegetation types have already been destroyed, but in fact phytochorion X is a transition zone and generally poor in species. Most of the major habitat types are represented within the protected areas systems of adjacent phytochoria. The most serious lack of coverage is the absence of any protection for the remaining Guineo-Congolian rainforest in the unit, for the *Dembos* cloud forests of Angola or for the mangrove and swamp forest at the mouth of the Zaire river.

m. Evaluation of Protected Area Importance

Only two reserves larger than 5000 ha have been included in the analysis of this unit. Kangandala Reserve, Angola, has been given priority A status as it is a woodland area and therefore more species-rich than the larger Shaba Reserve in Zaire.

n. Evaluation of Protected Area Effectiveness

Kangandala is relatively well-managed compared to other Angolan parks but the park boundaries require urgent revision in some areas due to human encroachments. Protection and management of Shaba need to be improved. Both protected areas have problems with poaching, especially of elephants in Shaba.

Both areas require improved levels of trained staff, budgets and equipment including well-equipped vehicles, radios and arms for anti-poaching patrols.

o. Assessment of Suitability of Protected Area Status

The status of the two protected areas (both category 4) is suitable to their management objectives if they could be effectively managed and protected. As elsewhere in Angola and Zaire one of the main problems is poaching, especially of elephants.

p. Identification of Major Gaps in the Protected Area System

Although the area of land protected within the unit is very small, conservation-wise this is not very important as phytochorion X is a transition zone and rather impoverished in species with very few plant or animal endemics. All the habitat types found within the unit also occur in other biogeographic units and are fairly adequately protected within the reserve network of the adjacent phytochoria, all of which are biologically more important and more species-rich than this unit.

Useful additions to the protected areas system of the unit would include the establishment of conservation areas in the coastal mangrove and in the remaining lowland rainforests of the Cabinda enclave, which still harbour populations of lowland gorillas and chimpanzees. If possible a suitable area of the *Dembos* cloud forest on the Angolan escarpment should also be protected and some protection given to an area of the coastal forest/grassland biome (15) which is not yet included in the protected areas system.

q. Recommendations for Reserve Additions and Extensions

1. Identify a suitable area of adequate size of undisturbed Guineo-Congolian rainforest in the Cabinda enclave for a conservation area to protect remaining populations of lowland gorilla and chimpanzees.
2. Identify a suitable area of adequate size for a reserve in the coastal mangrove on the Zaire estuary. This area could be usefully extended to include a representative sample of adjoining coastal swamp forest if undisturbed examples of this habitat remain.
3. Identify a suitable site to protect the distinctive *Dembos* cloud forest on the Angolan escarpment, between 300 and 1000 m.

r. Additional Conservation Needs

1. Although phytochorion X is biologically the least rich unit of the Afrotropical Realm it would be valuable to have more reserves in this unit. Surveys should be made in mangrove, coastal forest and remaining lowland rainforest to determine if there are any suitable areas of regional or local interest for inclusion within the protected areas systems of Angola or Zaire (at present Cabinda has no reserves). Special interest should be focused on areas with high species diversity or viable populations of endangered species e.g.lowland gorilla.
2. Simultaneously measures need to be taken to improve protection, management and staffing levels at the two existing reserves in the unit, with special emphasis on anti-poaching activities.
3. Develop and extend conservation programmes both within reserves and for the general populace to increase public awareness of the value of protected areas and wildlife. Special importance should be given to promoting conservation of endangered species such as gorilla.
4. Encourage tourism as appropriate, perhaps locally to a lowland rainforest area in Cabinda to view apes in the wild.
5. International assistance should be given to Angola in the form of technical assistance and training to help promote, establish and manage an adequate system of protected areas in this biologically rich but war-torn country.

3.9 THE GUINEA-CONGOLIA/SUDANIA REGIONAL TRANSITION ZONE (Unit XI)

a. Extent of Unit

The unit consists of a belt of terrain separating the Guineo-Congolian and Sudanian Regions. It extends from the Senegal coast to western Uganda for an east-west length of 5000 kms. It reaches the coast where the Dahomey Gap separates the rain-forest blocks of the Guinea-Congolian unit. The total coastline of the unit is c. 1500 kms. and its total land area is 1,165,000 sq.km. For extent of the unit see maps 3.1, 3.2 and 3.3.

b. Administrative Divisions

The unit passes through 15 different countries—Senegal, Gambia, Guinea Bissau, Guinea, Sierra Leone, Ivory Coast, Ghana, Benin, Togo, Nigeria, Cameroon, Zaire, Central African Republic, Sudan and just touches northern Uganda.

c. Dominant Vegetation

Maps 3.1 to 3.3 show the dominant vegetation of the unit. The Guinea-Congolia/ Sudania regional transition zone was formerly mostly forested with patches of *Isoberlinia* woodland and *Monotes* woodland on shallow soils. Almost all the original vegetation has been destroyed by fire and cultivation and the unit is now a mosaic of secondary grassland and secondary wooded grassland.

A few outlying patches of drier peripheral semi-evergreen Guineo-Congolian rainforest occur along the southern edge of the unit and along the Basse Casamance coastal plain to Senegal. These forests were once much more extensive. Most of the former forests of the the Fouta Djalon plateau have also been replaced by cultivation and secondary grassland. In the highlands the most abundant forest tree is *Parinari excelsa* but there are also some Afromontane species such as *Nuxia congesta.* Because of regional variation in rainfall and the extent to which the original vegetation has been modified by man, there is no simple relationship between latitude and the extent to which original forest survives within the transition woodland zone from forest to savanna (White 1983).

d. Distinct Habitat Types

The vegetation of the coastal plains of Ghana and Basse Casamance are rather distinctive. In the driest part of the Ghana coastal plain, near Accra, conditions are unfavourable to tree growth and the main vegetation is sparse, short grassland dotted with thicket clumps. Elsewhere various types of forest, less luxuriant than rainforest, represent the climax (White 1983).

Semi-evergreen forest and swamp forest extend along the West African coast to Basse Casamance and Senegal far beyond the climatic limits of rainforest. Although the *Parinari-Erythrophleum-Detarium* forests of Basse Casamance have no endemic species they are floristically and structurally distinct (White 1983). Today much of this forest has been replaced by ricefields and agricultural fields.
Mangroves are found on the deltas of the Saloum and Volta rivers.

e. Current Land Use

The unit has supported agriculturalists for several thousand years and spawned many of the great West African kingdoms, dating back to the early centuries of the millenium, their wealth based on long distance trade across the Sahara. This is also the area where several of Africa's staple food crops were first domesticated. Because of this long agricultural history and high human population densities, throughout the unit today there is little of the original vegetation remaining. The forests that were once widespread have been destroyed by fire and cultivation; on the Basse Casamance coastal plain for instance they have been replaced by ricefields or ground-nuts. The principal staple crops of the unit are millets, sorghum, yams and cassava. Maize is grown as a cash crop throughout the unit and groundnuts, oil palm and bananas are grown in the west. Some tobacco and cotton are also farmed in the unit.

f. Biological Richness and Endemism of Unit

The unit is biologically impoverished both because of its transitional nature and as a result of the extensive destruction it has experienced. There are probably less than 2000 plant species and rather few endemics (White 1983).

However the upland areas of Guinea and Sierra Leone between 700 and 1000 m support a few endemic species; a few Afromontane species also occur in Fouta Djalon, Guinea. The high plateau of Fouta Djalon

has been identified as an area of exceptional botanical interest with high species diversity (Droop, 1985). For their size the Accra Plains harbour a remarkable concentration of endemic and disjunct species (White, 1983).

Although the unit includes a great diversity of mammals (48 species of ungulates and diurnal primates) and birds (about 400 species recorded) none of these are endemics. These animals are increasingly threatened by habitat destruction and loss of natural vegetation.

g. Species of Special Economic Interest

A number of valuable wildlife species occur in the unit. Some, such as elephants and crocodiles, have valuable products of commercial potential. Other species such as leopards, the rare pygmy hippo, primates (for zoos and biomedical research) can command high prices in wildlife trade. All such trade is restricted by CITES regulations. The unit also has some potential for wildlife tourism though game viewing is more difficult here than in East Africa and facilities are not well-developed. By far the greatest economical value of the wildlife of the unit is its use as bushmeat by local inhabitants; in Ghana alone 75% of the population's protein is provided by bushmeat.

Many plants of the unit are important in local economies for food, fibre, medicines, dyes, building materials etc. Several African staple food crops were probably first domesticated in the region including:

Pennisetum americanum	Pearl millet	Cereal
Dioscorea rotundata	Yam	Root
Oryza glaberrima	African Rice	Cereal
Digitaria exilis	Fonio	Cereal
Digitaria iburua	Black Fonio	Cereal

The oil palm, *Elaeis guineensis,* was probably also domesticated in the unit as it is a species native to the West African forest fringes.

Both coastal and inland fisheries (along rivers and lakes) are important within the unit, providing much of the protein needs of local human populations.

h. Species of Special Biological and Conservation Interest

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Pan troglodytes	Chimpanzee	vulnerable
Lycaon pictus	Wild Dog	vulnerable
Panthera pardus	Leopard	vulnerable
Loxodonta africana	Elephant	vulnerable
Trichechus senegalensis	African Manatee	vulnerable
Ceratotherium simumcottoni	Northern White Rhino	endangered
Diceros bicornis	Black Rhino	endangered
Taurotragus derbianusderbianus	Western Giant Eland	endangered

No bird species from the unit are listed as threatened in the Bird Red Data Book of ICBP/IUCN.
The following reptiles found in the unit are listed as threatened in the Reptile Red Data Book of IUCN:

Dermochelys coriacea	Leatherback Turtle	endangered
Crocodylus niloticus	Nile Crocodile	vulnerable
Crocodylus cataphractus	African Slender-snouted Crocodile	indeterminate
Osteolaemus tetraspis	African Dwarf Crocodile	indeterminate

i. Additional Physical Features in Need of Protection

Rivers and their fringing vegetation and wetlands are generally under-represented in the protected areas network of the unit.

j. Ethnological or Historical Features in Need of Protection

The unit contains many sites of special ethnological or historical interest. There is an important Late

Stone Age site at Tiemassas in Senegambia. The earliest evidence of Iron Age civilisations comes from Nok on the Jos Plateau in Nigeria. The spread of iron technology made it possible for increasingly sophisticated societies to develop in West Africa and there are many important historical sites associated with these early kingdoms.

k. The Protected Areas System of the Unit

Maps 3.1, 3.2 and 3.3 show the location of the existing and proposed network of protected areas in the unit. Table XI.1 lists these areas, giving their status and the areas of their main habitat types.

Table XI.1 Protected Areas of the Guinea-Congolia/Sudania Regional Transition Zone

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
CM	Dendeng	8	.T.	c.600	F	2	3000	3000	3	600	C
CM	Fungom	8	.T.	200–1500	F/G	11a	800	800	3	160	C
CM	Kimbi River	4	.T.	800–900	F/G	11a	56	56	3	22	C
CM	Mbam et Djerem	4	.F.	0–500	F/G	11a	4000	4210	4	842	A
					F	2	200				
CM	Mbembe	8	.T.	200–1000	F/G	11a	280	280	3	56	B
CM	Pangar Djerem	4	.T.	600–900	F/G	11a	4000	4800	4	960	C
					F	2	800				
GH	Bui	2	.T.	122–244	F/G	11a	2800	3074	3	1537	B
					F/G	12	274				
GH	Digya	2	.T.	91–812	F/G	11a	3126	3126	2	2188	B
GH	Kalakpa	8	.T.	0–100	F/G	11a	324	324	2	97	C
GH	Kogyae	1	.T.	100–200	F/G	11a	324	324	3	162	C
GM	Kiangs West	2	.F.	c.100	F/G	11a	100	100	2	70	C
GU	Tornine	2	.F.	70–200	F/G	11a	2000	2000	4	200	B
IC	Comoe (part)	2	.T.	119–658	F/G	11a	2000	2000	2	1400	A
IC	Haut Bandama	4	.T.	200–500	F/G	11a	170	170	2	85	C
IC	Marahoue (part)	2	.T.	90–320	F/G	11a	400	900	3	450	C
					F	2	500				
IC	Mount Sangbe	2	.T.	200–500	F/G	11a	950	950	3	475	C
NI	Gashaka Gumti	8	.T.	200–1000	F/G	11a	6670	6670	3	1334	B
NI	Nazarawa	4	.F.	0–200	F/G	12	1900	1900	4	190	C
NI	Opara (part)	8	.T.	100–500	F/G	12	450	450	3	90	B
SD	Bangangai	4	.T.	500–1000	F/G	11a	170	170	3	68	C
SD	Lantoto	2	.F.	500–1000	F/G	12	760	760	4	76	B
SN	Basse Casamance	2	.T.	0–11	Mn	77	50	50	2	25	C
SN	Delta du Saloum	2	.T.	0–10	F/G	11a	700	730	1	657	A
					Mn	77	30				
TG	Togoda	4	.T.	0–200	F/G	11a	350	350	3	140	C
UG	Mount Kei (part)	4	.T.	500–1000	F/G	11a	200	200	3	80	B
ZR	Garaniba	2	.T.	710–1061	F/G	11a	4920	4920	3	2460	A

1. Analysis of Habitat Coverage versus Habitat Threat

Table XI.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table XI.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
11A	1133000	26	20166	1.7	6860	0.6
12	30400	20	274	0.9	1900	6.2
13	4100	30	0	0.0	0	0.0
15	6000	20	0	0.0	0	0.0
2	52300	27	1300	2.4	200	0.3
32	6800	30	0	0.0	0	0.0
77	15300	31	80	0.5	0	0.0
Totals	1247900	26	21820	1.7	8960	0.7

These figures indicate that protection of all habitat types is far from adequate, especially as only 1.7% of the total land area of the unit is included within protected areas. Another 0.7% is proposed for inclusion in the reserve network. However since this a transitional zone between two richer areas most of these habitat types are represented also in the protected networks of the adjacent phytochoria I and III. Major omissions are the lack of coverage of Jos Plateau mosaic (32, also not protected in biogeographic unit III), and coastal forest (15). At the moment only very small areas of mangrove and rainforest are protected. Both of these biologically rich habitats have already been reduced to less than a third of their former extents.

This is a densely populated unit and much of the original habitat has already been destroyed. It may no longer be feasible to find many suitable areas for extending the reserve network.

m. Evaluation of Protected Area Importance

The priority reserves of the unit are Comoe N.P. (Ivory Coast), Delta du Saloum N.P (Senegal) and Garamba N.P. (Zaire) home of the last population of the northern race of the white rhino. The proposed reserve of Mbam et Djerem (Cameroon) is also an important conservation area.

Most of the protected areas of the unit conserve areas of mixed forest and grassland where the largest densities of game are concentrated. Delta du Saloum is an important feeding site for winter migrants and has already been designated as a wetland of international significance.

n. Evaluation of Protected Area Effectiveness

With the exception of a few reserves and parks in Ghana and Senegal most of the protected areas of the unit have poor protection and management. Most protected areas lack trained staff, equipment and resources and have to operate on low budgets. Most parks lack adequate administration and infrastructure.

All the countries of the unit suffer from the same problems of poaching and encroachment of park lands for agriculture and grazing of livestock. Senegal pursues a policy of rigorous anti-poaching activities with severe penalties for offenders but even so poaching, particularly of elephant for ivory, continues. The countries of the unit may need to cooperate against organised paochers and the trade of trophies across national boundaries.

o. Assessment of Suitability of Protected Area Status

The status of most of the protected areas of the unit is suitable for their management objectives if they could be effectively protected and managed. The proposed reserves of Mbam et Djerem , Cameroon, and Lantoto N.P, Sudan, should be gazetted as soon as possible to give them full legal protection. Special attention should also be given to the several forest reserves of category 8 in Cameroon, Ghana and Nigeria. In a unit that has suffered considerable habitat destruction by land clearance and cattle grazing, these remaining forests are valuable refuges for wildlife but protection is inadequate under their current status.

p. Identification of Major Gaps in the Protected Area System

Only 1.7% of the total land area of the unit is protected within the reserve network, and only a further 0.7% is proposed for extending the reserve network. All habitat types are inadequately protected but many of these are transitional mosaics represented in the protected areas of adjoining biogeographic units.

Major biomes which are under-represented include:
Mangrove
Lowland Rainforest,and
Jos Plateau Mosaic (vegetation type 32).

All these habitats are already much reduced so it is essential that any identification of suitable sites for extending the reserve network is carried out as soon as possible before these habitats are totally destroyed.

q. **Recommendations for Reserve Additions or Extensions**

1. Establish the proposed reserve of Mbam et Djerem, Cameroon, which includes a small area of species-rich lowland rainforest.
2. Gazette the proposed national park of Kiangs West, Gambia.
3. Gazette the proposed national park of Tomine, Guinea. Effective protection of this area would do much to combat transfrontier poaching in Niokolo-Koba N.P. in neighbouring Senegal.
4. Establish the proposed reserve of Nazarawa, Nigeria.
5. Gazette and develop the national park of Lantoto, Sudan.
6. Redesignate the forest reserves of Dendeng, Fungom and Mbembe, Cameroon, as nature reserves (category 4) to improve protection and stop uncontrolled exploitation of wildlife.
7. Redesignate the forest reserves of Kalakpa, Ghana, as a nature reserve to protect and conserve this important forest area.
8. Redesignate the forest reserves of Opara and Nindam, Nigeria, as nature reserves to improve protection and stop uncontrolled exploitation. The Nindam F.R. near Kagoro has an unusual species community and is currently the focus of some conservation work by ICBP.
9. Identify areas of undisturbed mangrove within the unit for designation as conservation areas. Possible areas include the extensive mangroves of Guinea Bissau and Guinea.
10. Identify areas of undisturbed rainforest habitat and propose them as conservation areas.
11. Identify a conservation area of adequate size in the Jos Mosaic woodland/grassland mosaic to conserve a sample of this as yet unprotected habitat type.

r. **Additional Conservation Needs.**

1. Poaching is a major problem throughout the unit, particularly poaching of elephant for ivory. Only Senegal pursues a really active anti-poaching policy with stringent penalties for offenders and even here the Senegalese have already lost 90% of their elephant population. More anti-poaching units should be established in the other countries of the unit and fully equipped with vehicles, arms and radios. There will need to be greater cooperation between countries of the unit to stop cross-border poaching and trade in wildlife trophies.
2. Full recognition should be given to the value of bushmeat in the economies of the countries of the unit and hunting of wildlife should be strictly controlled to protect the resource. Research should be encouraged on wildlife populations both within and outside protected areas, with especial emphasis on the utilisation of non-threatened species on a sustained yield basis.
3. Surveys should be made to identify important wetland and mangrove areas to propose these areas for conservation status, also to protect more areas of lowland rainforest which is one of the top priority habitats for conservation action in Africa.
4. Special attention should be given to forest reserves which harbour important biological communities but receive inadequate protection under their present status.
5. Extensive reafforestation needs to be undertaken throughout the unit, using indigenous species such as *Terminalia superbus* and *T. ivorensis,* to provide wood for local communities and to help restore climatic stability to this zone. Deforestation of this unit has affected local climate and probably led to a reduction in the amount of rainfall received by the Sahel further north.
6. Throughout the unit there is considerable need to improve protection, management and staffing levels in reserves. International assistance should be mobilised to strengthen the capabilities of the national authorities in identifying, establishing, protecting and managing protected areas, with provision of aid in the form of technical assistance, funding, equipment and training of personnel.

3.10 LAKE VICTORIA REGIONAL MOSAIC (Unit XII)

a. Extent of Unit

The unit consists of the area around and including the Great Rift Valley lake Victoria, bounded on the west by the Zaire mountains and to the east by the Mau-Nandi escarpment of the East African mountains. The unit is completely land-locked (see map 3.3). It has a total area of 224,000 sq.km.

b. Administrative Divisions

The unit includes most of Uganda, the whole of eastern Rwanda and Burundi, and small parts of Zaire, Kenya and Tanzania. A small exclave occupies the Ruzizi Valley north of Lake Tanganyika (see map 3.3).

c. Dominant Vegetation

Map 3.3 shows the dominant vegetation of the unit. The Lake Victoria Regional Mosaic is the meeting place of five distinct floras: Guineo-Congolian, Sudanian, Zambezian, Somalia-Masai and Afromontane. The vegetation consists of a mosaic of floristically impoverished variants of the characteristic vegetation of the first four, in some cases with an admixture of Afromontane species (White 1983).

Much of the area's vegetation is a mosaic of lowland rainforest and secondary grassland with pockets of drier semi-evergreen Guineo-Congolian rainforest. Another large portion consists of mosaics of East African evergreen and semi-evergreen bushland and scrub forest and secondary *Acacia* wooded grassland. Swamp forest, dominated by species which are widespread throughout tropical Africa, occurs extensively on the shores of Lake Victoria and elsewhere. Small relict fragments of transitional rainforest remain in western Burundi between 1600 and 1900 m and in the Kakamega forest of Kenya, on the Nandi escarpment east of Lake Victoria, which contains both lowland rainforest and Afromontane species.

At the southern end of the unit are found areas dominated by wetter and drier Zambezian miombo woodlands. Around Speke Gulf on the southeastern shores of Lake Victoria there is an area of *Acacia-Commiphora* deciduous bushland.

d. Distinct Habitat Types

The swamp forests at the mouth of the Kagera river on the west shores of Lake Victoria are unique in being composed in almost equal proportions of. lowland, predominantly Guineo-Congolian, species and Afromontane species

The Kakamega forest of Kenya which is situated on the Nandi escarpment east of Lake Victoria is very distinctive. Although it lies between 1520 and 1680 m. it contains mostly lowland species, being the easternmost limit of many Guineo-Congolian rainforest trees. It also contains a number of rainforest birds and other fauna otherwise absent from the unit and several endemic forms.

e. Current Land Use

The area is rather fertile and has been mostly cleared for agricultural use and livestock raising. Principal crops are millet, sorghum, bananas, manioc, sweet potatoes, beans etc. In the more fertile areas commercial plantations have been established of coffee, cotton, tea, sugar cane and tobacco. Lake Victoria is a major fishery, but the introduction of Nile perch into the lake has had a deleterious effect on the production of other species and threatens the survival of several endemic fish.

f. Biological Richness and Endemism of Unit

The unit supports possibly no more than 3000 plant species of which very few are endemic. There are probably no endemic plant genera. (White, 1983).

Faunally, however, the area is very rich, due to the variety of vegetation types and the mixing bowl effect of the unit. This is one of the richest parts of Africa as far as bird diversity is concerned. 15% of the passerine birds found in the unit are endemics. The Lake Victoria Region is also relatively rich for butterflies and mammals but species endemism is low for these groups.

g. **Species of Economic Value**

The unit contains several plant species of commercial interest. Odera (1984) lists several commercially important timber tree species including:

Cordia abyssinica
Ekebergia rueppeliana
Fagara macrophylla
Maessopsis eminii
Manilkara butugi
Olea welwitschii
Polyscias kikuyuensis

In addition the following valuable species occur :-

Landolphia sp.	African rubber	latex
Trachylobium verrucosum	Copal	resin
Aloe spp.	Aloe	glucocides
Adansonia sp.	Baobab	medicines

A number of valuable wildlife species occur in the unit. Some such as elephants, crocodiles, rhinoceros etc. have valuable products of commercial potential. But by far the greatest commercial value of the wildlife of the unit is its potential for tourism through game viewing. Wildlife also provides some bushmeat to local inhabitants. Wildlife products are used commercially (horn, skin etc.) in the tourist souvenir industry.

Some primates are valuable for biomedical research and the chimpanzee, as Man's nearest living relative, is of particular biological and medical interest.

h. **Species of Special Biological and Conservation Interest**

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Cercopithecus hamlyni	Owl-faced Monkey	insuff.known
Cercopithecus lhoesti	L'Hoest's Monkey	vulnerable
Colobus badiusellioti	Elliot's Red Colobus	insuff. known
Colobus badiustephrosceles	Uganda Red Colobus	insuff.known
Pan troglodytes	Chimpanzee	vulnerable
Lycaon pictus	Wild Dog	vulnerable
Panthera pardus	Leopard	vulnerable
Acinonyx jubatus	Cheetah	vulnerable
Loxodonta africana	Elephant	vulnerable
Diceros bicornis	Black Rhino	vulnerable

The following bird species are listed as threatened in the Bird Red Data Book of ICBP/IUCN:

Balaeniceps rex	Shoebill	of special concern
Francolinus nahani	Nahan's Francolin	rare
Turdus kibalensis	Kibale Ground Thrush	indeterminate
Chloroptera gracilirostris	Papyrus Yellow Warbler	rare
Eremomela turneri	Turner's Eremomela	rare
Muscicapa lendu	Chapin's Flycatcher	rare

Only one reptile species found in the unit is listed as threatened in the Reptile Red Data Book of IUCN:

Crocodylus niloticus	Nile Crocodile	vulnerable

i. **Additional Physical Features in Need of Protection**

The Lake Victoria Regional Mosaic contains some interesting examples of Rift escarpment, shallow lakes and swamps, that should be included in the protected areas system.

j. **Ethnological or Historical Features in Need of Protection**

The unit contains several sites of special ethnological and historical value. Around Lake Victoria there are several major archaeological sites – at Nyabusoro, Sango Bay, Rusinga Island, Fort Ternan and Narosura with stone tools and other artefacts dating from the Early Stone Age.

k. **The Protected Areas System of the Unit**

Map 3.3 shows the location of the existing and proposed network of protected areas in the unit. Table XII.1 lists these areas, giving their status and the areas of their main habitat types.

Table XII.1 Protected Areas of The Lake Victoria Regional Mosaic

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
BR	Rusizi	4	.F.	500–1000	F	4	2	52	4	10	C
					B/G	45	50				
BR	Ruvubu	2	.F.	1000–1500	B/G	45	436	436	4	131	C
KY	Kakamega	2	.T.	1520–1680	F	2	97	97	3	49	A
KY	Lambwe	2	.T.	1200–1600	B/G	45	120	120	3	60	C
RW	Akagera	2	.T.	1250–1825	B/G	45	2500	2500	3	1300	B
RW	Mutara	4	.T.	c.1500	B/G	45	300	300	3	120	C
TZ	Biharamulo	4	.T.	1250–2000	F/G	11a	650	1300	3	520	B
					W	25	650				
TZ	Burigi	6	.T.	1000–1500	W	25	2200	2200	3	660	C
TZ	Ibanda	6	.T.	1000–2000	B/G	45	200	200	3	60	C
TZ	Rubondo	2	.T.	c.1130	F/G	11a	457	457	2	320	C
TZ	Rumanyika	6	.T.	1000–2000	B/G	45	800	800	3	240	C
UG	Budongo	4	.T.	1000–1500	F	2	352	352	2	106	B
UG	Bugoma	6	.T.	1000–1500	F	2	365	365	3	110	C
UG	Bugungu (part)	4	.T.	600–1300	F/G	11a	120	120	3	48	C
UG	Entebbe	4	.T.	500–1000	F/G	11a	52	52	2	26	C
UG	Itwara	8	.T.	c.1000	F	2	60	60	3	12	C
UG	Karuna	4	.T.	900–1300	F/G	11a	600	820	3	328	C
					F	2	220				
UG	Kasyoka–Maramagambo	8	.T.	1000–1500	F	2	500	500	3	100	C
UG	Katonga	6	.T.	1200–1500	B/G	45	208	208	3	62	C
UG	Kibale	6	.T.	1110–1590	F	2	260	560	2	280	B
					B/G	45	300				
UG	Kyambura	4	.T.	700–1100	B/G	45	157	157	3	63	C
UG	Lake Mburo	2	.T.	1200–1500	B/G	45	536	536	2	375	B
UG	Mabira	8	.T.	c.1000	F	2	300	300	3	60	C
UG	Maiaba	4	.T.	500–1000	F/G	11a	207	207	3	83	C
UG	Murchison Falls (pt)	2	.T.	500–1292	F/G	11a	2000	3000	2	2100	A
					F	2	1000				
UG	Queen Elizabeth	2	.T.	1000–5110	F/G	11a	100	1978	2	1385	A
					B/G	45	1878				
UG	Semliki	8	.T.	1200–1600	F	2	200	200	3	40	B
UG	Toro (part)	4	.T.	690–750	F	2	280	280	3	112	C
ZR	Virunga (part)	2	.T.	798–5119	B/G	45	3800	3800	2	2660	A

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table XII.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type within the unit.

Table XII.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
11A	109700	11	4186	3.8	0	0.0
2	9900	45	1949	19.6	625	6.3
25	9400	20	650	6.9	2200	23.4
26	2700	20	0	0.0	0	0.0
4	600	5	0	0.0	2	0.3
42	3300	20	0	0.0	0	0.0
45	70900	20	9291	13.1	1994	2.8
8	900	20	0	0.0	0	0.0
Totals	207400	16	16076	7.7	4821	2.3

Overall 7.7% of the land area of this unit is protected with good coverage of several major biomes including the Guineo–Congolian rainforests. Several habitat types with relatively small areas within the unit are not represented within the protected area network; all of these habitat types are, however, well represented within other biogeographic units.

The unit is densely populated and there are few areas of natural habitat outside the reserve system which have not been cleared for agriculture or otherwise degraded by the activities of men and livestock. Although table XII.2 shows 2.3% of the unit is proposed for inclusion in the reserve network most of this land is already included within forest reserves whose present status does not give adequate protection to conserve their wildlife. As the human population increases so will the demand for more land for agriculture. The only way to expand the existing reserve system is to upgrade the forest reserves, at present maintained for timber exploitation, to full reserve status to conserve their flora and fauna.

m. Evaluation of Protected Area Importance

The priority reserves of the unit are Kakamega N.P., Kenya, Murchison Falls N.P. and Queen Elizabeth N.P., Uganda and Virunga N.P., Zaire.

Other important conservation areas of the unit are Akagera N.P., Rwanda, Biharamulo Reseve, Tanzania, Budongo, Semliki and Kibale forests, Uganda, and Lake Mburo N.P. Uganda.

Although the unit is small its forests are important for conservation because of their species richness, which is reflected by their primate diversity, with 19 species in Uganda alone. Outlier forests like Kakamega and Kibale are important because they conserve several endemic trees and bird species.

n. Evaluation of Protected Area Effectiveness

Protection and management of the national parks and reserves of the Lake Victoria Region are generally poor. Many of the Ugandan parks were well managed in the past and are again recovering after the long periods of civil unrest of the Amin regime; they have therefore been scored as having fairly good management. Although parks staff remained loyal and at their stations through the civil turbulences they have had to cope not only with lack of funds and resources but with increasing incursions and poaching activities in the reserves with members of the armed forces among the worst offenders.

o. Assessment of Suitability of Protected Area Status

The present status of most parks and reserves of the unit is suitable for their management objectives if protection and management could be improved. Special attention should be focused on those protected areas presently classed as categories 6 and 8. In most cases these are forest reserves, a status which allows extensive destruction of the forest habitat and does not afford adequate protection to the reserves' wildlife. The present system in Uganda of small strict reserves within the boundaries of forest reserves is commendable but the conservation value of the forests would be greatly enhanced if the areas designated as strict reserves (only 11% of Kibale) could be extended.

p. Identification of Major Gaps in the Protected Area System

Overall the protected area system of the unit is fairly adequate with good coverage of most major biomes. The unit is one of the most densely populated parts of Africa and habitats not included within the system

have already been severely reduced and degraded; there is little more land available for extending the reserve system and already severe competition from other forms of land use.

Obvious gaps in the system are lack of any protected areas in swamp forest, drier Zambezian miombo woodland and the *Acacia–Commiphora* bushland. A small area of transitional rainforest will be included in the proposed Rusizi Reserve, Burundi. However only small areas of all of these habitat types occur in the unit and all are better represented within the protected area networks of adjacent biogeographic units.

q. Recommendations for Reserve Additions or Extensions

1. Gazette and develop the proposed Rusizi Reserve and Ruvubu N.P., Burundi.

2. Increase the areas afforded strict protection as nature reserves within the system of Ugandan forest reserves. These forest areas are important sites of biological richness for primates, birds and other wildlife. Kibale Forest, for instance, has 11 species of primates, including the only viable population of the red colobus *Colobus badius tephrosceles* in Uganda, and 276 species of birds. The Ugandan forest reserves are managed for timber production at present but in view of their biological importance larger areas should be protected and managed as conservation areas; this applies to the forests of Budongo, Bugoma, Itwara, Kasyoka-Maramagambo, Kibale, Mabira, and Semliki.

3. Upgrade the status of forest reserves in Tanzania, currently managed for timber production, to afford greater protection to wildlife.

4. Identify an area of undisturbed swamp forest (if any remain) to establish a conservation area in this important habitat.

5. Protect part of the open waters of Lake Victoria (and particularly the Kavirondo Gulf) by extending the boundaries of parks adjacent to the lake to at least 500 m offshore.

r. Additional Conservation Needs.

1. Improve protection and management of all reserves, including increasing trained staff, budgets and equipment. Parks in Uganda have suffered due to civil unrest which has discouraged tourists who used to provide much of the revenue for park budgets.

2. Take active steps to encourage tourism to national parks and protected areas throughout the unit by improving facilities and ease of access to reserves.

3. Forests are particularly important areas of the wildlife estate, with forest species often occurring at low densities. Throughout the unit, attention should be focused on ugrading management of forest reserves to give better protection to wildlife.

4. Develop land-use plans to take into account the needs of rural communities and how best they can benefit from utilising wildlife resources on a sustainable basis. The countries of the unit are some of the most densely populated in eastern Africa and there is unlikely to be continuing protection of the wildlife estate unless the whole populace receives tangible benefits.

5. Give careful scrutiny to further plans to increase the fish populations of Lake Victoria by introducing new species. The introduction of the predatory Nile perch has been an ecological disaster leading to the depletion of local populations of endemic fish species, and a fall in fishermen's catches; nor is the Nile perch popular as food among local communities living near the lake. Since lakes are particularly vulnerable to pollution increase environmental controls; also institute controls to prevent overfishing.

6. UNDP and EEC have already mobilised considerable financial aid to help Uganda to restore her system of protected areas and rehabilitate three of the country's finest national parks. Technical assistance with park management and training should also be continued to the other countries of the unit.

3.11 ZANZIBAR-INHAMBANE REGIONAL MOSAIC (Unit XIII)

a. Extent of Unit

The unit consists of a coastal belt of moister habitats along the east coast of Africa from southern Somalia to the Limpopo River. It has a total north-south length of 3500 kms, a coastline length of c.4500 kms and a total area of 336,000 sq.km.

b. Administrative Divisions

The unit falls across four African countries, including the south coastal part of Somalia, the coastal zones of Kenya and Tanzania and most of coastal Mozambique (see maps 3.3 and 3.4).

c. Dominant Vegetation

Maps 3.3 and 3.4 show the dominant vegetation of the unit. The greater part of the unit was naturally clothed in lowland rainforest and transition forest but most of the region has been cleared and is now a mosaic of secondary wooded grasslands and cultivation. Some relict forest patches are left on higher ground and steep valley sides, as well as some forest patches retained for religious and traditional purposes. These relict forests are of great conservation importance. Along the coast are sandy beaches fringed with *Casuarina* and small areas of mangroves.

d. Distinct Habitat Types

Small areas of distinct edaphic vegetation occur such as edaphic grasslands on seasonally flooded clay soils of the Tana river (Kenya) and the "tandos" between the Sabi and Buzi rivers (Mozambique). There are also some small areas of swamp forest and some rather distinct types of scrub forest.

e. Current Land Use

Most of the unit is relatively fertile and receives rain over much of the year. This, together with the coastal humidity, renders the area far less arid than much of East Africa which enjoys as high total rainfall. As a result the area has been heavily used for agriculture and supports a rather high human density. Very little of the original forest remains; it has been largely replaced by secondary wooded grassland and cultivation. Charcoal production is a serious threat to remaining patches of coastal forest.

Tourism is a major industry along part of the unit's coastline, especially in Kenya where tourism, based on coastal resources and wildlife, is the country's major source of foreign revenue.

f. Biological Richness and Endemism of Unit

Botanically, the unit is rather rich with a total of about 3000 species of flowering plants and high endemism. 38% of all plants and 48% of forest trees recorded from the area are endemic (White, 1983). The greatest concentrations of endemic plants so far found are in the Shimba Hills (Kenya) and Usambara Mountains, (Tanzania); the Usambaras are considered in unit VIII.

Faunally the area is fairly rich in mammal and bird species with endemism levels of about 12% among passerine birds. The mammal and bird endemics of the unit are found on offshore islands like Zanzibar or in 'islands' of remaining natural habitat such as the relict coastal forests.

g. Species of Economic Value

The unit contains several plant species of commercial interest. Odera (1984) lists 34 commercially important trees for Kenya, mostly from the montane (Afromontane unit VIII) areas but some extend into this unit. In addition the following valuable species occur :-

Landolphia sp.	African rubber	latex
Trachylobium verrucosum	Copal	resin
Aloe spp.	Aloe	glucocides
Adansonia sp.	Baobab	medicines

A number of valuable wildlife species occur in the unit. Some such as elephants, crocodiles, rhinoceros etc. have valuable products of commercial potential. Some primate species are traded for biomedical research. But by far the greatest economic value of the wildlife of the unit is its potential for tourism through game viewing. Wildlife also provides some bushmeat to local inhabitants and on a small scale for the tourist trade. Wildlife products are used commercially (horn, skin etc.) in the tourist souvenir industry.

The coral reefs and turtle beaches along the unit's coastline also have economic potential as a tourist attraction. Coral reefs are important for local fisheries while some coral species are sources for Pharmaceuticals. Coastal mangrove stands provide timber and firewood and protect prawn and fish spawning and nursery grounds.

h. **Species of Special Biological and Conservation Interest**

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Colobus badiuskirkii	Zanzibar Red Colobus	endangered
Colobus badiusrufomitratus	Tana River Red Colobus	endangered
Lycaon pictus	Wild Dog	vulnerable
Panthera pardus	Leopard	vulnerable
Acinonyx jubatus	Cheetah	vulnerable
Loxodonta africana	Elephant	vulnerable
Diceros bicornis	Black Rhino	endangered
Alcelaphus lichtensteinii	Lichtenstein's Hartebeest	indeterminate
Neotragus moschatusmoschatus	Zanzibar Suni	endangered

Although several of these large mammals are extremely rare within this region they are not considered as endangered throughout the whole Afrotropical realm. Only one subspecies, the Zanzibar suni with its limited distribution, is listed as endangered.

The following bird species are listed as threatened or possibly threatened in the Bird Red Data Book of ICBP/IUCN:

Otus ireneae	Sokoke Scops Owl	endangered
Anlhus sokokensis	Sokoke Pipit	vulnerable
Sheppardia gunningi	East Coast Akalat	rare
Turdus fischeri	Spotted Ground Thrush	rare
Cisticola restricta	Tana River Cisticola	insufficient data
Anthreptes pallidigaster	Amani Sunbird	rare
Anthreples rubritorques	Banded Green Sunbird	rare
Ploceus golandi	Clarke's Weaver	endangered

Two species endemic to the unit are considered endangered. The Sokoke Scops Owl and Clarke's Weaver are both confined to the Sokoke forest, a lowland forest on the Kenyan coast, parts of which have been destroyed by logging in recent years.

The following reptile species found nesting or living in the unit are listed as threatened in the Reptile Red Data Book of IUCN:

Chelonia mydas	Green Turtle	endangered
Eretmochelys imbricata	Hawksbill Turtle	endangered
Lepidochelys olivacea	Olive Ridley	endangered
Dermochelys coriacea	Leatherback Turtle	endangered
Caretta caretta	Loggerhead Turtle	vulnerable
Crocodylus niloticus	Nile Crocodile	vulnerable
Malacochersus tornieri	Pancake Tortoise	insuff.known

i. **Additional Physical Features in Need of Protection**

Offshore coral reefs, islands where seabirds breed and sandy beaches where turtles nest are all inadequately protected along the east coast of Africa.

j. **Ethnological or Historical Features in Need of Protection**

Since 1150 Arab traders have been active along the eastern coast of Africa and Kilwa, on one of the islands off Tanzania, became a trade and cultural centre, a leading rival to Mogadishu. Arab influence spread

along the east coast and with it Islam ; the Arab building styles and ancient mosques of towns like Lamu make this part of East Africa very attractive to tourists. Other noteworthy historical features include the Gedi ruins on the Kenya coast. Some coastal forest patches have religious and traditional significance.

k. The Protected Areas System of the Unit

Maps 3.3 and 3.4 show the location of the existing and proposed network of protected areas in the unit. Table XIII.1 lists these areas giving their status and the areas of their main habitat types.

Table XIII.1 Protected Areas of the Zanzibar-Inhambane Regional Mosaic

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
KY	Arabuko Sokoke	8	.T.	200–500	F	16b	360	350	3	70	A
KY	Arawale	6	.T.	85–100	B	42	532	532	3	160	C
KY	Boni	6	.T.	0–100	F/G	16a	339	339	3	102	C
KY	Dodori	6	.T.	0–100	F/G	11a	577	877	3	263	B
					Mn	77	300				
KY	Kiunga	6	.T.	0–30	Mn	77	200	250	2	67	C
KY	Shimba Hills	8	.T.	120–450	W	29c	192	192	2	58	B
KY	Tana River	2	.T.	40–70	W	16b	168	168	3	84	B
MZ	Bazaruto	2	.T.	0–50	F/G	16a	150	150	4	45	C
MZ	Marromeu	4	.T.	c.500	F/G	16a	1500	1500	4	300	C
MZ	Pomene	4	.T.	0–100	F/G	16a	2000	2000	4	400	C
MZ	Zambezi (part)	8	.T.	c.500	F/G	16a	8000	8730	4	873	A
					Mn	77	730				
SM	Far Wamo	4	.F.	0–100	B/G	16a	1400	1400	4	280	C
SM	Lag Badana	2	.T.	0–100	F/G	16a	2000	2000	3	1000	A
TZ	Sadani	6	.T.	0–50	W/G	16a	150	300	3	90	C
					Mn	77	150				
TZ	Selous (part)	4	.T.	100–1200	F/G	16a	10000	10000	3	4000	A

1. Analysis of Habitat Coverage versus Habitat Threat

Table XIII.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table XIII.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
16A	359800	38	14650	4.0	1889	0.5
16B	4900	50	168	3.4	0	0.0
77	15100	37	0	0.0	650	4.3
Totals	379800	38	14818	3.9	2539	0.6

Overall only 3.9% of the land area of phytochorion XIII is included within the protected area network of the unit, and another 0.6% is proposed or already included in existing forest reserves. There are only three major biomes in the unit and all three have been substantially reduced by human activities. As the population of the unit increases there will be increasing exploitation of the remaining patches of coastal forest and mangrove for timber, browse for livestock, charcoal and firewood, so it is imperative that remaining areas are given adequate protection before they are destroyed completely.

m. Evaluation of Protected Area Importance

The priority reserves of the unit are the Arabuko-Sokoke forest, Kenya, Lag Badana N.P., Somalia, and Selous Game Reserve, Tanzania. Both Lag Badana and Selous overlap two biogeographic units– phytochoria IV and XIII, – and include a broad spectrum of habitat types. Although not fully protected as a conservation area the forest reserve of Arabuko-Sokoke is an important, outlier forest, an example of the fast-disappearing coastal forest and also home to four species of endemic birds, including the Sokoke owl.

Other important conservation areas in the unit are Dodori National Reserve, the Shimba Hills and Tana River Primate Reserve. The last two both protect species found nowhere else.

n. Evaluation of Protected Area Effectiveness

Protection and management levels in the protected areas of the unit are generally inadequate. The coastal zone of the east African coast is densely populated and many of the reserves of the unit are surrounded by farmlands and rangelands which preclude extensions of the protected area. Conflicts with surrounding settlements include poaching for meat, illegal grazing of cattle, collection of wood for fuel and timber and agricultural encroachments.

Reserves in Mozambique and Somalia have little or no effective protection. Because of the ongoing civil unrest and border disputes in the two countries few resources have been available for conservation and some reserves have suffered as part of the war zones. Although attitudes to conservation and wildlife in Mozambique are changing with the success of the Zambezi Wildlife Utilisation Area, protected areas are suffering increasing pressure from human populations, cattle and farming developments, industries and poaching.

o. Assessment of Suitability of Protected Area Status

Many of the Kenyan protected areas of the unit are currently designated as category 6 (resource reserve) and 8 (forest reserve). Although this accurately reflects the present levels of utilisation within these reserves this status of protection is quite inadequate to conserve some of the important biotic communities found within these areas. Arabuko-Sokoke (at present a forest reserve for timber exploitation) and the Shimba Hills are especially important conservation areas and both should be afforded protection and management appropriate to the status of managed nature reserves; exploitation of timber and other resources in these reserves should be halted or carefully controlled to preserve the biological value of the reserves.

The status of the Tanzanian reserves is adequate if management is improved. In Somalia and Mozambique the status of the protected areas would be suitable for their management objectives if there were effective protection and management; at present management is non-existent with no staff or budgets for most reserves.

p. Identification of Major Gaps in the Protected Area System

An obvious gap in the protected area system of the unit is the lack of any adequately protected mangrove forest reserve. The Rufiji delta, Tanzania, has extensive stands of relatively undisturbed mangrove, some of the best mangrove on the eastern seaboard.

Coastal forests are also inadequately protected but there are only small areas of this important habitat remaining. It is therefore all the more important that areas such as Boni and Arabuko-Sokoke should be upgraded from their current status of forests reserves for the exploitation of timber and afforded better protection as nature reserves. These outlier forests are especially important as they protect endemic trees and bird species.

q. Recommendations for Reserve Additions and Extensions

1. Establish a reserve or national park to protect a sizeable part of the mangrove forests of the Rufiji Delta, Tanzania. If some of the offshore islands and coral reefs were included in this area it could be an important marine park, a habitat that is almost totally unprotected on the east African coast.

2. Survey the coastal areas of Kenya, Tanzania and Mozambique to identify other important coastal and marine habitats for conservation areas (see UNEP 1984). The proposed Ras Tenewi N.P. would be an important marine and coastal conservation area, particularly if it included a significant part of the Tana River delta.

r. Additional Conservation Needs

1. Revise the status of several of the Kenyan protected areas of the unit to increase protection of their

important biotic communities; coastal forest reserves should be upgraded to IUCN category 1 or 4.

2. Establish and extend education programmes to increase conservation awareness. Kenya and Tanzania already have impressive educational programmes which could provide models for the other countries of the unit. Emphasis should be placed on the value of wildlife resources and wise use and conservation of the marine habitat.

3. Stop clearance and degradation of remaining areas of mangrove forest. These are important fish spawning grounds and nurseries for fish, prawns etc. Mangrove is a particularly important yet undervalued habitat, valuable for its functions of coastal protection, spawning grounds etc.

4. Considerable international assistance should be mobilised to strengthen the capabilities of the national authorities in identifying, establishing, protecting and managing protected areas. International aid should be sought in the form of technical assistance, funding, equipment and training of personnel. Kenya and Tanzania already receive considerable technical assistance for conservation of protected areas; this should be maintained. In recent years Somalia and Mozambique have received little assistance in the conservation field – this should be substantially increased.

3.12 KALAHARI–HIGHVELD TRANSITION ZONE (Unit XIV)

a. Extent of Unit

The Kalahari-Highveld Transition Zone separates the Zambezian and Karoo-Namib Regional Centres of Endemism. The unit runs diagonally across Africa from 13°S in southern Angola to 33°S in the eastern Cape over the great Interior Plateau of southern Africa. It is more than 1800 km wide in the Highveld and Kalahari sectors but narrows sharply north of Windhoek. The total area of the unit is 1,223,000 sq.km.

b. Administrative Divisions

The unit extends over part of Namibia, Botswana and into Cape Province and Transvaal of the Republic of South Africa (see map 3.4).

c. Dominant Vegetation

Map 3.4 shows the dominant vegetation of the unit. The Kalahari-Highveld Region is a transition zone connecting four major phytochoria so its vegetation is complex. Most of the area is clothed in a mosaic of woodland, bushland and scrubland with grassland on the Highveld and the Natal and Transvaal sectors of the Drakensberg mountains.

d. Distinct Habitat Types

White (1983) divides the region into nine distinct subunits which largely coincide with the vegetation types shown on the map.

In the Zambezia/Kaokoveld-Mocamedes transition Zambezian and Karoo-Namib species occur intermixed, including mopane woodland and *Welwitschia.*

On the thick mantle of Kalahari sand wooded grassland is the characteristic vegetation. In Cape Province north of the Orange River this habitat has been severely degraded by overgrazing and much of the natural vegetation has been replaced by 'white ' desert grasses.

The Windhoek Mountains are now clothed in wooded grassland but the original vegetation was probably denser. The original grass cover has become sparse because of overgrazing.

The Kalahari and Karoo-Namib is an area of wind-blown sand which occurs as fixed dunes in the form of long parallel ridges. Sand covers 90% of the surface. In undisturbed areas the lower slopes of the dunes are clothed in vegetation but the upper slopes are subject to erosion by strong winds and cover is much sparser. The vegetation is a mosaic of lightly wooded grassland on the dune crests, pure grassland in depressions between the dunes and *Rhigozum trichotomum* shrubby grassland in deeper hollows where the underlying calcrete is near the surface.

Highveld grassland is the climax vegetation between 1220 and 2150 m on large parts of the high interior plateau in South Africa. The total tree flora of this area is very small and the development of woody vegetation is precluded nearly everywhere by the dry, very frosty winters (White, 1983).

Although typical Afromontane vegetation occurs on the Natal slopes of the Drakensberg above 1280 m, the corresponding slopes in Lesotho, below about 2900 m, cannot be included in the Afromontane Region. The Lesotho slopes are almost entirely covered by *Themeda-Festuca* grassland with a few isolated patches of scrub.

An area of transition grassland separates the Afromontane vegetation of the Natal Drakensberg from the Tongaland-Pondoland Region. This grassland, lying between 800 and 1700 m, was probably originally bushland with scrub forest in sheltered kloofs.

The Zambezia/Highveld transition is today primarily secondary grassland but original vegetation was probably bushland dominated by *Acacia caffra* (White, 1983).

e. Current Land Use

Much of the original vegetation of the region has been degraded or replaced by secondary grassland and scrub due to overgrazing by domestic livestock. The eastern part of the unit is an important cattle producing and sheep farming area. Botswana, in particular, has a large beef cattle industry producing meat for export as well as domestic consumption. The veterinary fences constructed in Botswana to control foot and mouth disease, by excluding wild game from cattle ranches, are a serious threat to wildlife. These fences block traditional migration and watering routes and some species populations have been drastically reduced in consequence.

South Africa is a major agricultural nation and food exporting country. The Transvaal has good

agricultural lands where cereals such as wheat, millets, sorghum and maize are the principal crops. Cash crops include oil palm and citrus fruits.

South Africa has major mineral resources of gold, diamonds, coal and iron ore; Botswana also has a huge belt of coal seams running diagonally across the country. Mining activities have modified the landscape and urban conurbations have sprung up around the mines. In the region of the Kimberley diamond mines much of the original *Acacia* has been felled for fuel for the mines.

The arid conditions of the Kalahari Desert are too dry to support any form of agriculture or livestock ranching. There are no permanent watercourses and drainage is ephemeral. This region probably had no human population until a few thousand years ago. Today the Kalahari is the last refuge of the !Kung Bushmen, traditional hunter/gatherers who subsist mainly on a diet of plants and tubers supplemented with occasional meat. So long as the Bushmen continue to hunt with their traditional weapons, bows and spears, their small harvest of game is no threat to wildlife populations.

f. Biological Richness and Endemism of Unit

The total flora of the unit is fairly large, possibly c.3000 species but this is because of the large number of marginal intruders extending into the unit from the four adjacent major phytochoria. There are very few endemic species and much of the interior has a very poor flora.

Faunally the unit is rather impoverished, especially when compared with unit II to the north, and levels of species endemism are low. The unit has about twice as many mammals (ungulates and diurnal primates) as the Cape and Karoo-Namib regions but only half the number of passerine birds.

g. Species of Special Economic Interest

The unit's wildlife is particularly valuable as the resource base for wildlife tourism based on game viewing (a substantial revenue earner in South Africa) and for game hunting, both for sport and to satisfy local needs. Bushmeat is important to local economies in both Botswana and South Africa; in Botswana more than 50 species of wild animals are eaten, including elephant, rodents and small birds, and in some areas wild game contribute 40% of the local diet (Sale 1981). This consumption of wild game allows Botswana to export large quantities of beef (to obtain foreign exchange) that would have been eaten locally had game meat not been available.

Skins are a valuable byproduct of animals killed for meat. Other commercially valuable byproducts include carcasses and bones (for bone meal) and trophies (horns, ivory etc.). Wildlife products are used commercially (horn, skin etc.) in the tourist souvenir industry. Both Botswana and South Africa have also developed crocdile farms, stocked with eggs and adults from the wild, to provide meat and skins for trade.

Native plants are also of economic value as food, fibre, building materials, fuel, medicines and fodder for livestock. Some plant species of commercial value include:

Sorghum caffrorum	Grain Sorghum	cereal
Eragrostis curvula	Weeping Love Grass	pasture
Digitaria decumbens	Pangola Grass	pasture
Dioscorea elephantipes	Elephant's Foot	drug
Carissa grandiflora	Natal Plum	edible fruit

h. Species of Special Biological and Conservation Interest

The following mammal species and subspecies of the unit are listed as threatened in the Mammal Red Data Book of IUCN :

Ambylosomus julianae	Juliana's Golden Mole	rare
Crocidura mamaquassiensis	Maquassie Musk Shrew	rare
Lycaon pictus	Wild Dog	vulnerable
Hyaena brunnea	Brown Hyaena	vulnerable
Panthera pardus	Leopard	vulnerable
Acinonyx jubatus	Cheetah	vulnerable
Loxodonta africana	Elephant	vulnerable

The South African Red Data Books for large and small mammals give more detailed information on the distribution and status of the mammals within the unit (Skinner et al. 1977, Meester 1976).

The following bird species of the unit are listed as threatened in the Bird Red Data Book of ICBP/ IUCN:

Gyps coprotheres	Cape Vulture	rare
Bugeranus carunculatus	Wattled Crane	of special concern
Sarothrura ayresi	White-winged Flufftail	indeterminate

The White-winged Flufftail known from only a few records in southern Africa may be seriously threatened or even endangered by drainage, damming and grazing of its marshland habitat.
The South African Red Data Book for Birds gives more detailed information on the distribution and status of the bird species of the unit (Brooke 1984).
The IUCN Red Data Book for Reptiles lists only one reptile species of the unit as threatened:

Crocodylus niloticus	Nile Crocodile	vulnerable

i. Additional Physical Features in Need of Protection

The spectacular mountain scenery of Lesotho, on the eastern fringes of the unit, deserves greater protection. Riverine habitats and wetland areas are also generally under-represented in the protected areas systems of the unit although they are important sites for wildlife.

j. Ethnological or Historical Features in Need of Protection

The unit contains several sites of special ethnological or historical interest. Archaeological excavations at Taung and Blaawbank Valley (Sterkfontein, Swartkrans and Kromdraai) were the first in Africa to yield fossil remains of early hominids. The discovery of the remains of *Australopithecus africanus* and *Australopithecus robustus* stimulated the search for more of man's ancestors both here and in eastern Africa.

The Kalahari Desert is of interest as the last refuge of the !Kung Bushmen, traditional hunter/gatherers following a lifestyle very similar to that of Early Man. Anthropological studies have revealed that Bushmen live in harmony with their environment and that their lifestyle is not as harsh as originally believed. Bushmen subsist primarily on wild plants, supplementing their diet with occasional meat. Most of their water needs come from plants and animals. On this diet they show no signs of malnutrition.

k. The Protected Areas System of the Unit

Map 3.4 shows the location of the existing and proposed network of protected areas in the unit. Table XIV.1 lists these areas, giving their status and the areas of their main habitat types.

Table XIV.1 Protected Areas of The Kalahari-Highveld Transition Zone

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
BT	Central Kalahari	4	.T.	500–1000	W/B	35a	11800	51800	3	20720	A
					B	44	40000				
BT	Gemsbok	2	.T.	C.1200	B	44	11400	24800	2	17360	A
					SD	56	13400				
BT	Khutse	4	.T.	500–1000	B	44	2440	2440	3	976	B
BT	Mabuasehube	4	.T.	c.1200	B	44	1792	1792	2	896	B
NM	Tsaobis–Leopard	4	.T.	500–1000	SD	56	350	350	2	175	C
NM	Waterberg Plateau	2	.T.	1000–1500	B	44	405	405	2	283	C
SA	Commando Drift	4	.T.	1010–1384	B/G	57b	60	60	1	42	C
SA	Bloemhof Dam	4	.T.	1239–1249	B	44	110	221	1	155	B
					G	58	111				
SA	Chelmsford Pub. Res.	5	.T.	1249–1270	W	24	68	68	1	14	C
SA	Doornkloof	4	.T.	1260–1480	B/G	57b	88	88	1	62	C
SA	Itala (part)	4	.T.	350–1550	W	24	129	129	1	90	C
SA	Kalahari Gemsbok	2	.T.	609–975	SD	56	9591	9591	1	8632	A

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
SA	Karoo Nature Reserve	4	.T.	740–1710	B/G	57b	140	140	1	98	C
SA	Mountain Zebra	2	.T.	1200–1957	B/G	57b	65	65	1	59	B
SA	Oviston	4	.T.	1320–1530	B/G	57b	130	130	1	91	C
SA	Sandveld	4	.T.	1232–1248	B	44	147	147	1	103	C
SA	Suikersbosrand	4	.T.	1608–1918	G	34	133	133	1	93	C
SA	Tsolwana	4	.T.	1350–1866	B/G	57b	76	76	1	53	C
SA	Tussein–die–Riv	4	.T.	1250–1520	B/G	57b	220	220	1	154	B
SA	Verloren Valei	4	.T.	2150–2316	G	58	20	61	1	43	C
SA	Verwoerd Dam	4	.T.	1265–1369	B/G	57b	112	112	1	78	C
SA	Willem Pretor's	4	.T.	1375–1510	G	58	120	120	1	84	C

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table XIV.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table XIV.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
20	40200	25	0	0.0	0	0.0
24	29000	60	129	0.4	0	0.0
34	20600	50	133	0.6	0	0.0
35A	268900	38	11800	4.3	0	0.0
35C	19600	60	0	0.0	0	0.0
36	56200	30	0	0.0	0	0.0
44	431700	40	56294	13.0	0	0.0
56	173700	42	23341	13.4	0	0.0
57B	99800	30	891	0.8	0	0.0
58	140500	30	251	0.1	0	0.0
Totals	1280200	38	92839	7.2	0	0.0

Several of the habitat types of the unit have already been seriously degraded as a result of overgrazing by domestic livestock. This is particularly true for the grassland habitats and bushland/grassland mosaics and transitions. These habitats are also those least well represented in the reserve network of the unit.

Overall 7.2% of the unit is protected with good coverage of the Kalahari bushland and the semidesert of the Kalahari and Karoo-Namib. There is as yet no coverage of the transition habitats between Afromontane and Highveld grassland (20, very little 24) and the grasslands of the Highveld are poorly represented within the protected area system (57b and 58).

m. **Evaluation of Protected Area Importance**

The priority A protected areas of the region are the Central Kalahari Game Reserve and Gemsbok National Park, Botswana, and Kalahari Gemsbok N.P., South Africa. Between them these protected areas conserve substantial areas of the Kalahari sands and semidesert habitat which is home to an interesting desert fauna and the !Kung Bushmen.

Many of the smaller reserves of the unit have been assigned priority C status since they are important only in a national context.

n. **Evaluation of Protected Area Effectiveness**

Levels of protection and management of parks and protected areas in the unit are generally good. Indeed South Africa and Namibia have some of the best managed reserves in the whole African continent.

Although management in Gemsbok N.P. is adequate, elsewhere in Botswana protection and management need to be improved. The Department of Wildlife and National Parks lack sufficient manpower, funds, equipment and infrastructure. The greatest problem facing all parks in the unit is poaching. Botswana also has a considerable problem beacuse of growing demand for land for beef cattle farming. Veterinary fences across the Kalahari grasslands, designed to exclude wild game from cattle ranches and stem the spread of foot and mouth disease, have blocked traditional migration and watering routes for wildlife and this has led to a serious decline in numbers of several species.

o. Assessment of Suitability of Protected Area Status

The status of most of the protected areas of the unit is suitable for their management objectives. Parks and protected areas in Namibia and South Africa are already well run in accordance with their status but there needs to be improvement in both protection and management of most of the Botswana reserves if they are to meet their management objectives.

At present several of the large semidesert areas are protected by their size and isolation from population centres and the fact that the land has little potential for agriculture or livestock grazing. But this isolation can also be a disadvantage for patrolling against poaching.

p. Identification of Major Gaps in the Protected Area System

Major habitat types with no protection include the transition areas between Afromontane scrub forest and the Highveld grasslands, and other transitional bushland/grassland areas. The Highveld grasslands and other transitional mosaics are also inadequately represented within the protected area system. These habitats are not very species-rich but they have already suffered the greatest degradation and changes due to overgrazing by livestock; only small areas remain undisturbed. It is imperative, therefore, that if samples of these habitats are to be conserved action should be taken very soon.

q. Recommendations for Reserve Additions or Extensions

1. Identify areas for new reserves in the Highveld grasslands and transitional bushland habits if any suitable areas remain undisturbed.

r. Additional Conservation Needs.

1. Develop landuse plans taking into account, and making special provision for, the needs of rural communities living adjacent to national parks. Develop programmes for rational use of wildlife resources in Botswana.

2. Monitor the effects on wildlife of veterinary fences in Botswana which are blocking traditional wildlife migration and watering routes, and seek ways to reduce their deleterious impact on wildlife. As foot and mouth disease is controlled in domestic cattle by vaccination programmes these fences should be removed if possible. This may necessitate changes in EEC beef import regulations.

3. Monitor the effects on wildlife of the artificial drainage of wetlands and lakes in Botswana. Throughout the unit identify and protect wetland sites of special importance to birds and other wildlife.

4. In both South Africa and Namibia tourism based on wildlife is an important revenue earner. As yet there is no programme of parks planning in Botswana although the tourist industry is developing rapidly (PADU/IUCN 1986). As wildlife tourism increases in Botswana it is essential to monitor the impact of visitors and their vehicles on both wildlife and the natural environment of the parks.

5. Botswana will require considerable assistance to improve park management and protection and help the national authorities to establish a national strategy for developing national parks and protected areas; EEC inputs are already promised. As wildlife tourism becomes more important to the national economy it is essential to establish a strong parks planning policy.

3.13 TONGALAND–PONDOLAND REGIONAL MOSAIC (Unit XV)

a. Extent of Unit

The unit extends along the east coast of southern Africa from the Limpopo river mouth (25°S) to Port Elizabeth (34°S). In the north the unit extends inland up to 240 km but in the south where mountains come close to the sea its width is no more than 8 km. The region has a total area of 148,000 sq.km.

b. Administrative Divisions

The unit includes the southernmost sector of Mozambique, Swaziland and parts of Natal, Transvaal and eastern Cape Province of the Republic of South Africa (see map 3.4).

c. Dominant Vegetation

Map 3.4 shows the dominant natural vegetation of the unit. Where the vegetation has not been completely destroyed it consists of a complex mosaic of forest, scrub forest, and evergreen and semi-evergreen bushland and thicket in a matrix of secondary grassland and wooded grassland. There are small patches of woodland in the north and of edaphic grassland and swamp forest on the coastal plain (White, 1983).

d. Distinct Habitat Types

Tongaland-Pondoland forest formerly extended as a narrow, more or less continuous, band along the coast, an evergreen forest with a canopy height between 10 and 30 m. Where Tongaland-Pondoland forest has been destroyed it is replaced by *Acacia karoo* wooded grassland. Swamp forest occurs on the coastal plain as far south as 31°S and is best developed near Kosi Bay.

Where the rainfall is too low to support forest, evergreen and semi-evergreen bushland and thicket are widespread, especially in the lowlying country between the coastal forests and mountainous interior in the north and in deep valleys in the south. Arborescent succulent species of *Aloe* and *Euphorbia* occur throughout the unit.

Badly drained grassland with scattered palms occurs at several places along the Mozambique coast.

e. Current Land Use

This is one of the more densely populated parts of Africa, with several of the Bantustan homelands included in the unit. Extensive areas of the original vegetation have been cleared to make way for agricultural lands. Although the unit is not as fertile as the Transvaal farmlands of unit XIV, it is an important cereal-producing region, growing millet and sorghum, and some wheat and maize. Cash crops include groundnuts, citrus fruit, sugar, and some cotton. The unit also lies within one of the major cattle-raising regions of Africa.

f. Biological Richness and Endemism of Unit

The unit supports about 3000 plant species. More than 200 of the larger woody species, some 40%, are endemic but the proportion of other endemic plants is probably less (White 1983). The family Achariaceae is centred on this region but not truly endemic; there are 20 or so endemic woody genera and two genera *Atalaya* and *Protorhus* occur nowhere else in Africa but are found in Madagascar and Asia.

Faunally, the unit is only moderately rich in mammal (29 ungulates and diurnal primates) and bird species (211 passerine birds) and levels of endemism are low. Because of the transitional nature of the vegetation and variety of habitats the unit is somewhat richer in bird species than the adjacent biogeographic units of phytochoria XIV and V.

g. Species of Special Economic Interest

The unit includes some interesting wildlife which is of considerable value to local and national economies both through tourism, based on game viewing, and game hunting for sport and food. Bushmeat is of considerable economic value in South Africa and skins are a valuable byproduct of animals killed for meat. Other commercially valuable byproducts from hunted animals, and animals killed during culling operations in national parks, include carcases and bones (for bone meal) and trophies (horns, ivory etc).

Crocodile farms have been established in the unit, stocked with eggs and adults from the wild, to produce meat and skins.

Native plant species are utilised by local peoples for food, building and craft materials, fibres, medicines, fuel and fodder for livestock. Economically valuable species include:

Digitaria decumbens	Pangola Grass	pasture
Dioscorea sylvatica	Wild Yam	drug
Sorghum caffrorum	Grain Sorghum	cereal
Aloe spp.	Aloe	glucocides
Adansonia sp.	Baobab	medicines
Carissa grandiflora	Natal Plum	fruit
Ficus nekbudu	Bark Cloth	bark cloth

Offshore and inland fishing are important sources of protein for the human populations of the unit.

h. Species of Special Biological and Conservation Interest

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Lycaon pictus	Wild Dog	vulnerable
Hyaena brunnea	Brown Hyaena	vulnerable
Panthera pardus	Leopard	vulnerable
Acinonyx jubatus	Cheetah	vulnerable
Loxodonta africana	Elephant	vulnerable
Diceros bicornis	Black Rhino	endangered

The South African Red Data Books give more detailed information on the distribution and status of large and small mammal species considered to be threatened in the unit (Skinner et al. 1977, Meester 1976).

The following bird species of the unit are listed as threatened in the Bird Red Data Book of ICBP/IUCN:

Geronticus calvus	Southern Bald Ibis	rare
Gyps coprotheres	Cape Vulture	rare
Bugeranus carunculatus	Wattled Crane	of special concern

The South African Red Data Book for Birds (Brooke 1984) gives more detailed information on the distribution and status of bird species considered to be threatened within the unit. This work lists 102 mainland breeding species of which 5 are considered endangered, 17 vulnerable and 42 species are rare in South Africa; the endemic Bald Ibis is considered to be out of danger.

The following reptiles which nest on the beaches of the unit are listed as threatened in the IUCN Red Data Book for Reptiles:

Dermochelys coriacea	Leatherback Turtle	endangered
Caretta caretta	Loggerhead Turtle	vulnerable

i. Additional Physical Features in Need of Protection

Interesting physical features requiring protection within the unit include coastal formations such as rocky cliffs, sandy beaches where sea turtles nest and coastal sand dunes. In a comprehensive review Tinley (1985) has identified coastal dune sites in southern Africa requiring priority conservation action. Sites identified for the unit include the "Red Desert" at Mtamvuna, the coast between the Tugela and Mlalazi rivers at Mtunzuni – the best example of a growing coastline in South Africa, and the entire coast dune range north from Cape St Lucia to the Mozambique border.

j. Ethnological or Historical Features in Need of Protection

The unit contains few sites of special ethnological or historical value.

k. **The Protected Areas System of the Unit**

Map 3.4 shows the location of the existing and proposed network of protected areas in the unit. Table XV.1 lists these areas, giving their status and the areas of their main habitat types.

Table XV.1 Protected Areas of The Tongaland-Pondoland Regional Mosaic

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
MZ	Maputo	4	.T.	2–104	F/G	16c	720	800	4	160	C
					Mn	77	80				
SA	Mkuzi	4	.T.	40–400	F/G	16c	138	251	1	176	C
SA	Addo	2	.T.	75–341	B	39	89	89	1	80	B
SA	Alexandria	4	.T.	0–362	F/G	16c	236	236	1	165	C
SA	Andries Vosloo	4	.T.	182–548	B	39	65	65	1	46	C
SA	Bathurst	4	.T.	0–827	F/G	16c	12	54	1	38	C
					B	39	42				
SA	Dukuduku Forest	4	.T.	4–70	F/G	16c	151	151	1	106	C
SA	FC Erasmus Trust For	4	.T.	40–400	W	29e	69	69	1	48	C
SA	Groendal Wildn. (pt)	4	.T.	90–1180	B	39	51	51	1	36	C
SA	Hluhluwe	4	.T.	100–550	F/G	16c	46	231	1	162	B
					W	29e	185				
SA	Itala (part)	4	.T.	350–1550	W	29e	130	130	1	91	C
SA	Kruger (part)	2	.T.	122–867	W	29e	4432	4432	1	3335	A
SA	Mkuzi	4	.T.	40–400	W	29e	113	251	1	176	C
SA	Ndumu	4	.T.	25–175	W	29e	101	101	1	71	C
SA	Pongola	4	.T.	146–730	W	29e	62	62	1	43	C
SA	Sodwana/C.Vidal	4	.T.	5–172	F/G	16c	579	579	1	405	B
SA	St Lucia	4	.T.	0–10	F/G	16c	368	368	1	258	C
SA	St Lucia Park	4	.T.	0–30	F/G	16c	125	125	1	88	C
SA	Tembe Elephant	4	.T.	34–100	F/G	16c	149	299	1	209	B
					W	29e	150				
SA	Umfolozi	4	.T.	100–550	W	29e	478	478	1	335	B
SW	Hlane	8	.T.	500–1500	W	29e	141	141	1	99	C
SW	Mlawula	4	.T.	500–1500	W	29e	120	120	1	84	C
SW	Ndzindza	1	.T.	500–1000	W	29e	55	55	1	50	C

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table XV.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table XV.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
16C	68700	50	2524	3.6	0	0.0
29E	42400	42	6075	14.3	0	0.0
39	28000	50	247	0.8	0	0.0
48	7400	20	0	0.0	0	0.0
77	1100	48	80	7.2	0	0.0
Totals	147600	46	8926	6.0	0	0.0

Overall 6.0% of the unit is already included within protected areas but most of this is made up by the good coverage of woodland (vegetation type 29e). Only a small area of mangrove is protected but this represents some 7% of the original area of this habitat type within the unit. At least half of the unit's mangrove has already been destroyed. Although there is some coastal forest within the protected area system this habitat is under-represented as is the semi-evergreen bushland and thicket typical of southern Africa. None of the wooded bushland of the Tugela basin is included within protected areas; only a small area is left but as this is transitional it is not very important for conservation.

m. Evaluation of Protected Area Importance

The priority protected areas of the unit are Maputo Reserve, Mozambique, and Umfolozi Reserve (famous for its white rhinos) and Addo and Kruger national parks, South Africa. Maputo, though poorly managed and lacking abundant wildlife, has some interesting remnant populations of endangered species and protects turtle nesting beaches. Other important protected areas of the unit are Tembe Elephant and Sodwana reserves of South Africa which have interesting concentrations of wildlife.

In general most of the protected areas of the unit are fairly small – Kruger N.P. and Maputo Reserve are notable exceptions. Although the South African reserves together represent samples of most of the vegetation types of the unit, their small size must be compensated by high levels of active management if they are to retain their present variety of wildlife.

n. Evaluation of Protected Area Effectiveness

Levels of protection and management in the protected areas of South Africa and Swaziland are good, as good as anywhere in the whole African continent and better than in most countries of the realm. However the small size of most of the reserves of the unit is in itself a management problem which makes it difficult to stop boundary encroachment. Another problem in many South African reserves is the control of exotic plants which have spread into the reserves from surrounding lands. Small size of reserves may also require very active management to preserve the variety of wildlife species which the reserve was originally established to protect. The successful reintroductions of white rhinos to protected areas throughout the unit from animals bred at Umfolozi is a good example of what can be achieved by such management.

In Maputo Reserve, as in most of the protected areas of Mozambique, protection and management are very poor. Although there have been severe problems within the reserve in the past – poaching, bush fires, illegal grazing of livestock and human settlements within the reserve itself, – some measures are now being taken to improve management. These include active anti-poaching measures, the building of game posts and resettlement of illegal settlers.

o. Assessment of Suitability of Protected Area Status

The status of most areas is suitable to their management objectives. The national parks and protected areas of South Africa and Swaziland have very good management. Maputo could be a useful conservation area if protection and management could be improved in accordance with the area's reserve status and management objectives.

p. Identification of Major Gaps in the Protected Area System

Woodland is particularly well-represented within the unit's reserve system and it is encouraging to see a high percentage of the unit's remaining mangroves included in protected areas. The other habitats of the unit are either under-represented or not represented at all. In particular there should be greater areas of coastal forest protected (if possible) and evergreen and semi-evergreen bush. Only very small areas of the wooded bushland of the Tugela basin remain; even though this is transitional scrubland it would be interesting to have some area of this habitat type included within the protected areas system.

q. Recommendations for Reserve Additions or Extensions

1. Identify and protect suitable areas of remaining coastal forest as conservation areas in the coastal mosaic. Such forests can be important refuges for bird populations.

2. Establish protected areas to conserve larger areas of evergreen and semi-evergreen bush and a representative sample of the Tugela woodland, if a suitable area remains.

3. Identify and protect wetlands of special importance in the unit to conserve their birdlife and other interesting fauna e.g. crocodiles.

r. **Additional Conservation Needs.**

1. Improve protection and management of the existing reserve system in Mozambique by increasing the levels of trained manpower, funding and equipment for the country's reserves. Many protected areas are under threat from guerilla activities and any improvement in parks management will first require solution of the military and political conflict within Mozambique (Tello 1986).

2. In Mozambique continue to develop land-use plans designed both to protect parks and wildlife and cater for the needs of rural communities. The establishment of the Zambezi Wildlife Utilisation Area has been successful in making local communities aware of the economic value of wildlife and the importance of rational utilisation.

3. Monitor long-term ecological changes in the small parks of the unit in order to implement effective management to maintain the present species diversity which the parks were established to protect.

4. Maintain the present South African policy of distributing surplus white rhinos and other rare or threatened species to suitable parks and protected areas throughout southern Africa as this increases the species' long-term chances of survival.

5. Mozambique is a poor country which has suffered from long periods of civil warfare and political unrest. As soon as the political situation allows, considerable international assistance should be mobilised to strengthen the capabilities of the national authorities in identifying, establishing and managing protected areas, with aid in the form of technical assistance, funding, equipment and training of personnel.

3.14 SAHEL REGIONAL TRANSITION ZONE (Unit XVI)

a. Extent of Unit

The Sahel Regional Transition Zone, as defined by White 1983, occupies a relatively narrow band, about 400 km wide, which extends across North Africa from the Atlantic Coast to the Red Sea (see maps 3.1, 3.2 and 3.3). The massifs of Adrar des Iforas, Aïr and Ennedi are responsible for a local increase in precipitation which permits a northerly extension of several Sahel species. The unit has a total area of 2,482,000 sq. km.

b. Administrative Divisions

The unit extends right across northern Africa through Senegal, Mauritania, Mali, Burkina Faso, Niger, the northernmost sectors of Nigeria and Cameroon, Chad and Sudan (see maps 3.1 to 3.3).

c. Dominant Vegetation

Maps 3.1, 3.2 and 3.3 show the dominant vegetation of the unit. The extensive sand sheets of the Sahel support wooded grassland in the south and semi-desert grassland in the north. Bushland is much more restricted and mostly confined to rocky outcrops. (White 1983).

Various types of scrub forest, bushland and wooded grassland occur on the massifs of Ennedi and Aïr. The upper slopes of two high mountains, Jebel Gurgeil and Jebel Marra, were formerly covered with scrub forest but this has been largely replaced by secondary grassland as a result of human activity. Similarly, overgrazing by the livestock of pastoralist herders in the northern Sahel has led to vegetation destruction and desertification of the region.

d. Distinct Habitat Types

Edaphic grasslands and wooded grasslands occur on Pleistocene clays in former shallow lake basins. Evergreen and semi-evergreen bushland occurs on the Erkowit Hills near Suakin, Sudan. Rocky outcrops in the Sahel zone support bushland or thicket, at least at water-receiving sites, as on the plateau of north-west Darfur and the lower slopes of Jebel Gurgeil.

The rolling plains and lava peaks of the upland plateau of Jebel Marra, above 1800-2000 m, are covered with montane grassland; this is secondary grassland, a consequence of more than 2000 years of human activity.

e. Current Land Use

Because of its geographical position on the southern fringes of the world's largest desert, the Sahel zone receives insufficient rainfall for permanent agriculture based on rain-fed crops. Nevertheless where the water supply permits permanent or seasonal settlement rain-fed crops are grown, even where rainfall is as low as 200 mm a year. Success is intermittent with crop failures on average once every three years. Permanent agriculture is only possible in the few places where permanent rivers, originating from wetter regions, provide water for irrigation. Sorghum and millets are grown as staple foods and dates as a staple and cash crop.

In most parts of the Sahel livestock-raising and pastoralism are the main sources of livelihood. Traditionally pastoralism involves common ownership of grazing lands and a nomadic or semi-nomadic lifestyle. In recent years the residents of the Sahel have become less nomadic and been encouraged to settle around new wells and bore holes. These factors, together with improved veterinary services and several years of good grazing prior to the 1973 drought, have led to a great increase in numbers of livestock and overgrazing of rangelands which are already subject to periodic droughts. In drought years the adverse effects of the drought on the vegetation are exacerbated by the high population of domestic animals and increased pressure on the land from an influx of 'drought refugees' and their animals from further north, seeking access to the waterholes. As a result the area of desertification has expanded and there has been a decrease in the productive capacity of the rangeland (White 1983, Sinclair and Fryxell 1985).

f. Biological Richness and Endemism of Unit

The unit supports about 1200 plant species of which probably fewer than 40 species (3%) are strictly endemic. Another 150 species or so are confined to the Sahel and other parts of Africa or Asia with a similar or drier climate (White, 1983).

Within the region the Aïr Mountains and Ténéré Desert have been identified as sites of significant plant endemism (Droop 1985).

Faunally, the unit is only moderately rich in mammals (25 species of ungulates and diurnal primates) and birds (211 species of passerines) with low levels of endemism. Several mammals of the region are of special interest, however, as they are desert species not found elsewhere in the Afrotropical Realm e.g. addax, scimitar-horned oryx.

g. Species of Special Economic Interest

The unit contains several plant species of commercial interest. Pearl millet *Pennisetum americanum* and sorghum *Sorghum bicolor,* both staple African food crops, are believed to have been domesticated in the region and several wild species of cereals are utilised during periods of famine (Oliver and Crowder 1981).

The Aïr and Ténéré region includes the site for the rare wild olive *Olea laperrinei* which is assigned the category vulnerable in the IUCN Plant Red Data Book (1978).

The unit has some interesting and valuable wildlife. Both elephants and crocodiles have products of commercial value, such trade being subject to CITES regulations. Plans for crocodile farms to produce skins and meat are underway in several countries of the unit, including Chad, Mali and Senegal (Luxmoore et al. 1985). Primates are valuable for biomedical research and baboons and patas monkeys are traded for this purpose from Chad and Senegal. Bushmeat is important to local populations in some parts of the unit. The region's wildlife also has potential commercial value for limited tourism, based on game viewing though this will necessitate the development of tourist facilities in parks and protected areas.

h. Species of Special Biological and Conservation Interest

The following mammal species and subspecies of the unit are listed as threatened in the Mammal Red Data Book of IUCN :

Lycaon pictus	Wild Dog	vulnerable
Panthera pardus	Leopard	vulnerable
Acinonyx jubatus	Cheetah	vulnerable
Loxodonta africana	Elephant	vulnerable
Addax nasomaculatus	Addax	endangered
Alcelaphus buselaphustora	Tora Hartebeest	endangered
Oryx dammah	Scimitar-horned Oryx	endangered
Gazdla leptoceros	Rhim, Slender-horned Gazelle	vulnerable

The following bird species is listed as threatened in the Bird Red Data Book of ICBP/IUCN:

Geronticus eremita	Northern Bald Ibis	endangered

The following reptile species, which nest on the coastal beaches or occur elsewhere in the unit, are listed as threatened in the IUCN Reptile Red Data Book:

Chelonia mydas	Green Turtle	endangered
Eretmochelys imbricata	Hawksbill Turtle	endangered
Crocodylus niloticus	Nile crocodile	vulnerable
Crocodylus cataphractus	African slender-snouted crocodile	indeterminate

i. Additional Physical Features in Need of Protection

The unit includes a number of interesting physical features such as ancient sand dunes, rocky outcrops and ancient lake beds but they are not threatened.

j. Ethnological or Historical Features in Need of Protection

The unit contains several sites of special ethnological and historical interest. There is a Late Stone Age site at Dar Tichit and Iron Age sites around Lake Chad. Ancient rock engravings have been found in the Aïr mountains. Other important historical sites include the ruins associated with the ancient empires of the western Sahel zone and northern Nigeria.

k. The Protected Areas System of the Unit

Maps 3.1, 3.2 and 3.3 show the location of the existing and proposed network of protected areas in the unit. Table XVI.1 lists these areas, giving their status and the areas of their main habitat types.

Table XVI.1 Protected Areas of The Sahel Regional Transitional Zone

Country	Name	Category	Gazetted	Altitude (m)	Biome	Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
BF	Sahel	6	.T.	200–500	B	43	16000	16000	4	3200	B
CH	Fada Archei	6	.T.	C.500	SD	54a	2110	2110	4	422	B
CH	Ouadi Rinie/Achim pt.	6	.T.	100–500	B	43	10000	50000	4	10000	A
					SD	54a	40000				
ET	Gash Setit	4	.T.	500–1500	B	43	1500	1500	4	300	C
ET	Yob	4	.T.	400–1000	B	43	1800	1800	4	360	C
ML	Asongo–Menaka	4	.T.	200–500	SD	54a	17500	17500	3	7000	B
NG	Air and Tenere (pt)	4	.F.	1000–1730	SD	54a	40000	40000	4	8000	A
NG	Gadabedji	4	.T.	405–478	SD	54a	760	760	4	152	C
NI	Lake Chad	4	.T.	500–1000	B	43	7044	7044	4	1409	B
SN	Djoudj	2	.T.	0–20	B	43	160	160	2	112	B
SN	Ferlo Nord	4	.T.	c.100	B	43	4870	4870	3	1948	B
SN	Ndiael	4	.T.	0–100	B	43	466	466	2	233	B

1. Analysis of Habitat Coverage versus Habitat Threat

Table XVI.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table XVI.2 Protection and Threat of Respective Habitats

Habitat	Orig.area (km^2)	Rem.%	Prot.area (km^2)	Prot.%	Prop.area (km^2)	Prop.%
38	700	50	0	0.0	0	0.0
43	1037200	21	15840	1.5	26000	2.5
54A	1335500	30	18260	1.3	82110	6.1
62	19800	20	0	0.0	0	0.0
64	32200	20	0	0.0	0	0.0
75	11400	14	0	0.0	0	0.0
Totals	2436800	26	34100	1.3	108110	4.4

Overall only 1.3% of the unit is included within protected areas and a further 4.4% is proposed for protection or included within partial faunal reserves. Coverage of all vegetation types, except semi-aquatic swamp habitat, is far from adequate. Although extensive areas of swampy habitat (64) are included within the protected area system, in this very arid unit this habitat is of special importance to wildlife and even greater areas should be protected. As yet only relatively small areas of semidesert grassland and wooded grassland are protected though more of the latter habitat is included within proposed reserves. At present there is no protection at all of the tiny amount of semi-evergreen bushland occurring in the unit or of the woodland-grassland mosaic (62).

m. Evaluation of Protected Area Importance

Priority A conservation areas of the unit, i.e. areas of international importance, include Ouadi Rime-

Ouadi Achim Faunal Reserve (Chad), and part of the proposed Aïr and Ténéré Reserve (Niger), the largest conservation area in Africa, which extends beyond the phytochorion boundary into the Sahara. In the arid and semidesert conditions of the Sahel most of the wildlife is well-dispersed and reserves must be large to afford protection to viable populations. Accordingly those protected areas afforded top priority are all of considerable size, some of the largest reserves on the whole African continent.

Many of the other protected areas of the unit are also important on a regional scale because they protect considerable areas of semidesert and Sahel bushland and the unique desert fauna adapted to these arid lands.

n. Evaluation of Protected Area Effectiveness

Levels of protection and management of parks and protected areas are generally poor or non-existent throughout the unit though the situation in Senegal is much better than elsewhere. Confronted with major environmental problems such as drought and desertification, the countries of the Sahel have given little attention or resources to the problems of protected area management.

Many of the Sahel reserves, though officially gazetted, exist only on paper with no well-defined boundaries; many are not even properly mapped. Between 1969 and 1973 the whole Sahel Region was devastated by drought. The rains failed again between 1982 and 1984 and overgrazing of the remaining poor pastures and destruction of woodland are leading to serious erosion and desertification. Since reserves are not protected they suffer as much as surrounding lands from overgrazing, fire and hunting. It is possible, however, that if these areas could be adequately protected their degraded habitats would recover.

Because of their large size and inaccessibility reserves are difficult to protect, especially from wandering nomads and their herds of livestock. Poaching is also a major problem, with poachers often much better organised and equipped than the parks staff who have to combat their operations. All parks and protected areas of the region, with the notable exception of those in Senegal, lack effective management, trained staff, budgets and equipment. Top priority should be given to improving management and protection of these reserves but this will require a realisation by governments that the wildlife of the Sahel is a valuable resource and the political will to exclude people and their livestock from some areas.

o. Assessment of Suitability of Protected Area Status

The status of most of the reserves of the unit is suitable for their management objectives if they could be better protected and more effectively managed. This is not true, however, in Burkina Faso and Chad. All partial faunal reserves should be upgraded to the status of full reserves and no hunting allowed within their boundaries either of endangered species or any other wildlife. It is also a mistake (common throughout the unit) to have hunting zones as buffers around the protected areas since many game species migrate over considerable distances and cannot be contained within the strictly protected zones. The wildlife of the Sahel, with its unique adaptations for living in this hostile, arid environment is a valuable resource which, with proper and careful management, could be utilised for the benefit of the human population. The present destruction of the habitat by domestic cattle and the uncontrolled hunting of wildlife have led to severe declines in the numbers of some game populations and it is essential that populations are properly protected and allowed to recover within properly managed protected areas.

p. Identification of Major Gaps in the Protected Area System

Some areas of all major habitats other than semi-evergreen bush (of which there is only a tiny area) and edaphic grasslands with *Acacia* (a transitional habitat) are already included within the reserve network of the unit. However the areas of semi-desert grassland and shrubland and *Acacia* wooded grassland already protected are relatively small and should be extended, as these are the areas where most wildlife is found. Similarly the area of semi-aquatic (swamp habitat) within the protected area system should be extended if possible as the new grasses of the floodplains are essential food for both wild and domestic mammals.

Surveys should be made to identify and protect lakes, riverine habitats and other wetlands important to waterbirds, migrating wildlife and other fauna e.g. crocodiles.

q. Recommendations for Reserve Additions or Extensions

1. Immediate priority should be given to the gazettement and development of the proposed Aïr and Ténéré National Nature Reserve, Niger, which will be the largest protected area in the whole of Africa and probably the most important reserve in this biogeographic unit. This huge reserve which extends beyond the Realm boundaries into the Sahara desert (the only reserve in the Sahara) protects a range of habitats from semidesert to the Tenere mountains with some unique plants and fauna.

2. Only the north-west corner of the Sahel Partial Faunal Reserve (Burkina Faso) is of biological interest. Much of the rest of the area is densely settled and overgrazed. Immediate steps should be taken to establish a reserve of category 4 status to conserve the remaining area of Sahelian vegetation and its fauna; the rest of the area should be degazetted (Spinage and Souleymane 1984).
3. Identify a suitable area of desert habitat in northern Sudan to protect the country's rich desert fauna; this habitat is important for at least eight species of threatened ungulates. Priority should also be given to establishing conservation areas in the arid zone of Sudan (habitat for gazelles and dry-area carnivores) and in the Red Sea Hills (important for Nubian ibex, gazelles and several other mammals not protected elsewhere).

r. Additional Conservation Needs

1. Although most countries within the unit have gazetted reserves, in the Sahel almost all of these reserves exist only on paper, are not mapped and have no properly recognised or marked boundaries. It is essential that all countries of the unit begin a programme of active implementation of their parks programmes and that governments realise that the establishment and management of national parks and protected areas is a viable and sensible alternative form of land use.
2. Poaching is a major problem throughout the unit, particularly of oryx and desert gazelles. Senegal already has an active anti-poaching programme but elsewhere there is a need to establish more anti-poaching units with fully trained personnel well-equipped with aircraft, vehicles, radios and firearms. Cooperation and collaboration between the parks departments of the region will be required to stop cross-border poaching raids and movement of trophies.
3. Inventory the use of wild resources and their importance in national economies, taking special note of those wild cereals utilised by the native population in times of drought. Many staple African domestic foods were first domesticated in the western part of the unit and other native wild plants may have potential for domestication.
4. Acknowledge the potential value of wildlife in the economies of the nations of the Sahel and take all possible measures e.g. hunting controls, protection of habitat, to conserve this valuable resource. Develop programmes such as game ranching for the rational use of wildlife on a sustained yield basis.
5. Monitor the effects on wildlife and fragile habitats of aid programmes to improve irrigation and provide water which allows permanent settlements in these arid regions. Sinclair and Fryxell (1985) argue convincingly that such aid has itself exacerbated the problems of desertification by allowing overstocking of livestock on already depleted vegetation, ultimately destroying the habitat even further for both wildlife and human populations.
6. Encourage international agencies concerned with environmental programmes to combat the environmental degradation of the Sahel to take note of the valuable role that well-managed and protected areas could play in stabilising the environment and protecting its wildlife. Encourage such agencies, e.g. World Bank, to support and help finance the establishment of protected areas to further the success of their own projects. International aid must be integrated to tackle the whole spectrum of problems facing the Sahel not concerned just with programmes in individual sectors.
7. IUCN and other international agencies should commit considerable resources, in terms of expertise and funding, to support ecodevelopment projects in the Sahel countries to develop community management of natural resources for sustainable development as outlined in the IUCN Sahel Report (1986).

3.15 THE EAST MALAGASY REGIONAL CENTRE OF ENDEMISM (Unit XIX)

a. Extent of Unit

The unit covers the eastern part of Madagascar and extends from the east coast westwards to include the central highlands, descending to approximately the 800 m. contour on their western side. In the north the unit extends to the northwest coast to include the Sambirano domain and the island of Nosy Be. The unit has a long coastline of about 1,400 kms, running almost the entire length of the island and has a total land area of 272,000 sq.km.

b. Administrative Divisions

The unit lies entirely within the Democratic Republic of Madagascar.

c. Dominant Vegetation

Map 3.5 shows the natural dominant vegetation of the unit (White 1983). The unit was originally clothed almost entirely in forests—Malagasy lowland rain forests (by far the richest habitat type on the island) below 800 m and three other types of evergreen forest in the highlands: moist montane forest and sclerophyllous montane forests on the eastern slopes and "tapia" forests on the western slopes. Over most of the area the original forests have been destroyed by human activities and replaced by a mosaic of cultivation and secondary formations. Extensive areas above 800 m are now secondary grasslands. Less than 20% of the unit is still forested and of this only 4.4% is regarded as primary forest (FAO 1981).

d. Distinct Habitat Types

On the highest peaks (above 2000 m) the characteristic vegetation is montane thicket, composed of a single stratum of woody plants no more than 6 m tall and often impenetrable. This vegetation is floristically impoverished and probably derived from montane sclerophyllous forest.

Rocky outcrops in the central highlands support distinctive rupicolous communities. Whereas the characteristic vegetation of rocky outcrops on the African mainland is bushland and thicket, similar outcrops in Madagascar support only small shrubs rarely exceeding 2 m in height.

Some areas of swamp forest occur in association with the several eastern lakes, and are dominated by screwpines (*Pandanus*), giant aroids (*Typhonodorum lindleyanum)* and the characteristic endemic fan-shaped Traveller's Tree *(Ravenala madagascariensis). Pandanus* occur in many forests throughout the island with a wealth of endemic and probably many threatened species. *Ravenala* also grow in secondary grasslands and on bare hillsides and are fairly resistant to fire.

Several distinct secondary grassland communties can be recognised (White, 1983) including – coastal grassland, "tanety" grassland in hilly regions, "tampoketsa" grassland on the plateaux north of Antananarivo, grassland on the western slopes (on old tapia forest lands) and grassland on mountain slopes above 2000 m.

e. Current Land Use

Madagascar today has a population of more than 9 million people with a population growth of 2.6% annually; this gives an average population density of 15 people per sq.km. over the whole island but parts of the eastern coastal plain and the central highlands are more densely populated. Three quarters of the island's population live by agriculture. Much of the lowland forest has been cleared for agriculture (tavy system) and the principal crops are rice, cassava, sugar cane, sweet potatoes, potatoes and maize. Areas abandoned after cultivation or destroyed by fire without cultivation tend not to be colonised by indigenous secondary forest but rather by exotic shrubs or grasses. Fire maintained grasslands are used as pasture for cattle but much of the secondary grassland in the mountains is barely used.

f. Biological Richness and Endemism of Unit

The unit is biologically very rich and very distinctive at both species and higher taxonomic levels. The flora includes at least 6100 species of flowering plants of which 79% are endemic and about 1000 genera with 16% endemic (White, 1983). Many of the palms of the east are unique to Madagascar and more than 1000 species of orchids, many endemic, are found in the eastern rainforests—more varieties than in tropical West Africa.

The fauna of Madgagascar is unique, ancient in origin and distinct through isolation. It is charaterised by high levels of endemism at species and higher taxonomic levels though, typically for an island fauna, most groups show rather less species than would be expected from an equivalent area of the African

continental mainland. Most of the fauna is forest-adapted and the eastern rainforests are considerably richer in species than the drier forests of the west.

The bird fauna of Madagascar, though relatively poor in number of species, shows remarkable uniqueness and striking differences from the birds of Africa. There are five families virtually confined to Madagascar—the mesites (Mesitornithidae), courols (Leptosomatidae), ground rollers (Brachypteraciidae) asities and sunbird asities (Philepittidae) and vangas (Vangidae). 83 (78%) of the island's 106 endemic species of birds are found in the eastern unit and 32 of these are exclusively rainforest dwellers and confined to the unit (Collar et al., in press).

94% of Madagascar's non-flying mammals are endemic (incluing the endemic families of lemurs and tenrecs) and 9 of the 28 known bats are also endemic. Many of these species occur in the eastern forests and some are confined to the unit. 17 of the 28 lemurs are found in the eastern forests. The amphibia (144 species) and reptiles (258 species) are very richly represented on Madagascar and have very high endemism (over 90% for reptiles and 98% for amphibia). Again the eastern unit is the richest, especially for amphibia, over 60% of which are confined to the low altitude, moist eastern forests.

g. **Species of Special Economic Interest**

Little is currently known of the commercial potential of the native flora of Madagascar. In the past the eastern forests were logged commercially for rosewood, ebony and marquetry timber. Several of the ethnic groups use a wide range of plants for medicinal purposes, food and other uses. The rosy periwinkle provides a drug used worldwide to check childhood leukaemia. Further ethnobotanical studies are required to evaluate the properties of the island's rich flora but it is likely that the unit contains many commercially valuable species. A long list of useful plants has already been collated by Plotkin et al. (1985). The various forms of wild Malagasy coffees and vanillas may be useful for crossbreeding to produce hardy hybrids; both coffee and vanilla are important commercial crops in Madagascar.

In addition the following valuable species occur :-

Euphorbia intisy	African rubber	latex
Cryptostegia spp.	Wild rubber	latex
Tachylobium verrucosum	Copal	resin
Catharanthus roseus	Rosy periwinkle	pharmaceutical
Raffia sp.	Raffia	fibre

Madagascar's unique fauna of lemuroid primates are of especial value and interest for the study of primate behaviour, interpretation of primate evolution and for wildlife tourism.

h. **Species of Special Biological and Conservation Interest**

The following mammal species are currently considered threatened and listed for inclusion in the Mammal Red Data Book of IUCN :

Varecia variegata	Ruffed Lemur	vulnerable
Allocebus trichotis	Hairy-eared Dwarf Lemur	endangered
Phaner furcifer	Fork-Marked Lemur	vulnerable
Daubentonia madagascariensis	Ayeaye	endangered
Indri indri	Indris	endangered
Avahi laniger	Woolly Lemur	vulnerable
Propilhecus diadema	Diademed Sifaka	endangered
Hapalemur griseus	Grey Gentle Lemur	vulnerable
Hapalemur simus	Broad-nosed Gentle Lemur	endangered
Lepilemur microdon	Microdon Sportive Lemur	vulnerable
Lepilemur dorsalis	Grey-backed Sportive Lemur	vulnerable
Lepilemur mustelinus	Weasel Lemur	vulnerable
Lemur fulvus	Brown Lemur	vulnerable
Lemur rubriventer	Red-bellied Lemur	endangered
Lemur macaco	Black Lemur	endangered

The following bird species are listed as threatened in the Bird Red Data Book of ICBP/IUCN:

Tachybaptus rufolavatus	Alaotra Grebe	endangered
Tachybaptus pelzelnii	Madagascar Little Grebe	insuff.data
Aythya innotata	Madagascar Pochard	endangered
Eutriorchis astur	Madagascar Serpent Eagle	endangered
Mesitornis unicolor	Brown Mesite	insuff.data
Sarothrura watersi	Slender-billed Flufftail	indeterminate
Coua delalandei	Snail-eating Coua	extinct
Tyto soumagnei	Madagascar Red Owl	indeterminate
Brachypteracias squamiger	Scaly Ground Roller	rare
Brachypteracias leptosomus	Short-legged Ground Roller	rare
Atelornis crossleyi	Rufous-headed Ground Roller	rare
Uratelornis chimaera	Long-tailed Ground Roller	rare
Neodrepanis hypoxantha	Yellow-bellied Sunbird Asity	indeterminate
Phyllastrephus cinereiceps	Grey-crowned Greenbul	rare
Phyllastrephus tenebrosus	Dusky Greenbul	rare
Xenopirostris polleni	Pollen's Vanga	rare
Crossleyi xanthophrys	Madagascar Yellow-brow	indeterminate
Newtoniafanovanae	Red-tailed Newtonia	indeterminate

The following reptile species which nests in the unit is listed as threatened in the IUCN Reptile Red Data Book:

Caretta caretta	Loggerhead turtle	vulnerable

The following butterfly species is listed as threatened in the IUCN Red Data Book of Threatened Swallowtail Butterflies:

Papilio mangoura	rare

i. **Additional Physical Features in Need of Protection**

There are some interesting volcanic formations in the Massif du Tsaratanana which includes Mount Maromokotra, the highest peak on the island.

j. **Ethnological or Historical Features in Need of Protection**

The unit contains a number of sites of ethnological and historical interest especially in the highland areas around Antananarivo, where the Merina ethnic group were the first tribe to develop skills in architecture and metallurgy.

In addition there are a number of sites of palaeontological interest where fossil fauna have been found which throw important light on the evolution of the Malagasy fauna and particularly the evolution of the prosimian primates.

k. **The Protected Areas System of the Unit**

Map 3.5 shows the location of the existing and proposed network of protected areas in the unit. Table XIX.1 lists these areas, giving their status and the areas of their main habitat types.

Table XIX.1 Protected Areas of The East Malagasy Regional Centre of Endemism

Name	Category	Altitude (m)	Biome Vegetation	Habitat area (km^2)	Total area (km^2)	Management	Contrib. score	Priority
Zahamena	1	800-1500	F 1b M 5	500 232	732	3	366	A
Andringitra	1	1000-2658	M 19c M 5	112 200	312	3	156	B
Marojejy	1	90-2137	M 5	601	601	3	300	A
Tsaratanana	1	480-2876	M 19c M 5	330 156	486	3	243	B
Ambatovaky SR	4	800-1175	F 1b	600	600	3	240	A
Anjanaharibe-Sud	4	1000-2000	M 5	321	321	3	128	B
Marotandrano	4	200-1000	M 18	422	422	3	169	B
Ambohitantely	4	1200-1650	M 18	20	56	3	22	C
Manombo SR	4	0-140	F 11b	50	50	4	10	C
Kalambatritra	4	1000-1644	M 18 M 5	142 140	282	3	113	B
Andohahela (I)	1	120-1956	M 5	631	631	3	316	A
Pic d'lvohibe	4	1000-1890	M 5	35	35	4	7	C
Betampona	1	275-550	F 1b	22	22	3	11	C

1. **Analysis of Habitat Coverage versus Habitat Threat**

Table XIX.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table XIX.2 Protection and Threat of Respective Habitats

Habitat type	Original area (km^2)	%age remaining	Protected area (km^2)	%age protected	Proposed area (km^2)	%age proposed
F 1b	80,729	c.15	1,122	1.4	400	0.4
M/G 18	121,354	c.30	584	0.5	-	0
M 5	45.312	c.20	2,316	5.1	-	0
M 19c	3,646	c.30	442	12.0	-	0
F/G 11	21,875	c.20	50	0.2	-	0
Totals	272,916	c.25	4,514	1.6	400	0.1

These figures indicate that the coverage of all vegetation types is far from adequate. The lack of extensive coverage in the secondary mosaic vegetation types 18 and 11 are not too important as these are of low conservation interest. Although 12% of the remaining montane forest (19c) is protected the actual area is fairly small. Most serious lack of coverage is in the lowland rainforest zone of type 1b.

m. Evaluation of Protected Area Importance

From species distribution maps the Sambirano region appears to be of the highest importance for the conservation of many endemic mammals. However this area is densely populated and it is unlikely that there are any substantial areas of natural lowland forest left.

The reserves of Zahamena and Ambatovaky are of the highest priority for ecosystem conservation, since they protect extensive areas of lowland rainforest, the most species rich habitat on the island. While Ambotavaky is relatively undisturbed because of its isolation, Zahamena exemplifies all of the problems facing protected areas throughout Madagascar. The reserve has problems relating to its legal status and encroachment from surrounding populations with an enclave of 3000 people within its boundaries; as a consequence there is increasing deforestation within the reserve. Because of these problems Zahamena should achieve conservation priority as a test case on how best to safeguard protected areas while providing for the needs of local human populations.

R.N.I.11 Andohahela is important because within its three sectors it includes representative samples of two very different habitat types – the humid forests of the east and the very different and much drier thorny thickets of the dry south. Because of this range of habitats the reserve protects a great variety of plants and animals typical of both Madagascan biogeographic realms. Marojejy has also been given top priority as it includes large areas of moist montane forests.

Small reserves under 20 sq.km. have not been included in this analysis but could be important for protecting much of the Malagasy fauna since many species have very limited and local distributions due to the climatic variations and dissected topography of the island. Many lemur species also have restricted home ranges and achieve high densities in small areas so that small reserves such as Perinet (and Berenty and Beza Mahafaly in the south, unit XX) can play an important role in their protection; in all cases the conservation value of these areas would be considerably enhanced if the reserves could be enlarged.

n. Evaluation of Protected Area Effectiveness

Levels of management and protection effectiveness are still very low. The total budget for all reserves in 1984 was about $900, exclusive of salaries, and several areas have no budget. Most reserves have few or no permanent staff to combat the threats of fire, zebu cattle and agricultural incursions. Staff have no transport and are not able to reach the reserves so that patrols are rare. Many of the reserves do not have properly marked boundaries and none have proper management plans. In spite of the often considerable knowledge and energy of Eaux et Forêts personnel, protection is minimal. Some reserves, such as Ambatovaky and the other mountain massifs, are protected by their isolation.

Because of the low levels of staffing and the lack of effective control on the ground all reserves in the unit have been scored as having low management effectiveness.

o. Assessment of Suitability of Protected Area Status

The status of most areas is suitable for their management objectives if they could be more effectively managed. However, there are no national parks in this unit and the general public are not permitted to enter nature reserves. Creation of one or more national parks could help attract more interest and more local support for the protected area system of the unit.

p. Identification of Major Gaps in the Protected Area System

All the major vegetation types of the unit are included in the protected area system though mostly inadequately. There is a sharp cline in climatic conditions from north to south of the unit that makes it necessary to have several examples of each vegetation belt included within the protected area system. Moreover several endemic mammals and birds are not protected by any of the existing reserves.

There are a few obvious gaps in the network of protected areas. No reserve now protects the Masoala peninsula, only locality for the red ruffed lemur *Varecia variegata rubra* ; the threatened Madagascar serpent eagle *Eutriorchis astur* may also occur here. No reserves protect the hairy-eared dwarf lemur *Allocebus trichotis,* or the broad-nosed gentle lemur *Hapalemur simus.* Faunal and floral surveys to determine the distribution of other endemic species will no doubt reveal other gaps in the system.

Preliminary satellite maps suggest that there has been as much as 50% reduction in forest cover in some humid forest regions between 1950 and 1973 (Faramalala in prep.) Identification of possible protected areas urgently depends on completion of at least a preliminary map of forest cover, followed by faunal surveys.

q. **Recommendations for Reserve Additions and Extensions**

1. Re-establish a reserve on the Masoala Peninsula. A reserve established in 1939 was degazetted in 1964 to allow exploitation of this valuable and distinctive area and the only sizeable reserve including sea-level forests. This is the only known habitat of the red ruffed lemur and an important habitat for at least three threatened bird species, *Brachypteracias leptosomus, B. squamiger* and *Tyto soumagnei* as well as at least six non-threatened endemic birds

2. Identify from satellite maps and ground surveys a large undisturbed tract of lowland forest and establish a new reserve of at least 10000 hectares. Possible areas include the Mahakira plateau (only known locality for the hairy-eared dwarf lemur), the forests west of Maroantsetra and Antongil Bay, and mainland lowland forest at the latitude of Nosy Borah (Ile St Marie) extending in the south to the 'Sihanaka Forest', the area of rainforest southeast of Lake Alaotra. ICBP also identify these areas of eastern rainforest as important for bird conservation. A large block of lowland forest should protect the complete spectrum of Malagasy rainforest birds and other fauna.

3. Extend the reserve of Perinet-Analamozaotra from its present size of 810 ha to 10,000 ha to include more of the adjacent species-rich forests. Since the forests to the south are very fragmented the extension should include forest to the north of the present reserve.

4. There is an urgent need to establish a reserve in the region of Lake Alaotra if this is still feasible for the protection of this important swamp, a breeding ground for such rare birds as the Alaotra grebe and Madagascar pochard. The Alaotran race of the grey gentle lemur *Hapalemur griseus* is also recorded from the reedbeds.

5. Surveys should be made to identify a suitable reserve in the lowland forests of the Sambirano domain which are currently not protected although an area of great interest and distinctiveness.

r. **Additional Conservation Needs.**

1. Improve protection, management and staffing levels at all reserves, and clearly mark all boundaries of protected areas.

2. Conduct extensive surveys for the planning of an expanded and more comprehensive system of protected areas, especially in the lowland rainforest areas. An essential prerequisite of such a survey is the preparation from satellite maps and ground surveys of a vegetation map showing the extent of remaining forest cover; this project should have highest priority.

3. Surveys should be made in the eastern forests to determine the distribution and status of lemurs and other mammal species, endemic rainforest birds, amphibians, reptiles, butterflies and other high-profile invertebrates and plants. For example the aye-aye once had an extensive range through the north-west and east of the island, and a faunal survey would probably locate more aye-aye populations needing protection other than those animals released on Nosy Mangabé island; recently this species has been recorded in Perinet. Data from faunal surveys should be recorded on standard inventory sheets and lodged with the relevant scientific and management authorities in Madagascar.

4. Surveys should be made to identify wetlands and lakes important for waterbirds and other fauna e.g. crocodiles. In particular surveys should be made of the Lake Itasy region and the east coast wetlands from Sambava northwards and from Tamatave southwards.

5. Extend conservation education programmes to improve conservation awareness in Madagascar, stop hunting of lemurs etc.

6. Conservation funds should be used to support education programmes and local initiatives to discourage the widespread practice of burning land to clear it for agriculture. As protection from wild fires all protected areas should have cleared fire breaks along their boundaries; such firebreaks will also serve to mark reserve boundaries. Firebreaks will require funds for establishment and regular clearing.

7. Revise legislation to protect raptorial birds and the Nile crocodile which are currently listed as vermin.

8. Considerable international assistance should be mobilised to strengthen the capability of the Madagascar authorities in surveys, planning, training personnel and to provide equipment for protected areas management.

3.16 THE WEST MALAGASY REGIONAL CENTRE OF ENDEMISM (Unit XX)

a. Extent of Unit

The unit consists of the western part of Madagascar from sea level ascending to an altitude of about 800 m on the western side of the central mountains which run the entire length of the island. The unit extends from Cap d'Ambre in the north to the southernmost parts of the island but excludes a small exclave in the Sambirano domain; see map 3.5. The unit has a long coastline of about 1,500 kms along the entire western side of the island and has a total land area of 322,000 sq.km.

b. Administrative Divisions

The unit lies entirely within the Democratic Republic of Madagascar.

c. Dominant Vegetation

Map 3.5a shows the original dominant vegetation of the unit. The unit was originally clothed almost entirely by two main vegetation types – Malagasy dry deciduous forest over most of the western half of the island and Malagasy deciduous thicket in the drier areas of the extreme southern tip of the island. The wetter northern part of the island is somewhat anomalous with vegetation on higher ground more similar to the rainforests of the east. Most of the original vegetation of the unit has been destroyed by Man's activity, either cleared for agriculture and/or burned to provide pasture. Secondary grasslands now cover most of the unit.

d. Distinct Habitat Types

Distinctive variants of Malagasy dry deciduous forest grow on lateritic clays, sandy soils and calcareous plateaux respectively. Rather lusher forests grow in riparian habitat along major rivers. Baobab trees are common in the western forests; seven species occur on Madagascar compared to one species in east Africa.

In the semi-arid south and south-west the xerophytic forests are dominated by succulent Euphorbiaceae and Didiereaceae, a family endemic to Madagascar. The southwest has 18 endemic plant genera.

The wetter forests of the Montagne d'Ambre region in the far north are more similar in species composition and structure to the eastern rainforests than to the dry forests found elsewhere throughout the unit.

There are some pockets of mangroves along the west coast, about 21,000 ha in all (Rabesandratana 1984).

e. Current Land Use

Madagascar today has a population exceeding 9 million with an annual population growth of 2.6%, an average population density of 15 per sq.km. Large areas of the south and west, however, have very low population densities (2-5 per sq.km) with the inhabitants largely pastoral. Nevertheless much of the natural vegetation has disappeared because of human activity. The more fertile parts of the unit are used for agriculture (tavy system) with the principal crops being rice, cassava, sugar cane, sweet potatoes, and maize. Most of the area is grassland, however, and is burned every year. Burning off of pasture to provide new growth at the start of the dry season is probably the major cause of deforestation in western regions. These pasture areas are used for grazing by an estimated 9 million cattle.

f. Biological Richness and Endemism of Unit

The unit is of moderate biological richness but is highly distinctive at both species and higher taxonomic level. The flora contains about 2400 species of flowering plants of which about 79% are endemic and about 1000 genera of which about 20% are endemic (White, 1983). Although the eastern evergreen forests are richer in species diversity, the drier forests of the west and southern thickets show a higher degree of endemism. The endemic family Didiereaceae is a striking feature of the spiny desert in the south and southwest.

The fauna of Madagascar is unique, ancient in origin and distinct through isolation. It is characterised by high levels of endemism at species and higher taxonomic levels though, typically for an island fauna, most groups show rather less species than would be expected from an equivalent area of the African continental mainland. Most of the fauna is forest-adapted and thus the eastern unit of the island is considerably richer than the west in species number.

65 of the island's 106 endemic species of birds are found in the western unit and 12 of these are currently believed to be confined to the unit, ten in the dry south.

94% of Madagascar's non-flying mammals are endemic (including the endemic families of lemurs and tenrecs) and 9 of the 28 known bats are also endemic. Although the eastern forests are richer than those in the west there are numerous mammal species entirely confined to the western forests or thickets. 15 of the 28 lemurs occur in the western forests and ten are endemic to the unit. The west also has a long list of reptile species many of which are endemic to the unit, including the angonoka tortoise, one of the world's most threatened reptiles.

g. **Species of Special Economic Interest**

Little is currently known of the commercial potential of the native flora of Madagascar. Several of the ethnic groups use a wide range of plants for medicinal, food and utility purposes e.g. *Euphorbia intisy* and several palms. In the Tulear region alone 78 plant species are utilised for their medicinal properties. Further ethnobotanical studies are required but it can be expected that the rich flora of the unit contains many commercially valuable species. Plotkin et al. (1985) have already compiled an impressive list of locally useful species.

Some forests of the south and southwest are being cleared for charcoal.

Madagascar's unique fauna and lemuroid primates are of especial value and interest for the study of primate behaviour and are a potential attraction for wildlife-based tourism.

h. **Species of Special Biological and Conservation Interest**

The following mammal species are currently listed as threatened in the Mammal Red Data Book of IUCN :

Propithecus verreauxi	Verraux's Sifaka	insuff.known
Phaner furcifer	Fork-Marked Lemur	vulnerable
Cheirogaleus medius	Fat-tailed Dwarf Lemur	insuff.known
Microcebus coquereli	Coquerel's Dwarf Lemur	endangered
Lemur macaco	Black Lemur	vulnerable
Lemur fulvus	Brown Lemur	vulnerable
Lemur coronatus	Crowned Lemur	insuff.known
Lemur mongoz	Mongoose Lemur	vulnerable
Lepilemur septentrionalis	Northern Sportive Lemur	insuff.known
Lepilemur edwadsi	Milne-Edwards' Sportive Lemur	insuff.known
Lepilemur leucopus	White-footed Sportive Lemur	vulnerable
Lepilemur ruficaudatus	Red-tailed Sportive Lemur	endangered
Lepilemur dorsalis	Grey-backed Sportive Lemur	vulnerable

The following bird species are listed as threatened in the Bird Red Data Book of ICBP/IUCN:

Tachybaptus pelzelnii	Madagascar Little Grebe	insuff.data
Ardea humbloti	Madagascar Heron	insuff.data
Anas bernieri	Madagascar Teal	vulnerable
Haliaeetus vociferoides	Madagascar Fish Eagle	endangered
Mesitornis variegata	White-breasted Mesite	rare
Monias benschi	Subdesert Mesite	rare
Amaurornis olivieri	Sakalava Rail	insuff.data
Charadrius thoracicus	Madagascar Plover	rare
Phyllastrephus apperti	Appert's Greenbul	rare
Xenopirostris damii	Van Dam's Vanga	rare
Monticola bensoni	Benson's Rock Thrush	insuff.data

The following reptiles which occur in the unit are listed as threatened in the Reptile Red Data Book of IUCN; most are endemic to the unit:

Geochelone yniphora	Angonoka Tortoise	endangered
Chelonia mydas	Green Turtle	endangered
Eretmochelys imbricata	Hawksbill Turtle	endangered
Lepidochelys olivacea	Olive Ridley	endangered
Caretta caretta	Loggerhead Turtle	vulnerable
Crocodylus niloticus	Nile Crocodile	vulnerable
Geochelone radiata	Radiated Tortoise	rare
Pyxis arachnoides	Madagascar Spider Tortoise	indeterminate
Pyxis planicauda	Madagascar Flat-tailed Tortoise	indeterminate
Erymnochelys madagascariensis	Rere Turtle	indeterminate

The following butterflies of the unit are listed in the IUCN Red Data Book of Threatened Swallowtail Butterflies:

Papilio morondavana	Madagascan Emperor Swallowtail	vulnerable
Papilio grosesmithi		rare

i. Additional Physical Features in Need of Protection

The unit has a number of interesting physical formations that should be preserved including several karst limestone areas which contain interesting cave systems. The largest and best-known cave system is the Grotte d'Andrafiabe in the Ankara special reserve but there are other cave areas in the Tsingy de Namoroka and the spectacular karst scenery of the Tsingy de Bemaraha reserve.

The Tsimanampetsotsa nature reserve contains a distinctive physical feature in the form of a shallow brackish lake of calcium sulphates. This lake is important for flamingoes and other waterbirds.

There are some interesting volcanic formations in the unit, including a spectacular crater lake and cascades in the Montagne d'Ambre National Park in the extreme north of the island.

j. Ethnological or Historical Features in Need of Protection

The unit contains a number of sites of ethnological and historical interest, including the fortress-like tombs built by the Mahafaly people. There are also a number of sites of palaeontological interest where fossil fauna have been found which throw important light onto the evolution of the Malagasy fauna and particularly the evolution of the lower primates.

k. The Protected Areas System of the Unit

Map 3.5b shows the location of the existing and proposed network of protected areas in the unit. Table XX.1 lists these areas, giving their status and the areas of their main habitat types.

Table XX.1 Protected Areas of The West Malagasy Regional Centre of Endemism

name	categ-ory	altit. range (m)	habitat type	habitat area (km^2)	total area (km^2)	manage-ment	contr. score	Prior-ity
Ankarafantsika	1	75-390	F/G22 F 7	500 105	605	3	302	A
Tsingy de Bemaraha	1	75-700	F 7 F/G22	1200 320	1520	3	760	A
Tsingy de Namoroka	1	120-210	F/G22 F 7	190 27	217	3	108	B
Andohahela (2 + 3)	1	120-1956	T/G46	129	129	3	65	B
Tsimanampetsotsa	1	10-160	T 41	432	432	3	216	B
Mont.d'Ambre N.P.	2	1000-1446	F 7	182	182	2	127	B
Isalo N.P.	2	800-1082	F/G22	815	815	3	407	A
Ankara	4	200-300	F 7	182	182	3	73	B
Andranomena	4	0-50	F 7 F/G22	40 24	64	3	26	C

Table XX.1 Protected Areas of The West Malagasy Regional Centre of Endemism

name	categ-ory	altit. range (m)	habitat type	habitat area (km^2)	total area (km')	manage-ment	contr. score	Prior ity
Bemarivo	4	0-120	F 7	116	116	3	46	B
Maningozo	4	200-500	F/G22	79	79	3	32	C
Kasijy	4	120- 500	F/G22	188	188	3	75	B
Tampoketsa d'Analamaitso	4	800-1200	F/G22	171	171	3	68	B
Analamerana	4	200-600	F 7	347	347	4	69	B
Forêt d'Ambre	4	300-1000	F/G22	48	48	4	10	C
Manongarivo	4	1000-1876	F 7	352	352	4	70	B
Bora	4	370- 500	F 7	48	48	4	10	C
Ambohijanahary	4	600-1100	F/G22	248	248	4	50	B

1. Habitat Coverage versus Habitat Threat

Table XX.2 shows the original areas, degree of protection afforded and estimated relative loss or degradation of each habitat type.

Table XX.2 Protection and Threat of Respective Habitats

Habitat type	Original area (km^2)	%age remaining	Protected area (km^2)	%age protected	Proposed area (km^a)	%age proposed
T/G 46	31,250	c.30	129	0.4	-	-
T 41	38,125	c.15	432	1.1	-	-
F/G 22	198,875	c.30	2603	1.3	-	-
F 7	51,875	c.15	1499	2.9	-	-
Mn 77	3,210	c.6o	-	-	-	-
Totals	323,125	c.30	4663	1.4	-	-

These figures show that the protected area system of this unit is inadequate for all vegetation types. This is particularly serious in view of the fast loss of original forest and the lack of forest regeneration caused by the regular burning of most of the unit.

m. Evaluation of Protected Area Importance

The priority reserves of the unit are the large reserves of Tsingy de Bemaraha and Isalo and Ankarafantsika which are of much greater size than the other reserves of the unit. Tsingy de Bemaraha is an area of spectacular natural beauty and both it and Ankarafantsika protect representative samples of the flora and fauna of the drier eastern forests; Isalo N.P. may be less important biologically but has been accorded priority A because of its large size.

Andohahela reserve is interesting because it straddles two biogeographic units and the transition of vegetation types is sharper here than anywhere else in Madagascar with rainforest and dry thicket found on opposite sides of the same ridge. The eastern rainforest block is of greater biological and conservation importance than parcelles 2 and 3 which are considerably disturbed. Other important protected areas are Tsingy de Namoroka, Montagne d'Ambre N.P. and the unique lake of Tsimanampetsotsa.

n. Evaluation of Protected Area Effectiveness

Levels of management and protection effectiveness are still very low. Most of the reserves have few or no permanent staff to combat the threats of fire, zebu cattle and agricultural incursions. A single guard may be responsible for guarding and patrolling many thousands of hectares even though he may be stationed far from the reserve and have no transport. Many of the protected areas do not have properly marked boundaries and none have proper management plans. All reserves have been scored as having low management effectiveness except Montagne d'Ambre N.P. which has recently improved; here management has been scored as medium . Although Ankarafantsika has a larger and more active guard force than many reserves it has scored poorly for management because of on-going boundary encroachment by agriculturalists.

o. **Assessment of Suitability of Protected Area Status**

The official status of the various reserves is adequate to their functions if management was more effective.

p. **Identification of Major Gaps in the Protected Area System**

An obvious gap in the protected area system is the lack of any significant mangrove forest reserve. The west coast of Madagascar has some of the most important stands of mangrove in the entire western Indian Ocean.

All types of original forest are under-represented and some occur in only very small reserves. For instance, the only reserve of more than 5000 ha protecting an example of the Malagasy deciduous thicket (vegetation type 41) is the Lake Tsimanampetsotsa reserve, although this Didiereaceae bush is the characterisitc original type of the southern domain. There is an urgent need to establish a reserve to protect a large block of this spiny forest.

q. **Recommendations for Reserve Additions or Extensions**

1. There is a need for a considerable increase in the area of protected areas in this unit but field surveys would be needed to identify the most suitable places. Almost all remaining, relatively large patches of surviving forest would be valuable additions.

2. New additions to the reserve system should certainly include an example of mangrove and a large block of Malagasy deciduous thicket vegetation (Didiereaceae bush).

3. Extend R.N.I. 7 Ankarafantsika to include Lake Ampijoara and the hills to the north of the lake. The lake is an important habitat for waterbirds.

4. Revise the boundaries of parcelle 2 of R.N.I.11 Andohahela to excise cultivated areas in exchange for equal amounts of undisturbed forest. Extend parcelle 2 to include extensive tracts of spiny forest on its western edge.

5. Extend R.N.I.9 Tsingy de Bemaraha to include a parcel in the west covering a region between Antsalova, Bekopaka, Manombolo River and the sea; this area would include Lakes Masamba and Bemamba which are important feeding grounds for flamingoes and other waterbirds. This region is an area of great natural beauty,with spectacular karst scenery in the Bemaraha massif, and has been proposed as a World Heritage Site.

6. Create a new reserve or national park in the Sept Lacs region of Tulear province, as proposed by the 1970 conference. Establish a reserve around Lake Ihotry to embrace both the lake and a large area of *Didiereacea* bush with its distinctive flora and fauna. The Lake Ihotry region is important for waterbirds and some of the most threatened endemic birds in Madagascar, including two beautiful species *Monias benschi* and *Uratelornis chimaera* found only in this region (see Collar et al. 1985).

r. **Additional Conservation Needs.**

1. Improve protection, management and staffing levels at all reserves. Boundaries of all reserves should be clearly marked, perhaps with firebreaks which would also protect the reserves from the spread of fires deliberately started on adjacent agricultural lands.

2. Conduct extensive surveys for the planning of an expanded and more comprehensive system of protected areas, especially in the lowland forested areas. A prerequisite for such surveys is the preparation of an up-to-date vegetation map from satellite imagery and ground surveys to show the present extent of natural vegetation cover.

3. Surveys should be made of remaining tracts of mangrove on the west coast to identify a suitable area for a reserve to protect this habitat. Sites of interest include the mouths of the Mangoky, Tsiribihana and Betsiboka rivers, Cap Saint-Andre,the Antsohihy area and the coast west of Ambodibonara.

4. Faunal surveys should be carried out to determine the distribution and status of the large, diurnal western forest lemurs and the status and conservation needs of other rare endemics, such as the angonoka tortoise *Geochelone yniphora* found only in the Baly Bay region. All faunal data should be recorded on standard inventory sheets and copies lodged with the appropriate scientific and management authorities in Madagascar.

5. Surveys should be made of all wetlands both on the coast and around Lakes Ihotry and Kinkony to identify important habitats for waterbirds and other fauna such as amphibians and reptiles e.g. crocodile and the endemic freshwater rere turtle *Erymnochelys madagascariensis*, which is restricted to slow-moving rivers and lakes in western Madagascar. Also offshore islands should be surveyed to identify and protect important breeding sites for seabirds and the endemic Madagsacar sea eagle.

6. Extend conservation education programmes to improve conservation awareness in Madagascar, to

stop hunting of lemurs and threatened species of waterfowl, and to discourage the present practice of feu de brousse to clear agricultural and grazing lands. Support local initiatives to discourage local farmers from burning their lands.

7. Revision and enforcement of current legislation is necessary. In particular protection should be afforded to raptorial birds and the Nile crocodile which are currently listed as vermin. Some endemic races of *Ardea* herons are also listed as vermin; their true impact on fish stocks requires evaluation and if impact is slight they should be removed from the vermin list.

8. Considerable international assistance should be mobilised to strengthen the capability of the Madagascar authorities in surveys, planning and training personnel, and to provide equipment for protected areas management. IUCN and other international agencies should cooperate with the Madagascar government to implement environmental and conservation projects identified in the National Conservation Strategy.

3.17 OFFSHORE ISLANDS (Unit XXI)

a. Extent of Unit

This chapter deals with all the main islands in the Gulf of Guinea and those tropical offshore islands lying south of the Equator between the African mainland and the mid-oceanic ridges in the Atlantic and Indian Oceans (except for Madagascar). The islands lying on the continental shelf close to the mainland such as Bioko (Fernando Po) and Zanzibar have been included in the major phytochoria; Bioko in unit I and Zanzibar in Unit XIII. The island of Socotra, lying on the African continental shelf 225 km east of Gape Guardafui belongs, floristically, in the Somalia-Masai Regional Centre of Endemism, phytochorion IV.

This unit Offshore Islands – is a convenient grouping of islands and not a true biogeographic unit. It includes:

–islands in the Gulf of Guinea: Principe, São Tomé and Annobon. Bioko is considered part of unit I.
–Ascension and Saint Helena (South Atlantic)
–the Comoro archipelago comprising the four volcanic islands of Anjouan, Mayotte, Mohéli and Grand Comore, in the Mozambique Channel
–the Seychelles archipelago of 77 islands, covering an area of 26,000 ha
–Aldabra (9,700 ha) and other coral islands of the West Indian Ocean
–the Mascarenes—Mauritius, Reunion and Rodrigues.

Although the Seychelles show floral affinities with both the Indo-Malayan and Afrotropical Realms we have chosen to include them in the latter because of their geographical position.

b. Administrative Divisions

The islands of the region come under several different administrative divisions: São Tomé and Principe, Equatorial Guinea (Annobon), U.K. (Ascension and Saint Helena), Comoro Islands, Seychelles, Mauritius, France (Reunion).

c. Dominant Vegetation

The vegetation of the larger islands is often complex and markedly different from corresponding vegetation on the mainland (White 1983).

Both **São Tomé** and **Principe** were formerly covered with dense forest but much of this forest has been cleared for cocoa and coffee plantations. **Annobon** has some savanna, dry forest and mist forest above 500 m.

The two South Atlantic islands of **Ascension** and **St Helena** are both of recent volcanic origin. Ascension is probably no more than 10,000 years old and the indigenous vascular flora is very poor with only seven species of flowering plants (three endemic) and twelve species of pteridophytes (three endemic). Most of the vegetation today, even far from settlements, consists of species deliberately or accidentally introduced by man. The indigenous flora of St. Helena is also small though there are more than 1000 introduced species, many naturalized. There are only 39 species of flowering plants (38 endemic). Before its discovery in 1502 most of the island was covered with scrub forest but this has been almost completely destroyed for fuel and timber or by clearing for agriculture.

Little is known about the vegetation of the **Comoros** but about half the 935 vascular plants occurring there are indigenous and 136 species are endemic. Natural vegetation only survives on any scale in the mountains. The most extensive and luxuriant forests (20-30 m high) occur on the southern and eastern slopes of Karthala above the limit of cultivation. With increasing altitude the forest becomes shorter and is replaced by 6-8 m thickets of *Philippia comorensis.* Recent lava flows are colonised by pioneer species including *Nuxia pseudodentata* (White 1983).

The indigenous flora of the **Seychelles** islands consists of 233 species of which 72 are endemic. Subsequent to settlement of the islands many weeds have been introduced and the original vegetation has been greatly modified and destroyed over large areas. The original vegetation of the islands included coastal formations including mangrove, lowland rainforest up to 300 m on Mahé and Silhouette, intermediate forest from 300 to 550 m on these two islands with many endemic species, mossy montane forest above 550 m on Mahé, and drier forest in parts of Mahé, Silhouette and Praslin. The lowland rainforest no longer exists and the other forest types remain only as small relict patches. Most of the land is occupied by plantations or secondary communities.

The **Mascarenes** include the three volcanic islands of **Mauritius, Reunion** and **Rodrigues.** The indigenous vegetation has disappeared from most of Mauritius and even where it has not been destroyed

it is threatened by more vigorous, invasive exotic species. The lowland forests have been virtually destroyed but some upland communities remain including swamp forest, *Sideroxylon* thicket, upland forest, mossy forest on Mt Cocotte and *Philippia* thicket. On Reunion vegetation zones are not clear cut and some tree species have wide distributions. Apart from mangrove and other coastal communities other vegetation types include dry megathermic forest (now destroyed), moist forests of low stature (few trees exceed 15 m) extending from sealevel to 1800 m, 'tamarin' scrub forest and ericoid communities on mountain slopes above 2000 m.

On Rodrigues natural plant communities have vanished and only individual plants remain. The original vegetation was low forest 10-15 m high with palm stands and the drought-resistant screw-pine forming the characteristic vegetation of the coral plain on the drier eastern coast.

The scattered low **islands of the Western Indian Ocean** are of two kinds: raised limestone reef islands like Aldabra and sand cays on sealevel reefs. On many of the islands the primary vegetation has been destroyed either to make way for coconut plantations or by guano diggers as on St. Pierre and some islands of the Aldabra group. On Aldabra itself the vegetation is little disturbed by Man but has been modified by the grazing of the resident tortoise population.

For more detailed descriptions of these island vegetations see White (1983).

d. Distinct Habitat Types

Most of the islands off Africa have distinctive floras, a mixture of plant species found on the mainland and their own endemic species. Because of the long history of isolation endemism is high.

Mangrove occurs on several offshore islands with small patches on the coasts of São Tomé (Gulf of Guinea), some of the Seychelles, Reunion and Aldabra.

The tortoise turf of Aldabra is also noteworthy because of the remarkable way this vegetation has been modified by the resident tortoise population of the island.

e. Current Land Use

Most of the African offshore islands have lost most of their natural vegetation as a result of the activities of human settlers, either clearing the land for agriculture or felling wood for fuel and timber. On many islands a high proportion of the contemporary flora has been deliberately or accidentally introduced by Man.

On São Tomé and Principe the natural forests have been almost completely destroyed and replaced by plantations of cocoa (on São Tomé) and coffee and cocoa on Principe. On Mauritius 75% of the island's original forests have been replaced by sugar cane plantations and other crops.

This pattern of agricultural crops replacing natural vegetation is repeated on all the populated offshore islands where soils are sufficiently fertile. On many of the Western Indian Ocean islands the original vegetation has been destroyed to make way for coconut plantations.

f. Biological Richness and Endemism of Unit

Together the islands off the African coast support a large number of plant species, some of which are also found on the African mainland but many are endemics. Some of the more distant offshore islands, such as St Helena and Ascension, have only a small number of indigenous species with most of their present flora consisting of exotics introduced by Man.

On some islands levels of plant endemism are high. The Comoros islands have a flora including 935 vascular plants of which 416 are indigenous and 136 endemic i.e 33% endemism among the native flora. Similarly the Seychelles support a native flora of 233 species of which 72 are endemic (31% endemism).

The fauna of the offshore islands include many interesting and unique species including the giant tortoises of Aldabra, the pink pigeon, and Mauritius kestrel of Mauritius (one of the world's rarest birds) and interesting subspecies of monkeys on São Tomé and Principe. Although the islands are generally poor in species they show high levels of faunal endemism, as is typical for offshore islands. Island endemics are particularly vunerable to habitat disturbance, a situation that is well illustrated on Mauritius where, of the 40 or so known indigenous birds, the dodo is now extinct and populations of Mauritius kestrel, pink pigeon and echo parakeets are dangerously low.

g. Species of Economic Interest

The islands of the western Indian ocean and Seychelles are the native habitat for coconuts *Cocos nucifera;* the coconut has become an important staple food for many island peoples. Other species of economic value include the amazing coco de mer, *Lodoicea maldivica*, a valuable tourist curio.

The unique island endemics are themselves commercially valuable as tourist attractions for limited tourist development. Specialist visitors come to view the unique Mauritian birds and the giant tortoises of Aldabra but far more tourists are drawn by the spectacular coral reefs and sandy tropical beaches of the Seychelles and other Western Indian Ocean islands.

Introduced long-tailed macaques on Mauritius are a serious pest and harmful to local birdlife but since these animals are a popular research animal there is scope for limited trade to supply monkeys for biomedical research. The deer *Cervus timorensis* was also introduced to Mauritius. This species has potential for game farming for meat and velvet.

h. Species of Special Biological and Conservation Interest

The following mammal species and subspecies are listed as threatened in the Mammal Red Data Book of IUCN :

Lemur fulvus mayottensis	Brown lemur	vulnerable
Lemur mongoz	Mongoose lemur	vulnerable

Both lemur species are found only in Madagascar and the Comoros and the Comoro brown lemur is a distinct subspecies. The mongoose lemur occurs only in the north-west forests of Madagascar and on the Comoros islands of Moili (Mohéli) and Ndzouani (Anjouan) and since its forest habitats are disappearing rapidly this species is believed to be seriously endangered.

The following reptiles are listed as threatened in the Reptiles Red Data Book of IUCN:

Chelonia mydas	Green Turtle	endangered
Eretmochelys imbricata	Hawksbill Turtle	endangered
Lepidochelys olivacea	Olive Ridley	endangered
Caretta caretta	Loggerhead Turtle	vulnerable
Geochelone gigantea	Aldabra Giant Tortoise	rare

The following swallowtail butterflies are listed as threatened in the Threatened Swallowtails Red Data Book of IUCN:

Graphium levassori	(Comoros)	vulnerable
Papilio phorbanata	(Reunion)	vulnerable
Papilio manlius	(Mauritius)	indeterminate
Papilio aristophontes	(Comoros)	indeterminate

The following bird species of offshore islands are listed as threatened in the Bird Red Data Book of ICBP/ IUCN:

Pterodroma aternma	Mascarene Black Petrel	endangered
Fregata aquila	Ascension Frigatebird	rare
Bostrychia bocagei	Dwarf Olive Ibis	indeterminate
Falco punctatus	Mauritius Kestrel	endangered
Falco araea	Seychelles Kestrel	out of danger
Atlantisia rogersi	Inaccessible Rail	rare
Gallinula cooneri	Gough Moorhen	rare
Charadrius sanctaehelenae	Saint Helena Plover	rare
Columba thomensis	Maroon pigeon	vulnerable
Nesoenas mayeri	Pink Pigeon	endangered
Psittacula eques	Mauritius Parakeet	endangered
Otus pauliani	Grand Comoro Scops Owl	rare
Otus insularis	Seychelles Scops Owl	rare
Otus hartlaubi	São Tomé Scops Owl	rare
Collocalia elaphra	Seychelles Swiftlet	rare
Coracina typica	Mauritius Cuckoo Shrike	vulnerable
Coracina newtoni	Réunion Cuckoo Shrike	vulnerable
Hypsipetes olivaceus	Mauritius Black Bulbul	vulnerable
Lanius newtoni	Sao Tomé Fiscal Shrike	indeterminate

Copsychus sechellarum	Seychelles magpie robin	endangered
Acrocephalus rodericanus	Rodrigues Warbler	endangered
Acrocephalus sechellensis	Seychelles Warbler	rare
Nesillas aldabranus	Aldabra Warbler	endangered
Amaurocichla bocagei	São Tomé Short-tail	indeterminate
Humblotia flavinstris	Grand Comoro Flycatcher	rare
Terpsiphone corvina	Seychelles black paradise flycatcher	rare
Zosterops ficedulinus	São Tomé White-eye	indeterminate
Zosterops modestus	Seychelles White-eye	endangered
Zosterops mouroniensis	Mount Karthala White-eye	rare
Zosterops chloronothus	Mauritius Olive White-eye	vulnerable
Neospiza concolor	São Tomé Grosbeak	indeterminate
Foudia rubra	Mauritius Fody	endangered
Foudia flavicans	Rodrigues Fody	endangered
Foudia sechellarum	Seychelles Fody	rare
Dicrurus fuscipennis	Grand Comoro Drongo	rare
Dicrurus waldeni	Mayotte Drongo	rare

The ICBP/IUCN Book of Threatened Birds of Africa and Related Islands also lists many more island species as near-threatened . This is a combination of the fact that many species are endemics with small ranges and limited distributions and their vulnerability to habitat disturbance.

i. Additional Physical Features in Need of Protection

Spectacular physical features also needing protection include the many rich coral reefs off the Seychelles and Comoros islands, the volcanic peaks of Karthala (Comoro) and sandy beaches where sea turtles come to lay their eggs.

j. Ethnological or Historical Features in Need of Protection

The unit contains few sites of special ethnological or historical value.

k. The Protected Areas System of the Unit

Many of the offshore islands have no protected areas at all and those that do exist tend to be very small. For the purposes of this review we have only considered terrestrial reserves larger than 2000 ha. Table XXI.1 lists these areas, giving their status and the areas of their main habitat types. For more detailed information and maps of localities of the reserves of the Offshore Islands see the detailed country sheets prepared by PADU for the IUCN Directory of Afrotropical Protected Areas (1986).

Table XXI.1 Protected Areas of The Smaller Offshore Islands of Africa

country	name	categ-ory	altitude	habitat type	habitat area (km^2)	total. area (km")	manage-ment	priority
MA	Macchabee-Bel Ombre	4	50-650		36	36	2	A
CO	Karthala Volcano	pr.	200-2560	F/G 16a	50	50	2	B
SY	Aldabra	1	0-3	Mn 77 G	20 188	208	1	A
SY	Morne	8	0-905	F 19	31	31	3	B
RE	Hauts de St. Phillippe	pr	500-2900	M/F	35	35		A
RE	Mazerin	pr	500-2600	F	20	20		B

1. Analysis of Habitat Coverage versus Habitat Threat

We have made no estimates for loss of habitat types throughout the region. On many of the offshore islands of Africa human settlement has led to extensive clearance of lowland habitats, particularly lowland forests. On Mauritius, for instance, 75% of the island's original forests have been cleared to make way for sugar cane and other crops. Reunion, the largest of the Mascarene islands, has lost very little of its forests above 1800 m though most forests below 600 m have gone, especially in the densely populated coastal

lowlands. However, there are still good opportunities on Reunion for establishing conservation areas to protect some of the island's unique plant and bird species.

m. Overview of Protected Area Systems of the Offshore Islands

The area of land protected on the offshore islands of Africa is very small. Several islands have no reserves at all, for instance São Tomé, Principe and Annobon. Saint Helena has a total of 1900 ha of protected forests, many in small blocks, but much of the island's original vegetation has been destroyed by human activities or by the introduction of exotic plants and animals.

On the islands off the east coast of Africa many of the gazetted reserves are very small indeed, designed to protect islets important for sea bird nesting or a few endemic animals. Thus at 169 ha Round Island is one of the largest Mauritian reserves; the island is given protection status to conserve its birds and four endemic reptiles.

Habitats that are still underprotected within the terrestrial reserve system include mangrove and some of the mountain forests—on Réunion, Comoros, São Tomé, Principe and Annobon. Proposals put forward by Castroviejo et al. (1986) to establish a conservation area to include the whole of Annobon and a marine area should be implemented. Elsewhere there should be urgent action taken to identify areas suitable for reserve status because of their species-rich flora and fauna or high levels of endemism. A proposed ICBP expedition to São Tomé and Principe, a country closed to most would-be visitors, should be able to ascertain areas for conservation priority on these islands.

As well as extending the system of terrestrial reserves it is important to establish a good system of marine reserves to protect some of the fine coral reefs, sandy cays, seabird islets and turtle-nesting beaches found within the unit.

Priority reserves of the unit are Aldabra, because of its unique and well-studied ecosystem, and Macchabee/Bel Ombre nature reserve on Mauritius, which covers a wide range of habitats and harbours the last wild populations of Mauritius kestrel. The proposed Hauts de St Phillipe reserve on Reunion is also considered of high conservation priority as it will protect some of the island's remaining mountain forests, important for both endemic plants and birds.

Other Conservation Needs

Problems of protection and management of native flora and fauna are common throughout the unit. Many of the island reserves are very small, so small that it is unlikely that they will retain their endemic species without active manipulative management. Such management programmes are already being implemented in Mauritius where captive breeding programmes have been established for Mauritius kestrel and pink pigeon with the aim of returning healthy birds to the wild.

The main threats to indigenous species are destruction of habitat, e.g. clearance of lowland forest for agriculture, and introduction of exotic species. Exotic plants now constitute a major part of the flora on some islands of the unit and in Mauritius, for instance, introduced vines are smothering and killing native vegetation even within reserves. Introduced domestic animals and introduced species that have gone feral are also a threat to native flora and fauna. Long-tailed macaques introduced to Mauritius are a serious threat to some of the island's endemic threatened bird as they raid nests to steal eggs and young. Whenever possible management programmes for reserves should include some measures for eradication of exotics and replanting of native plants.

Other conservation priorities are improving levels of protection and management at most reserves, and implementation of programmes for training and conservation education. For an assured and secure future for the network of protected areas it is essential that they have public support. Education programmes should be aimed at all sectors of the community from rural farmers to government officials and decision makers to increase appreciation of the vital role played by protected areas, and particularly protected forests, in protecting watersheds, preventing soil erosion, conserving genetic resources and protecting wildlife and other natural resources of value to local communities. In addition, protected areas have an important aesthetic, educational and recreational role, enhancing the lives of local communities.

3.18 OVERVIEW OF PHYTOCHORION NEEDS FOR CONSERVATION

Table 3.1 gives the area of each of the Afrotropical Realm phytochoria, together with the percentage of equivalent natural habitat remaining, the percentage included in the existing protected area system, the percentage proposed for protection and the percentage equivalent protection contributed by such protected areas when management objectives and levels of management effectiveness have been taken into account (see section 1.4 for methodology).

On the basis of these figures, scores for the urgency of increased protection have been given as determined by the scattering of values on figure 3.1. This score is determined from the equivalent percentage of natural habitat remaining in the unit and the percentage equivalent protection already afforded to it. The broadening of vertical cells towards the baseline of the diagram reflects the increasing urgency for establishing protected areas as habitat loss increases until the no scope line is reached when no additional options remain for increasing protection. Thus highest urgency is given to units which are grossly underprotected but in which significant protection can still be achieved and lowest urgency is **given** to units where adequate protection has already been provided or where no further protection is possible. The urgency scores thus realised are transferred to table 3.1.

Conservation importance is based on the phytochoria S6ores for relative importance for plants and animals (itself the mean of importance for birds and mammals). These scores are based upon the degree of species richness and levels of local endemism noted for plants, selected bird families (passerines) and

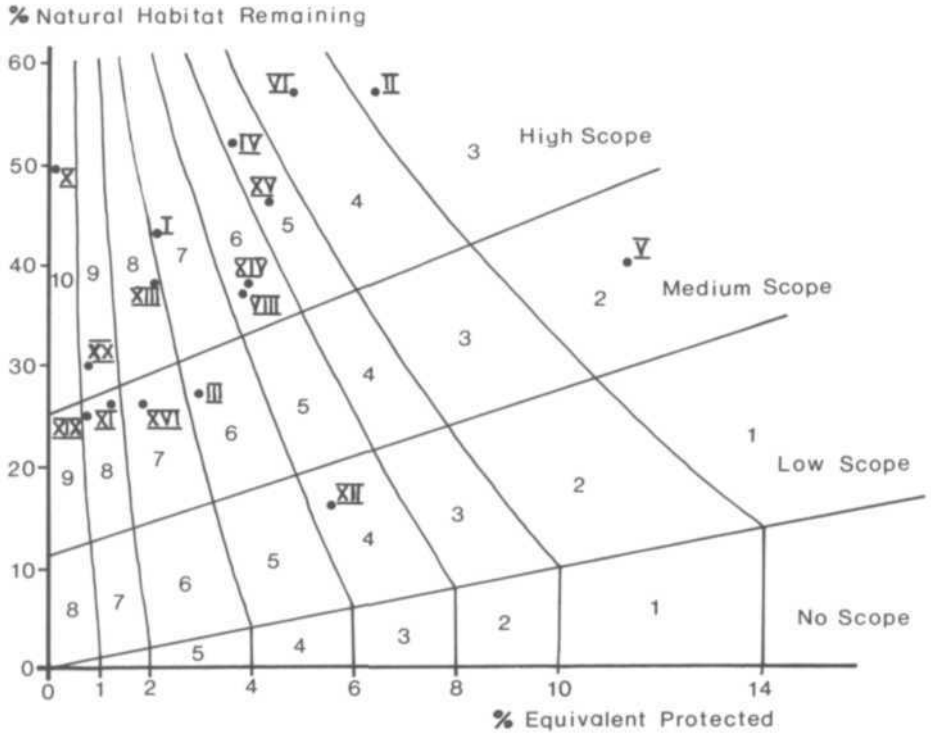


Figure 3.1 *Scatterplot of Phytochoria to establish urgency scores for protection.*

selected mammal families (ungulates and diurnal primates) and presented in table 2.1 (see section 1.4 for methods of calculation). The product of the conservation importance scores and urgency for additional protection scores give the final index for priority for conservation action (table 3.1). This index indicates where conservation action is most needed to achieve full representational coverage of the major biogeographical units of the Realm.

There are five units which score as still greatly underprotected (more than 2.0) and where major species losses are going to occur unless more conservation effort is mobilised. These are, in order of priority, I (Guineo-Congolian) with a score of 7.0, XIX (East Malagasy) 4.3, VIII (Afromontane/Afroalpine) 2.8, XX (West Malagasy) 2.5 and III (Sudanian) 2.3. In addition unit XXI (Offshore Islands), which was not included in the analysis because of inadequate data on habitat areas, would, on the basis of the high levels of bird and plant endemism combined with the paucity of protected areas and extreme vulnerablity of island ecosystems, also score as underprotected.

There are seven phytochoria – II, IV, X, XI, XII, XV and XVI which score between 1.0–2.0 and should be regarded as needing some additional attention but which are reasonably well served with protected area networks.

There are four phytochoria – V (Cape Regional Centre of Endemism), VI (Karoo-Namib), XII (Lake Victoria Regional Mosaic) and XIV (Kalahari-Highveld Regional Transition Zone) which score rather low (less than 1.0) for priority for action because they are fairly adequately protected and/or have little further scope for extra protection.

Table 3.1 Phytochorion Scoring of Priority for Conservation Action.

No.	Phytochorion	Area (km')	Rem. %	Prot. %	Prop. %	Cont. %	Urg. sc.	Pl. imp.	Mam imp.	Bird imp.	Av. imp.	Total imp.
I	Guineo-Congolian	2815500	43	3.6	0.8	2.1	7	100	100	100	1.00	7.0
II	Zambezian	3939100	57	7.7	5.0	6.4	3	79	38	72	0.65	1.9
III	Sudanian	3565400	27	4.4	1.7	2.9	6	18	34	24	0.38	2.3
IV	Somalia-Masai	1990100	52	4.8	3.0	3.6	5	22	50	49	0.36	1.8
V	Cape	76600	40	16.1	0.0	11.3	2	61	9	12	0.36	0.7
VI	Karoo-Namib	692600	57	7.0	2.1	4.2	4	31	9	9	0.20	0.8
VIII	Afromontane	647000	37	4.5	2.7	3.8	6	47	40	51	0.46	2.8
X	Guinea-Congolian/ Zambezia Transition	766200	49	0.3	0.0	0.1	10	6	18	27	0.14	1.4
XI	Guinea-Congolian/ Sudanian Transition	1247900	26	1.7	0.7	1.2	8	6	37	22	0.18	1.4
XII	Lake Victoria	207400	16	7.7	2.3	5.5	4	9	21	48	0.22	0.9
XIII	Zanzibar-Inhambane	379800	38	3.9	0.6	2.0	8	20	18	27	0.21	1.7
XIV	Kalahari-Highveld	1280200	38	7.2	0.0	3.9	6	5	17	12	0.10	0.6
XV	Tongaland-Pondoland	147600	46	5.1	0.0	4.3	5	34	15	15	0.24	1.2
XVI	Sahel Transition	2425400	26	1.5	1.6	1.8	7	4	34	14	0.14	1.0
XIX	East Malagasy	272916	25	1.6	0.1	0.8	8	76	49	12	0.53	4.3
XX	West Malagasy	323125	30	1.4	0.0	0.8	9	30	42	8	0.28	2.5

(Columns refer to total area (sq. kms.), % natural habitat remaining, % of area protected, % of area proposed for protection, % equivalent protection contribution, urgency for additional protection score, plant importance score, mammal importance score, bird importance score, average conservation importance score and total priority for conservation action score.)

This level of evaluation is very much an overview. Priority for action is not uniform throughout any of the phytochoria. Priorities for action within the respective phytochoria are identified in the individual unit reviews in section 3. Thus the highest priority for Unit I is to preserve the disappearing rainforests of the Guinea sub-unit, rather than protect huge new areas in the middle of the Zaire basin. Even where the overall phytochorion picture looks good, there are some high priorities to fill specific gaps in the protection coverage. Thus in unit VI, which scores as one of the units least in need of further conservation action, we still need to protect examples of Succulent Karoo vegetation.

Part Four
GENERAL CONSERVATION ISSUES

Part Four – GENERAL CONSERVATION ISSUES

4.1 DESERTIFICATION

Huge amounts of publicity and attention have been focused in the last three years on the plight of human populations in the drought-stricken parts of Africa along the southern edge of the great Sahara desert, in the belt of semi-arid vegetation known as the Sahel.

The drought has also had serious consequences for wildlife conservation resulting from direct depletion of both animal and plant resources and also from indirect pressures due to increased harvesting by humans and changes in land-use by humans and domestic stocks resulting from the drought.

The Sahel lies mostly between 10° and 20°N and affects areas of Mauritania, Senegal, Mali, Burkina Faso, Niger, Chad, Sudan, Ethiopia, Djibouti, Somalia and North Kenya. The belt is covered in sparse open *Acacia* shrub and grassland but supports a rich and interesting fauna and a substantial human population of pastoral herdsmen.

Rainfall is normally between 100-500 mm per year (more in the south than the north of the belt) and the rainfall pattern is highly seasonal. A rainbelt forms earlier in the south, moving gradually northwards, causing corresponding migrations of insects, birds, large mammals and human pastoralists. These annual migrations make it difficult to protect wildlife within the confined boundaries of small protected areas. Consequently some very large protected areas have been proposed and established such as the Aïr/Ténéré Reserve in Niger and the Ouadi Rime/Ouadi Achim reserve in Chad.

Over the last seventeen years, rainfall has been far less than average. Authors have disagreed as to whether the famines are a direct result of climate or rather the result of changing land-use and land degradation. There is also disagreement as to whether the climate itself is the result of a natural fluctuation or whether it has been affected by human activities.

The whole subject has been well reviewed by Sinclair and Fryxell (1985) who provide convincing arguments to show that the problem is largely due to human disturbance of the originally stable ecosystem. They go on to make some very pertinent recommendations for the restoration of Sahelian productivity.

According to these authors, the original balanced land-use involved pastoralists migrating north and south following the rainfall patterns over the region which enabled then to find water for their cattle, allowed the vegetation to recover from grazing and to seed and permitted the coexistence of a varied and rich biota. In the dry season, the herds moved south onto farmland where the cattle could still find food and provided in return valuable fertilizer through manuring. This balanced pattern has existed for several hundred years and withstood many periods of severe drought.

Three factors have upset this balance – 1) the development of agricultural projects (mostly peanuts) which has restricted the migratory pastoralists from using much of their traditional southern feeding areas, 2) the establishment of waterholes to intensify ranching and encourage permanent settlement and 3) the provision of medical and veterinary services and other benefits which have led to high population growth rates for both people and cattle (3% per annum for the human population). All three processes have been intensified through well-meaning "assistance" by major "developed" countries.

Overgrazing, particularly around waterholes, has led to replacement of perennial grasses by annual grasses and eventually by perennial unpalatable herbs and shrubs or desertification and erosion. Loss of vegetation and vegetation litter, and the resulting drop in albedo, result in medium-term climatic changes tending to promote drought conditions, which exacerbate the problem and deny quick recovery of the degraded ecosystem. Ironically, the principal reason for cutting vegetation is to provide browse for stock.

Short-term solutions such as provision of food and the establishment of new agricultural settlements can only make the problem worse. Only destocking will allow a return to the pre-1960s' condition and that regeneration of the damaged habitats has to take place by self-repair through natural succession.

Sinclair and Fryxell offer an eight point formula for restoration of the Sahel:

1) many of the people must be moved to new areas;
2) they must be educated to establish a new rural economy suitable for that new land;
3) family planning programmes should be introduced to control population increase;

4) herds must be severely restriced and culled;
5) vegetation succession of degraded lands must be closely monitored;
6) when the habitat has suitably recovered, modified migration or rotational grazing systems can be reintroduced;
7) wells should not be dug if they do harm to the migratory system;and
8) the respective governments must be encouraged to institute these measures.

Such a solution will be enormously difficult and expensive to implement and will take at least 25 years to achieve; it may even be politically impossible. Lack of action will lead to complete desertification and loss of this region to both man and wildlife. A huge international effort is needed to achieve this recovery. Donor countries will have to coordinate their programmes if these are to be constructive. Aid programmes must tackle the whole complex of inter-related factors, not merely tackle individual sectors such as agriculture, health, water supply, livestock etc. With this in mind the IUCN Sahel Report (1986) proposes support for a massive network of many small ecodevelopment projects, designed to develop community management of natural resources for sustainable development.

To these sound recommendations we add only the need for reforestation of the vegetation zones to the south of the Sahel. Over most of that region there has been a fast transition from rainforests to savanna-like conditions. Up to 35% of rainfall on rainforest is returned to the atmosphere through transpiration. In former times much of this moisture would be carried north to fall as rain on the Sahel. Destruction of rainforest not only reduces transpiration levels it creates local 'hot spots' so that rainbearing winds move higher and do not drop their moisture.

Almost all of phytochorion XI was once closed forest but has been cleared so that savanna is the dominant habitat over most of the unit. In West Africa the narrow belt of rainforest has been almost entirely destroyed. This must surely be adding to the climatic deterioration of the Sahel. Substantial reforestation of this southern vegetation belt would probably benefit the climate of the Sahel as much as efforts to re-afforest the Sahel itself.

4.2 WETLANDS.

Various types of wetland occur in the realm and support distinctive flora and fauna of great conservation and also often economic interest. Most of these habitats are azonal in nature and cannot be classified under the biogeographical units within which they fall. For convenience recommendations for action in conserving wetland sites have been included under the respective unit and country reviews but in this section we list and evaluate the major wetlands of the Realm according to their habitat type. Table 4.1 gives a crude evaluation of conservation interest of each site by scoring on a 2, 1, 0 basis for site importance for conservation of:- flora, game animals, water birds nesting, water birds feeding, fish, crocodiles/turtles and sirenians. Also included are indications of principal threats from:- cutting/draining, pollution, introduced species, overfishing, other developments. The protection status of each site is given together with a priority for action. We have also indicated those sites which we regard as being of international significance. Such sites meet the standards required for listing as Wetlands of International Importance under the RAMSAR Convention but very few African countries have yet joined this convention or submitted sites for such listing. Those countries with wetland sites listed here as of international significance should be encouraged to join the RAMSAR Convention and to nominate these sites.

The following classification of wetland sites has been used.

a. Mangroves

Mangrove occurs only on shores where the vigour of the surf is broken by sand bars or coral reefs or islands. It is most extensive on the deltas of large rivers but also occurs in small bays and lagoons and can penetrate far inland along rivers (White, 1983). Mangrove occurs along the coasts of both West and East Africa but in the west it is confined to the tropics, extending from Senegal to Zaire. On the east coast it extends from Somalia to Natal, South Africa. In total mangrove occurs along 6000 km of the coastline of mainland Africa. Another 217,600 ha are found on Madagascar (Koechlin et al. 1974), nearly all on the west coast. In addition mangrove is found on the offshore islands of Madagascar and Aldabra (Seychelles) and there are small stands but not forest on Mauritius and Reunion.

Maps 3.1-3.5 show the distribution of mangrove in the Afrotropical Realm. Mangrove develops best under a rainforest climate but it is not confined to the equatorial zone. In Africa the tallest stands, at the

Table 4.1 Major Afrotropical Wetlands

	Country	Flora	Game	Waterbirds breed	Waterbirds feed	Fish	Croc/Turtle	Sirenians	Total	Cut/Drain	Pollution	Introduction	Over-fishing	Development	Protection status	International significance	Priority action	Comment
SODA LAKES																		
Natron	TZ			2	2				4	?	?			*	nil	*	A	establish Protected Area
Nakuru	KY	1	2	1	2	1			7		*	*			NP2	*	B	check pollution
Magadi	KY			1	2				3	*				*	nil		B	too late
Amboseli	KY	1	2	1	1				4	?					NP2		B	
Manyara	TZ	1	2	1	2	1	1		8		?		*	?	NP2	*	B	
Ezasi	TZ		1	1	1				3						nil		B	
Elementaita	KY				2				2					*	nil		B	
Chew Bahir	ET	1	2	1	1				5	*					nil		A	include in P.A.
Sagara	TZ	1	1	1	1		1		5				*	*	nil		B	
Bogoria	KY		1	1	2	1	1		6				*		NP2		B	protect water
Baringo	KY		1	1	1	1	1		5	*	*	*	*	*	nil		B	create P.A.
Rukwa	TZ	1	1	2	2	1	1		8			?	*	*	nil		B	
Balangida	TZ			1	1	?	?		2			?	?	?	nil		C	low priority
Zwai	ET		1		1				2		?		?		nil		C	
Langano	ET		1		1				2		?		?		nil		C	
Abiatta	ET		2	2	1	1			6				*	*	nil		B	include in N.P.
Shala	ET		2	2	1	1			6				*	*	nil		B	include in N.P.
Awasa	ET				1	1	1		3				?	?	nil		C	
Abaya	ET				1	1	1		3				?	?	nil		C	get part in N.P.
Chano	ET				1	1	1		3				?	?	nil		C	get part in N.P.
SALT PANS																		
Nxai Pan	BT	1	1		1				3						NP2		B	
Kaputa	ZM	1	1		1				3						6		B	
Uwanda	TZ	1	1		1				3						4		B	
Makgadikgadi	BT	1	1		1				3						4		B	
Moremi	BT	1	2	1	2		1		7				*	*	4	*	A	maintain
Malosa	MW	1	2		1				4						8		B	
Etosha	NM	1	2	1	2				6						NP2	*	A	maintain
Mweru Wantipu	ZM	1	1		1		2		5				*	*	4		B	
INLAND FRESHWATER SWAMPS AND FLOODPLAINS																		
Malagarasi	TZ	2	2	1	1	1	1		8	*				*	nil	*	B	needs P.A.
Bangweulu	ZM	1	2	1	1	1	1		7	*				*	pt6	*	B	improve management
Kafue Flats	ZM	1	2	1	1	1	1		7	*				*	pt6	*	B	maintain
Liuwa Plain	ZM	1	2	1	1	1	1		7	*				*	pt2	*	B	maintain
Okavanga	BT	1	2	1	2	1	2		9	*	*	*	*	*	pt2	*	A	limit spraying
Ouebi Scebeli	SM	1	1		2	1			5					*	pr4		B	establish P.A.
L. Abbe swamp	ET	1	1	1	1				4					?	nil		B	join Mille Sardo
L. Assale	ET	1	1		1				3					?	nil		B	needs survey
In. Niger Delta	ML	2	2	2	2	1	1		10	*			*	*	nil	*	A	join Elephant W.R.
Oueme Delta	BN	1	1		1	1	1		5					*	nil	*	B	needs survey
Pungue plain	MZ	1	1	1	2				5					?	pt2		B	more protection
Lac du Bam	BF	1	1		1				3					?	nil		C	
Upper Volta	BF	1	2		1	1			5				*	*	pt2		B	
Sudd	SD	1	2	2	2	1	2		10	*				*	Pt	*	A	extend Shambe G.R.
Machar marshes	SD	1	1		1				3					?	nil		C	
Lotagipi swamp	SD	1	1		1				3					?	nil		C	
Lufira valley	ZR	2	1	1	1				3					*	pr4		B	
Cuvette Centrale	ZR	1	2	1	1	1	1		7				*	*	pr		B	establish P.A.s
N. Zaire swamps	ZR	1	2	1	1	1	1		7						nil		B	establish P.A.s
Upemba Swamps	ZR	2	1	1	1	1	1		7				*		2		B	maintain N.P.
Chari plain	CM	1	2		1				4	*				*	nil		B	needs attention
L. Chad	CH +	1	2	1	2	1	1		8	*			*	*	PH	*	B	more P.A.s needed
Mba Illi plain	CM	1	2		2				5	*				*	nil		B	needs survey

	Country	Flora	Game	Waterbirds breed	Waterbirds feed	Fish	Croc/Turtle	Sirenians	Total	Cut/Drain	Pollution	Introduction	Over-fishing	Development	Protection status	International significance	Priority action	Comment
Nyong river	CM	1	2		1				4	*			*	pr4			B	establish P.A.
Logone plain	CM	1	2	1	2				6	*			*	pt2	*		B	protect hydrology
Dande plain	ZW	1	1	1	1				4	*			*	nil			B	
FRESHWATER LAKES																		
Turkana	KY		1	1	2	2	2		8				*		pt	*	B	maintain
Albert	ZR +		1	1	1	1	1		5					*	pt2		B	N.P. protect lake
L. d'Aleg & Mal	MR		1		1	1			3	?			*	?	nil		B	protect lakes
L. Rkiz	MR		1		1	1			3	?			*	?	nil		B	rehabilitate
Naivasha	KY	1	1	1	2	1	1		7		*	*		*	nil		B	
Edward	ZR +		1		1	1	1		4				*		pt2		B	extend N.P. to water
Kivu	ZR +				1	1	1		3			*	*	*	nil		C	
Tanganyika	ZR +	1	1	1	1	2	1		7		*	*	*	*	nil	*	A	needs protection
Malawi	MW +	1	1	1	1	2	1		7		*	*	*	*	pt2	*	A	no introductions
Chilwa	MW	1	1	1	1	1	1		6	*	*			*	nil		C	too late
Mweru	ZR +	1	1		2	1	2		7				*	?	pt2	*	A	extend N.P. to water
Tana	ET					2			2					?	nil		B	
Volta	GH		1		1	1	1		4				*	*	pt2		B	extend Digya N.P.
Bosumturi	GH	?	?		?	?			?				?	?	nil		C	survey
Victoria	UG +	1	1	1	1	2	2		8		*	*	*	*	nil	*	A	needs attention
Kyoga	UG	1	1	1	1	1	1		6			*	*	*	nil		B	
Kariba (art.)	ZW +		2	1	1		1		5			*	*	*	8		C	well attended
Mburo	UG	1	2		1	1	1		6			*	*	*	NP2		B	
Chad	CH +	1	2	1	2	1			7	*				*	nil	*	B	guard watershed
George	UG		1		1	1			3			*	*	*	nil		B	
L. Abbe	ET		1		1	1	1		4	?			?	*	nil		B	needs survey
Kainji	NI		1		1	1	1	2	6				*	*	pt2		B	extend NP.
Ossa	CM	1	1		1	1			4					?	4		B	
Oku	CM	1	1		1	2			5				?	?	pr4		B	establish P.A.
Balambi Mba	CM	1	1		1	2			5				*	*	pr4		B	
Guier Diagle	SN			1	1	1	I		4	*			*	*	nil		B	
Kisale/Kibale	ZR	1	1		1	1	1		5				*		nil		B	survey
Lualaba	ZR	1	1		1	1	1		5				*		nil		B	survey
Lada Retenue	ZR	1	1		1	1	1		5				*		nil		B	survey
Lac Tumba	ZR	1	2	1	1	2	2		9				*	*	nil	*	A	establish P.A.
Mai-Ndombe	ZR	1	2	1	1	2	2		9				*	?	nil		B	survey needed
Nanga	CN	1	1		1	1	1	1	6				*	?	nil		B	survey
Nsumbu	ZM	1	1	1	1	1	1		6						2		B	maintain
L. Akagera	RW	1	1		2				4						2		B	
Zimbabwe lakes	ZW	1	1		1	1	1		5			*	*	*	8		B	maintain
WESTERN MANGROVES																		
Saloum Delta	SN +	1	2	2	2		1		8	*					NP2	*	A	maintain
Basse Casamance	SN	1	1	2	1		1	2	8				*		NP2		B	maintain
Gambia estuary	GM	1		1	1		1	1	5	*	*			*	pr2		B	gazette reserve
Guinea coast	GU	2	1	1	1		1	1	7	*				*	nil		A	needs protection
G. Bissau coast	GB	2	2	1	1		1	1	8	*				*	nil	*	A	needs protection
S. Leone River	SL	2		1	1				4	*				*	nil		C	too damaged
Sherbro River	SL	2	2	1	1		1	1	8						pr4	*	A	establish P.A.
Cape Mount	LB	1	1		1		1		4					*	1		C	improve
Greenville	LB	1		1	1		1		4	*				*	nil		C	low priority
Assini	IC	1	1	1	1		1	1	6	*				*	NP2		B	maintain
Volta Delta	GH	2	1	1	1		1		6	*				*	nil		B	needs P.A.
Lagos	NI	2			1		1	?	5	*	*			*	nil		C	needs P.A.
Niger Delta	NI	2	1	1	1		1	1	7	*	*			*	nil		B	needs P.A.
Cross Delta	NI	2	1	1	1		1	1	7	*				*	pr4		B	process reserve
Douala Edea	CM	2	1	1	1		1	2	8					*	4	*	B	maintain
Rio Utambini	EG	1	1	1	1		1	1	6						nil		C	political impasse
Libreville	GA	1		1	1		1		4	*			*		nil		C	low priority
Cap Lopez	GA	1		1	1		1		4	*			*		nil		C	low priority

	Country	Flora	Game	Waterbirds breed	Waterbirds feed	Fish	Croc/Turtle	Sirenians	Total	Cut/Drain	Pollution	Introduction	Over-fishing	Development	Protection status	International significance	Priority action	Comment
Zaire estuary	ZR +	1		1	1	1	1		5	*		*		nil		B		needs P.A.
Azagny	IC	1	1	1	1		1	2	7					NP2		B		maintain
EASTERN MANGROVES																		
Gulf of Aden	SM	1			1	1			3	*			*	*	nil		B	
Tadjoura Gulf	DJ	1			1	1			3	*			*	*	nil		B	
E. Somalia	SM	1	1		1		1		4	*			*	*	pt2		B	maintain Dodori
Kenya coast	KY	2	1	2	1	1		1	8	*				*	2	*	A	maintain parks
Tanzania coast	TZ	1		1	1	1			4	*			*	*	6		B	upgrade
Rufiji Delta	TZ	2	1		1	1			5	*			*	*	nil		B	establish P.A.
Lindi	TZ	1			1	1			3	*			*	*	nil		C	
E. Mozambique	MZ	1	1		1		2		5	*			*		nil		B	
Zambezi estuary	MZ	2	1	2	1	1	1		8	*			*	*	8	*	B	upgrade reserve
Rio Buzi estuary	MZ	1		1	1	1	1		5	*			*	*	nil		B	
Sao Sebastião	MZ	1		1	1				3	*			*	*	PH		C	
Inhambane Bay	MZ	1		1	1				3	*			*	*	nil		C	
Lorenzo Marques	MZ	1			1	1			3	*			*	*	4		C	improve Maputo
Natal coast	SA	1	1		1				3	*				*	nil		B	
W. Madagascar	MD	2	1	1	1	1	1		7	*	*		*	*	nil	*	A	establish Tulear P.A
Aldabra Atoll	SY	1	1	2	1	1	1	1	7					*	2	*	B	maintain
COASTAL FRESHWATER SWAMPS AND LAGOONS																		
Limpopo Delta	MZ	1	1	1	1		1		5				*		nil		B	survey
Zambezi Delta	MZ	1	2	1	1		1		6				*		Pt4	*	B	extend P.A.
Aby Lagoon	IC	1	1	1	1		1	?	5					*	nil		C	survey needed
St. Lucia	SA	1	2	1	1	1	1		7					*	4		B	maintain
Kosi/Sibayi	SA	1	1		1	1	1		5					*	nil		C	low priority
Ghana coast	GH	1	1		2	1	1	?	6	*				*	nil		B	needs survey
Diawling Delta	MR	1	1	1	2	1	1	?	7				*		pr2		A	establish P.A.
Djoudj Delta	SN	1	1	1	2	1	2	1	8			*	*	*	NP2	*	B	increase P.A.s
Lekki lagoon	NI	1	1	1	1	1	1	?	6		*		*	*	nil		B	needs survey
Coastal lakes	SL	1	1		1		1	?	4					*	pr1		B	Mabese/Mape
Petit Luango	GA	1			1		1	1	4		*		*	*	4		B	improve
Azagny	IC	1	1	1	1		1	2	7					NP2		B		maintain

mouth of the River Niger, are 45 m tall (Rosevear 1947). Mangroves frequently show a marked zonation of species. The occurrence and abundance of individual species are influenced by three main factors: frequency and duration of flooding with seawater, degree of mixing with freshwater at river mouths and concentration of brackish water, and the consistency of the soil (sandy or clay) (White, 1983).

Five species of mangrove are found in West Africa and are completely different from those found in East Africa. The east coast has a more diversified mangrove flora with 9 species; the same nine species also occur on Madagascar.

Mangrove swamps have their own unique fauna—mudskippers, crabs etc, and they are also important nursery grounds for the milt of many fish species of commercial importance, also prawn breeding grounds. They can be useful sites for commercial fish farms and brackish water ponds. Mangroves also serve a vital, and often unrecognised, role in protecting the shoreline. In West Africa some mangrove areas have been cleared and reclaimed for growing rice and other crops.

Mangrove is of considerable economic importance. It provides poles and planks for house and boat building, and is an important source of fuel. In East Africa mangrove tannin is used to preserve fishing nets, ropes and sails and formerly large quantities were exported.

Salm and Chong Seng (UNEP, 1984) give a review of the mangrove areas of East Africa and propose new additions for the reserve system. The Rufiji Delta is a particularly good example. Several proposals have been made in this review to protect areas of western mangroves; in particulalr the mangroves on the Sherbro River (Sierra Leone) and in Guinea and Guinea Bissau are in need of some protection.

b. Coastal Lagoons and Swamps

A characteristic habitat type is found where sand bars and mud banks have formed a sea barrier leaving old, poorly drained alluvium as a mosaic of lagoons, lakes or grassy swamps. Similar coastal swamps are found at the landward edge of the deltas of some of the major rivers. These areas are of great interest to wildlife. Such habitats are found along the coast from Senegal to Angola on the west side of Africa and from Mozambique to South Africa on the east.

c. Inland Freshwater Swamps and Floodplains

Throughout the wetter parts of tropical and subtropical Africa water accumulates in depressions and gives rise to lakes and swamps. Swamp forest occurs throughout the Guineo-Congolian Region wherever conditions are suitable but is most extensively developed in the Zaire basin and the Niger delta. At its most luxuriant it is similar to rainforest with trees reaching 45 m. Guineo-Congolian swamp forest has a diversified endemic flora though is somewhat poor in species. Within this unit there are also few reed-swamp and aquatic plant communities. Elsewhere in Africa most of the shallower lakes, except those which are strongly saline, have a wide belt of reed-swamp dominanted by papyrus *Cyperus papyrus.* Papyrus is widespread in tropical and south Africa and in Madagascar below 2300 m. Reed swamp also occurs in sheltered bays on the shores of deeper lakes and in the backwaters and lagoons of the larger rivers.

Conditions favourable to the development of reed-swamp are widespread in eastern and southern tropical Africa. In Uganda swamp occupies 6% of the total land surface; the largest areas are produced by the Nile, especially where the Victoria Nile flows through Lake Kioga. Further north, in the Sudan, the White Nile and its tributary, the Bar el Ghazal, form the largest swamp in the world, the Sudd, extending over an area of 150,000 km^2.

There are also many swamp areas in the Zambezian region, principally the Okavango, Busanga and Lukanga Swamps and those associated with Lakes Upemba, Mweru, Mweru Wantipa, Bangweulu, Shirwa and Chiuta. Smaller swamps fringe the flood plains of the Zambezi and Kafue rivers. The largest swamp areas in West Africa are on the shores of Lake Chad and in the valley of the Upper Niger south of Timbuctoo.

There have been several plans for the draining and cultivation of African reed swamp or harvesting the reeds for manufacturing paper and hardboard. There are considerable dangers in exploiting such a fragile ecosystem. The water hyacinth, a native of tropical America, was introduced to Africa where it is now a serious pest clogging irrigation canals and waterways.

Many of the larger African rivers in the areas of rather seasonal rainfall have wide floodplains which are inundated only occasionally but support rather distinct grass and reed vegetation and can be immensely important to local wildlife populations; they are often the focus of largescale seasonal game migrations.

d. Freshwater Lakes

Large freshwater lakes occur in several of the continent's major depressions e.g. Zaire basin, Lake Victoria depression, Lake Chad depression and in the Rift Valleys. Small lakes are also found in uplifted highland terrain, old volcanic craters etc. In addition, there are now a number of artificial lakes resulting from dams or made as reservoirs, some of which have become colonised by substantial wildlife resources.

Two lake systems are of particular importance for the evolution of African endemic fish. Firstly, the three lakes, Victoria, Tanganyika and especially L. Malawi are the home of an enormous list of endemic fish species (especially mouthbrooders and other cichlids). Secondly, the Zaire basin lakes Tumba and Mai-Ndombe are the remains of a formerly much larger lake system which was also a centre of fish evolution and remains the main home of many endemic species, including the curious mormyrid or elephant-snouted fish.

Open water is very important for local fisheries but there are grave dangers to native species if exotics are introduced. The disastrous introduction of Nile perch into Lake Victoria, which has proved harmful to endemic wild species as well as human fisheries, is a case in point.

Because of their heavy use by fishermen, it is usually difficult to acquire lakes as fully protected areas, but it would be wise to zone off vital fish breeding areas for special protection. Lamprey (1974) suggests that where protected areas currently adjoin lakes, the protected area boundary should be extended 500 m into the water.

e. Alkaline/Soda Lakes

Several of the lakes of the Great Rift Valley are characterised by high levels of alkaline soda and support a distinct and often spectacular biota. Concentrations of soda vary from lakes that are almost solid with

soda crystals, such as Lake Magadi and parts of Lake Natron, to lakes that are only mildly alkaline, such as Lakes Baringo and Bogoria in Kenya. The soda lakes support a specialised community of alkaline-tolerant crustaceans which form the basic food of the spectacular Greater and Lesser Flamingoes. Huge flocks of these beautiful birds on these lakes are one of the most impressive natural sights of Africa.

f. **Halophytic vegetation**

Saline soils are frequently found in arid and semi-arid regions where rainfall is insufficient to wash away salts produced by weathering. Only a relatively small number of plants – halophytes – grow on saline soils. In parts of the Karoo (unit VI), especially the 'vloere', the vegetation is mainly halophytes (White 1983).

In eastern tropical Africa halophytic vegetation occurs in most of the lake basins of the Eastern Rift, principally Lakes Turkana, Bogoria, Nakuru, Elementeita, Magadi, Natron, Manyara, Eyasi, Rukwa. Lakes Baringo and Naivasha are much less saline, L. Mweru Wantipa in Zambia also supports halophytic vegetation. Some of these lakes are surrounded by extensive salt deposits, the basis of important local industries.

Many of the flat valleys in the drier parts of Tanzania have alkaline soils, e.g Pangani River. In southern tropical Africa saline soils are more localised than in eastern Africa. Principal sites are the Etosha depression (Namibia), Makarikari basin (Botswana), and Changane valley (Mozambique).

g. **Special Problems of Wetland Conservation**

Conservation of Wetlands carries some special problems:-

Wetlands are generally very vulnerable ecosystems depending upon the delicate balance of water levels and water flow, sedimentation, micro-climate, etc., all of which can be easily changed by on-site or neighbouring developments.

Wetland sites are also very dependent upon factors way outside their immediate boundaries. Changes in siltation levels and run-off patterns resulting from developments far upstream can affect the balance of a mangrove forest at the coast. Pollution from a factory can spread through waterways to reach delicate wetland ecosystems. Introduced species are free to pass along the same interconnecting waterways to compete with indigenous species or change local conditions.

A new drainage or irrigation canal can affect watertable levels over large areas. Boreholes and wells result in lowered local water-tables: grazing by domestic animals or fires set by man can transform wetland vegetation; a dam or barrage can cut off adult fish from their spawning grounds; water soluble toxins in herbicides or pesticides drain into wetland sites.

Over much of Africa water is life and human needs for water are bound to exceed wildlife considerations. That wetland sites in the Realm are facing serious ecological stress is seen in the numbers of wetland birds and other fauna being listed as threatened. But whilst Man's developments cause damage and change to many sites and threaten some wetland species, Man is also busy creating new wetland sites in the form of reservoirs, dams and irrigation systems. These new sites are often of great value to wildlife ready to take advantage of the new conditions provided and some excellent new wildlife areas have been created (e.g. Lakes Kainji, Kariba and Volta).

Another problem with the conservation of wetland sites is that many waterways are international boundaries, not the sole responsibility of one protection agency. Moreover, human needs for water, fish, transport routes etc. make it impossible to give exclusive "protective" status to many sites, however important they may be for conservation. Since the viability of protected wetlands is, more than with most other habitats, dependent upon appropriate landuse practices outside which maintain the quantity and quality of water flow, the establishment of wetland protected areas is only one element in a more comprehensive approach to water resource and landuse planning.

For these and other reasons wetlands are the focus of particular specialised attention by IUCN through their wetlands office, through the international convention RAMSAR and through the wetlands offices of other agencies (e.g. ICBP). Two forthcoming documents—the IUCN Directory of African Wetlands and ICBP Review of African Wetlands of Importance to Birds will focus in more detail on this topic.

The conservation priorities of coastal wetlands are treated by Salm and Chong Seng (UNEP 1984) and by Saenger et al., (1983). Hamilton and Snedaker (1984) provide general principles for the management of mangrove resources.

4.3 TSETSE CONTROL

Tsetse flies (*Glossina* spp.) have been a scourge to man both as carriers of the devastating disease sleeping

sickness among humans and as vectors for the spread of nagana disease among domestic cattle. From as early as 1906 programmes have been implemented in various areas of Africa to attempt to control and eradicate these diseases by eradicating the tsetse.

Early measures included the large-scale shooting of wild game to destroy the wild reservoir of nagana disease and widespread burning of bushland to kill the flies' larval stages. In Zimbabwe (then Southern Rhodesia), for example, by 1960 game control operations had led to the destruction of some 750,000 head of wild game and reclaimed 26,000 sq. kms of infested land (Ford, 1971.) Similar operations were undertaken in several other countries in southern Africa. In general this huge slaughter was unsuccessful at controlling tsetse populations (except in Zimbabwe) and even led to substantial increases in wild populations of some game (Child et al., 1970). Elsewhere in southern Africa about 45,000 sq.kms were cleared of bush and since this land was soon colonised by human settlers this clearance for tsetse control often led to total loss of the wildlife resources of the area concerned.

More recently cheaper and more effective control measures have been achieved with the use of insecticides. Over 300,000 sq.kms of Africa have now been sprayed with insecticide (Matthiessen and Douthwaite 1985). These operations certainly helped control tsetse flies but also resulted in massive mortality among other groups of insects and at least 69 species of vertebrates. Even plants (such as Orchidaceae and Aclepidaceae) which have co-evolved with specific insects, on whom they depend for fertilisation, were locally eliminated (Downing and Russell, 1981).

Recent improvements in the means of delivering insecticides and types and concentrations of chemicals involved have greatly reduced the deleterious effects on other wildlife resulting from tsetse control operations. Large scale spraying still continues in Zimbabwe, Botswana, Zambia, Nigeria, Cameroon and Somalia. Tsetse control programmes will undoubtedly continue for the forseeable future.

There is hope of developing measures that are even more cost effective and less environmentally damaging. The use of tsetse attractive targets baited with synthetic chemicals scented like cow's breath and insecticide-impreganted mesh screens is proving highly successful in Zimbabwe. It could be even more effective if the scent funnel of attractant chemicals could be improved to draw in flies from an even wider radius.

Even though relatively safe tsetse control may be on the way such control may lead to environmental degradation by allowing an increase in the numbers of domestic cattle which may in turn lead to overgrazing and other inappropriate forms of land-use. To safeguard against such possibilities the EEC, FAO and other international agencies assisting tsetse control are insisting that such operations should only be implemented after detailed land-use plans have been prepared and discussed.

All in all the vicious tsetse fly may have been one of the great saviours of Africa's wildlife and its indiscriminate eradication may not always be in the longterm interests of either wildlife or humans.

4.4 RHINOCEROS POACHING

Perhaps the most dramatic and most visible loss of Africa's wildlife heritage has been among African rhino populations which have recently been drastically reduced as a result of intense, and often carefully planned and well-financed, international poaching operations for valuable rhino horn.

The rhino population has been declining sharply for many years. Hillman (1981) drew attention to the plight of both black and white rhinos when she published the first continent-wide estimates of between 14000-15000 black rhinos, 3000 southern white rhinos and less than 1000 northern white rhinos. Despite attempts to tackle the problem by a) giving better protection in the field, b) tightening up export control and c) attacking overseas markets, the situation has continued to slide downhill.

A new estimate for 1984 by Western and Vigne (1985) puts the continental figures at only 8,800 black rhinos, 3920 southern whites and only 28 northern white rhinos remaining. Primary losses of black rhinos have been in CAR, Kenya and Zambia, whilst northern white rhinos have been lost from Sudan and Zaire. The northern white rhino is now "effectively extinct" in Uganda, CAR and almost certainly in Sudan. Only 17 are positively known to survive in the Garamba National Park in Zaire where a major WWF project is trying to save this last population.

The increases in both black and white rhino populations in South Africa and Zimbabwe show that rhino populations can be successfully rehabilitated if sufficient input is made to control poaching. It is unlikely, however, that most of the poorer African countries can afford such resources and indeed the costs of protection per rhino mount sharply as population density is decreased and populations become fragmented.

Western and Vigne (1984) predict that rhinos in the northern and central parts of their range will soon

become extinct and that they will survive only in zoos and southern Africa unless they can be saved in their three eastern strongholds—Kenya, Tanzania and Zambia which in total account for about 60% of Africa's black rhinos and do have sufficiently well-developed game departments and lucrative tourist industries, based on game viewing, to justify and enable the needed levels of protective management.

Probably the real fate of these populations will depend on the patterns of world trade in rhino products. Martin (1983) has made a detailed study of world trade in rhino parts. North Yemen, Singapore, Taiwan, China and South Korea are the principal consumers, whilst Khartoum (in a CITES member country) is the principal port of export. Some hope can be gained from the fact that the Far Eastern price for rhino horn has stabilised although supplies are dropping. The oriental pharmacists are increasingly turning to alternatives to rhino horn in preparing traditional medicines.

North Yemen remains the main consumer of rhino horn (for decorative dagger handles) despite a declared ban on import. More efforts must be brought to bear to try to close these international trade outlets and control the smuggling of rhino horn. It is more likely that the rhino can be saved in the international trade arena than through the running gun battles now being fought between poachers and game wardens.

4.5 THE PROTECTION OF CRITICAL HABITATS

Inevitably the area of land that can be included in protected areas is limited. In the whole Realm 4.4 % of the total area is already designated as protected and a further 0.9 % has been proposed for protection. It is doubtful if the majority of African governments will approve very much more land for protection as conservation areas. Equally, however, it is improbable that all the land outside protected areas will be converted to permanent agricultural, pastoral or urban use. There will always be wide areas of semi-wild rangelands, forestry lands and unused areas which constitute habitat for a large (currently the largest) proportion of the Realm's wildlife.

The survival of many species depends upon such "unprotected" habitats. It is important to recognise the importance of such critical habitats for wildlife and ensure that adequate restrictions are placed on their development and use so that they can continue to provide the necessary requirements of the wildlife concerned.

Wetlands are a case in point. Africa's rivers, lakes and swamps are critical habitats for many of the Realm's fish, amphibians, reptiles, birds and invertebrates. Yet these wetlands are crucial routes of communication, fishing grounds and water sources for man and his herds so that few wetland sites can be declared as total protection areas – see above.

Migratory birds are another problem for conservation. Large numbers of Palaearctic breeding birds winter in Africa where they depend on vital stop-over points and dispersed winter feeding grounds, largely outside the protected area system. These include wetlands, forests, mountains and even agricultural lands and gardens.

Similar problems are faced with migrations of large game. Many protected areas provide refuge for game populations which range over larger areas than can be included within the protected areas. Much of the Nairobi National Park game leaves the park to feed on the Athi Plains in July. Closure of the corridor by fenced ranches would enormously reduce the numbers of animals that could be supported by the park and hence reduce its value as a national park.

More famous is the great annual migration of wildebeest and other game from Serengeti through the Mara and back through North Tanzania. As much of the migration route as possible has been included in protected areas but much of the route crosses Maasai tribal cattle lands and the survival of the big game populations depend very much on the attitudes of the Maasai and their management of their rangelands. The wild game do spread diseases to Maasai cattle as well as compete for grazing. This conflict requires very careful and diplomatic handling if the migration pattern is to be maintained. The Maasai must get a fair return for their services to wildlife if they are to cooperate willingly.

Even larger migrations of game occur in the Sahel and Sub-Sahelian belt of Africa, where game populations follow the seasonal movements of the rainfall patterns (Sinclair and Fryxell, 1985). Although some huge reserves have been established to contain local game movements, e.g. Aïr-Ténéré and Ouadi Rime/Ouadi Achim, there are other important migrations in the Niger Inland Delta (Mali), Lake Chad region, North Cameroon, Sudan and Somalia. The development of permanent waterholes, ranches and farms in this belt threaten these migration pathways as well as leading to degradation of the vegetation on which the wildlife depends.

The traditional pattern of cattle ranching in Africa has involved herding domestic cattle on open

rangeland to compete with and mix with wild ungulates. Rinderpest and tsetse fly have always taken their toll and many parasites are freely exchanged between wild and domestic stock. Modern quality controls, especially those imposed by overseas markets such as the EEC, are forcing African ranchers to isolate their cattle from wild animals. This has involved the erection of thousands of miles of game fences, especially in Botswana, Zambia and Zimbabwe, sometimes reinforced by game-free zones in which thousands of wild animals have to be killed. This policy will continue to have very serious repercussions on the movement of wildlife to critical seasonal feeding grounds as well as reducing the genetic transfer between adjacent game populations.

The concept of elephant migration corridors has been developed with mixed success in some Asian countries (Sri Lanka, India, Thailand). Faced with the current heavy pressure from poachers in Africa, the possibility for protecting elephant populations outside protected areas is currently not very feasible.

Much greater attention will have to be paid to the needs of wildlife on lands outside protected areas in the next decade. It will be necessary to examine the policy and practices of forestry, animal husbandry and fisheries as well as establishing guidelines for the use and protection of international waterways and transfrontier resources. One step which must be implemented as soon as possible is the need to conduct environmental impact assessments (EIAs) before approval for major development programmes are implemented. The international conservation agencies can play a threefold role here—firstly, in lobbying, bullying and embarrassing the international and bilateral development agencies into complying with this fundamental requirement and by adopting their own policies of EIA; secondly, in advising individual countries on legislation and other means to protect themselves from environmentally damaging developments; thirdly, in implementing an independent environmental monitoring and early warning system (already within the terms of reference of GEMS and GRID of UNEP). The Conservation Monitoring Centre of IUCN currently monitors the development of the Protected Areas systems (PADU) and the status of individual species (Threatened Plants and Species Conservation Monitoring Units). It should adopt a more habitat-orientated approach and monitor habitats (within the framework of GEMS/GRID) and link its species data and protected areas data with the habitat data.

4.6 SPECIES CONSERVATION NEEDS

a. The Protection of Primate Resources

Primates are a highly valuable resource. Being our nearest living relatives, they have wide appeal and interest to the public and scientists alike. Through primate studies we learn more about the evolution of our own species, and through biomedical experimentation, which is dependent on primates, the lives of many millions of persons are saved and improved. The World Health Organisation (WHO) has estimated that the lives of about 5 million children a year are saved through international immunization programmes. Such programmes are only possible, at present, because vaccines are first tested on primate subjects.

In addition to these aesthetic and practical reasons for conserving primates, monkeys and apes are such important fruit predators and seed dispersers that they constitute one of the major regulating factors controlling regeneration in forests and woodlands in Africa. Conservation of primate resources is central to the conservation of the ecosystems in which they live.

The Primate Specialist Group of IUCN/SSC has drafted an Action Plan for African Primate Conservation which assigns vulnerability categories to the species and subspecies of the Realm. On the basis of this and the degree of protection already afforded the various primate habitats a list has been drawn up of priorities for conservation action (Oates 1985).

Priority sites where information is inadequate and further surveys are needed include—Oban Forests, E. Nigeria; the Cameroon-Nigeria Vanderlahds; the Republic of Congo; Forêt des Abeilles, Gabon; Fernando Po; Gola Forest, Sierra Leone; East and Central Ivory Coast and Northeast Gabon.

Priority sites for establishing or developing management of protected areas are identified as Korup National Park, Cameroon; Lopé Reserve, Gabon; Dja N.P., Cameroon; Lomako Forest, Zaire; Tai N.P., Ivory Coast; Virunga Volcanoes and Okumu F.R., Nigeria.

Additional areas given high priority include:- Madagascar; Sapo, Liberia; W. Ghana parks; Kahuzi-Biega, Zaire; Simen Mts. N.P., Ethiopia; Uzungwa Mts., Tanzania; Tana River G.R., Kenya; Kenyan Coastal Forests; Jozani F.R., Zanzibar; Muzuni Forests and Uzi Island, Zanzibar; Kibale F.R., Uganda; Nzungwe Forest, Rwanda and the Mahale Mts., Tanzania.

These areas of importance are plotted in fig. 4.1. Those areas which also coincide with areas of special conservation significance for plant conservation, bird conservation or other priority conservation projects are listed in Table 4.7 as sites of special conservation importance.

Figure 4.1 *Map of Sites of Primary* (˜) *and Secondary* (™) *Importance for Conservation of Primates.*

b. The Protection of Threatened Birds

Three important new documents deal with the protection of Africa's threatened bird resources :- South African Red Data Book Birds (Brooke, 1984), Threatened Birds of Africa and Related Islands – ICBP/ IUCN (Collar and Stuart, 1985) and Forests Important for Threatened Bird Species Conservation in the Afrotropical and Malagasy Region (Collar and Stuart, in prep.).

In South Africa 102 resident birds are regarded as threatened (all classes) at the national scale (Brooke, 1984) although only 7 of these are regarded as threatened on the continental scale (Collar and Stuart, 1985). A breakdown of these 102 species into size and biome categories is revealing :-

	Large	Medium	Small	Total
Forest	4	2	7	13
Woodland	11	10	9	30
Grassland	5	1	7	13
Wetland	27	6	3	36
Marine	5	5	–	10
Total	52	24	26	102

These show a predominance of large birds and a great predominance of birds from dry and especially wet (wetland) grasslands but relatively few threatened forest species. These findings suggest "that the grasslands and wetlands of South Africa have been subjected to greater ecological stresses than has commonly been realised" (Brooke, 1984). Wetland sites in South Africa are clearly in need of particular protection and careful management.

42 of the threatened birds of South Africa are only peripheral populations of tropical species, most of which are not considered threatened on a continental scale. The same holds true for another 40 species which are widespread in other parts of Africa.

On the continental scale, the pattern of threat faced by bird communities is very different. If we examine the crude size/habitat breakdown of the 168 species of the Realm's birds listed in the IUCN Red Data Book, we see that this list shows a very high predominance of forest birds (52%) and small birds (60%).

	Large	Medium	Small	Total
Forest	6	24	57	87
Woodland	–	5	16	21
Grassland	1	9	17	27
Wetland	10	3	11	23
Marine	4	6	–	10
Total	20	47	101	168

On the continental scale, the threatened species are those confined to shrinking forest patches or endemic to offshore islands. The authors of the IUCN Red Data Book (Collar and Stuart, 1985) are therefore working on a second book to identify specifically those forest areas needed to protect these threatened species. They have kindly allowed us to extract some preliminary findings for inclusion in this review – see tables 4.2 to 4.5 which identify the forest areas most important for conservation of threatened Afrotropical birds.

We have mapped those forests containing more than one threatened species or essential for the preservation of a species as being sites of prime bird conservation importance (fig. 4.3) and other sites with threatened species as of secondary importance. Where these sites correspond with sites also important for the conservation of plants and other animal groups (and most do) they are also listed in table 4.7 as sites of enhanced conservation interest.

Figure 4.3 *Map of Sites of Primary* (˜) *and Secondary* (™) *Importance for Bird Conservation.*

Table 4.2 Forests with more than one threatened bird species

No. of species	Forest
11	Sihanaka (Madagascar)
7	Tai (Ivory Coast)
	South-west Mauritius
	South-west São Tomé
	Usambaras (Tanzania)
	Uzungwas (Tanzania)
	Itombwe (Zaire)
6	Sokoke (Kenya)
	Nimba (Liberia)
	Ituri (Zaire)
5	Grand Gedeh/Grebo (Liberia)
4	Amboim/Gabela (Angola)
	Mt Cameroon (Cameroon)
	Mt Kupe (Cameroon)
	Mt Oku (Cameroon)
	Mt Karthala (Comoros)
	Mahé (Seychelles)
	Gola (Sierra Leone)
	Ulugurus (Tanzania)
3	Bailundu (Angola)
	Mt Nlonako (Cameroon)
	Rumpi Hills (Cameroon)
	Obudu Plateau (Nigeria)
	Nyungwe (Rwanda)
	Pugus (Tanzania)
	Bwindi (Uganda)
	Kivu (Zaire)
2	Kakamega (Kenya)
	Loffa-Mano (Liberia)
	Ankarafantsika (Madagascar)
	Zombitsy (Madagascar)
	Chiradzulu (Malawi)
	Soche (Malawi)
	Thyolo (Malawi)
	Namuli (Mozambique)
	Mulanje (Malawi)

(source: Collar and Stuart, in prep.)

Table 4.3
The 29 forests essential to the preservation of every threatened forest bird species are:

Angola:	Amboim/Gabela Bailundu
Cameroon:	Mt Cameroon Mt Kupe Mt Oku
Comoros:	Mt Karthala
Djibouti:	Day
Equatorial Guinea:	Pico de Sta Isabel (Fernando Po)
Ivory Coast:	Tai
Kenya:	Sokoke Taita
Liberia:	Nimba
Madagascar:	Ankarafantsika Sihanaka Zombitsy
Malawi:	Mulanje
Mauritius:	South-west forests
Reunion:	Plaine des Chicots
Rwanda:	Nyungwe
São Tomé:	South-west forests
Seychelles:	Mahé highlands
Tanzania:	Ulugurus Usambaras Uzungwas
Uganda:	Kibale
Zaire:	Itombwe Ituri Kabobo Marungu

(source: Collar and Stuart, in prep.)

Table 4.4
The 12 forests most urgently in need of conservation today for threatened birds:

Mount Oku (Cameroon)
Day (Djibouti)
Tai (Ivory Coast)
Nimba (Liberia)
Chiradzulu (Malawi)
Mulanje (Malawi)
Soche (Malawi)
Thyolo (Malawi)
South west Mauritius
Gola (Sierra Leone)
Marungu (Zaire)

Table 4.5
The 12 forests where ecological study of the birds is longest overdue:

Amboim/Gabela (Angola)
Taita (Kenya)
Ankarafantsika (Madagascar)
Sihanaka (Madagascar)
Zombitsy (Madagascar)
Namuli (Mozambique)
South-west São Tomé
Daloh (Somalia)
Ngoye (South Africa)
Ulugurus (Tanzania)
Ituri (Zaire)
Lendu (Zaire)

(source: Collar and Stuart, in prep.)

c. Plant Conservation Priorities

The Threatened Plants Unit of CMC/IUCN are preparing a Red Data Book of Plant Sites in need of protection in Africa. The book lists specific sites and also undefined sites such as vegetation types or floristic elements. The criteria for inclusion are that sites:

– must be threatened or under minimal threat of large-scale devastation.
– must have at least one, preferably more, of the following characteristics:
  1) high plant species diversity
  2) high plant species endemism
  3) represent a unique vegetation type, not known elsewhere; or vegetation type under widespread threat and currently inadequately protected.

Important sites are shown in fig. 4.2 and those that overlap with conservation priorities for other taxa are listed as sites of enhanced conservation importance in Table 4.7. The following sites have been selected for the Afrotropical Realm:-

Specific sites:	Loma Mts.	(Sierra Leone)
	Gola High Forest	(Sierra Leone)
	Mt. Nimba	(Liberia/Guinea/Ivory Coast)
	Fouta Djallon	(Guinea)
	Tai Forest	(Ivory Coast)
	Mt. Cameroon	(Cameroon)
	Usambara Mts.	(Tanzania)
	Uzungwa Mts.	(Tanzania)
	Mt. Mulanje	(Malawi)
	Huilla Plateau	(Angola)
	Imatong Mts.	(Sudan)
	Simen Mts.	(Ethiopia)
	Socotra Is.	(S. Yemen)
	Aïr/Ténéré	(Niger)

Unspecified Sites

S.E. Nigeria
Lowland rainforest of Cameroon
Lowland rainforest of Gabon
Part of Haute Katanga (Zaire)
Coastal forests of Kenya/Tanzania .
Part of Mbola District (Zambia)
Kalahari Sands (Zambia, Zimbabwe, Botswana, S. Africa)
Serpentine flora of Great Dyke (Zimbabwe)
Succulent flora of Somalia
Forests of S.W. Ethiopia
Part of Cape Floristic Region (S. Africa)
Eastern Moist Forests of Madagascar
Western Deciduous Forests of Madagascar
Southern Spiny Thicket of Madagascar
Reunion Island

d. **Conservation of Domesticable Species**

A few domestic crops and animals have wild stock or wild relatives living in the Afrotropical Realm, the conservation of which must be regarded as a high practical priority. In addition numerous species currently unused or underutilised have considerable potential for domestication or cross-breeding with domestic varieties. Species of commercial interest have been listed under their respective phytochoria but it is worth listing the conservation requirements of the most valuable species. In table 4.6 the principal commercial plants of the Realm are listed together with their distributions. It can be seen that whilst most species are fairly widespread and adequately protected a few are very restricted and in need of greater protection. A list of sites important for crop species protection emerges, namely:

West African Rain Forests
Madagascar Rain Forests
Aïr/Ténéré
Ethiopian Highlands
W. African Woodland/Grassland Transition

Where specific sites known to contain valuable wild crop resources are also known to be of special importance for the conservation of other taxa they are listed in Table 4.7 as sites of enhanced importance for conservation.

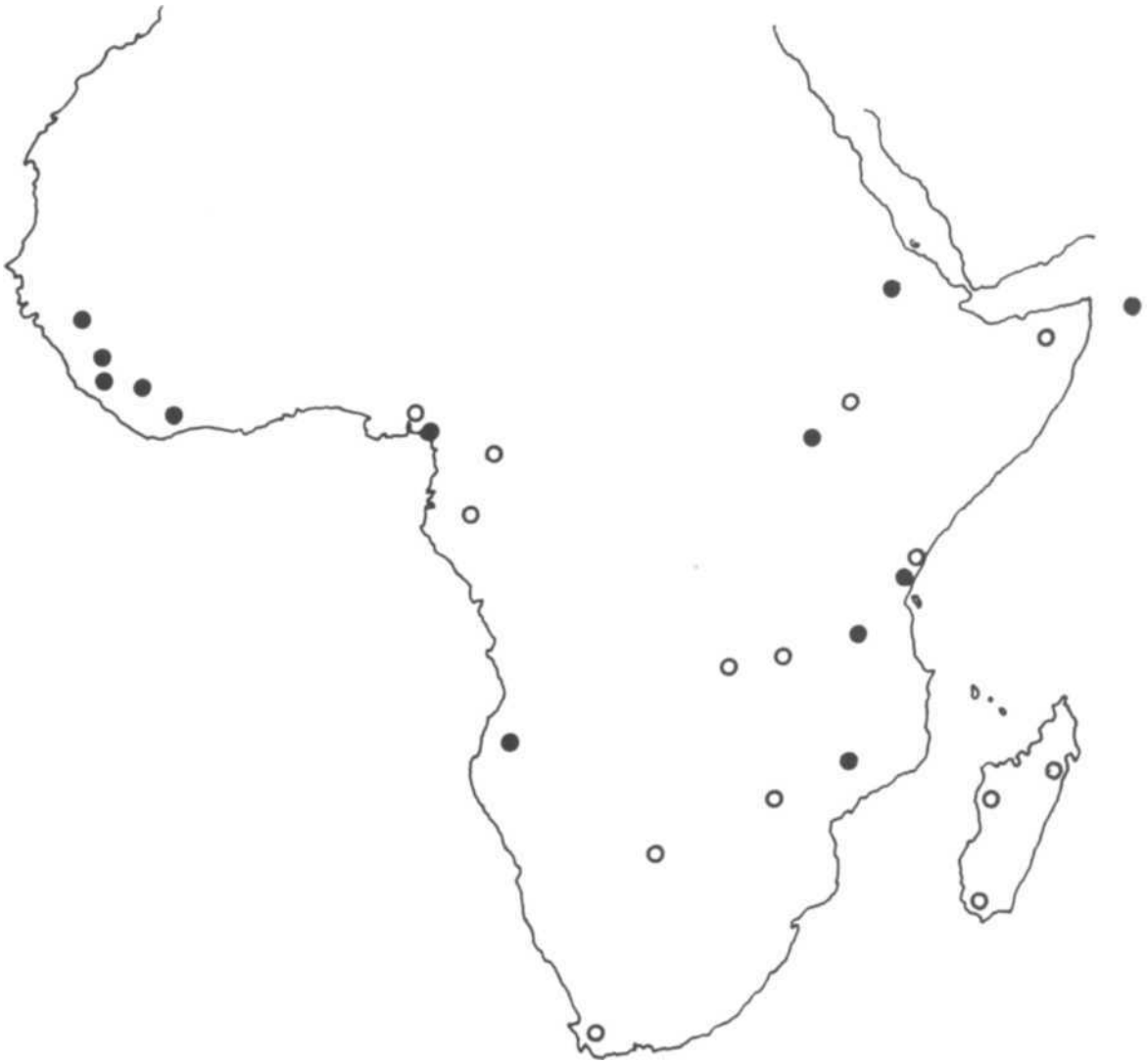


Figure 4.2 *Map of Sites* (˜) *and Areas* (™) *of Plant Conservation Importance.*

Table 4.6 Principal Economic Plants Native to Africa

Coffea arabica	Arabic coffee	Ethiopian Highlands
Coffee liberica	Liberian coffee	West Africa
Landolphia spp.	African rubber	E. & W. Africa
Euphorbia intisy	Wild rubber	Madagascar
Cryptostegia spp.	Wild rubber	Madagascar
Acacia Senegal	Gum arabic	N. Africa
Trachylobium verrucosum	Copal	E. Africa & Madagascar
Copaifera spp.	Copal	W. Africa
Daniella agea	Copal	W. Africa
Tetraclinis articulata	Sandara resin	N. Africa
Pterocarpus erinaceus	Kino resin	W. Africa
Daniella thurifera	Frankincense	W. Africa
Urena lobata	Fibre	Nigeria to Zaire
Afromomum melegueta	Grains of Paradise	W. Africa
Adansonia sp.	Baobob (medicine)	Widespread
Eleusine coracana	African millet	N. Africa
Sorghum vulgare	Sorghum	N. Africa
Avena sativa	Wild oats	Ethiopian Highlands
Hordeum sp.	Wild barley	N. Africa
Triticum sp.	Wild wheat	Ethiopian Highlands
Oryza glaberrima	African rice	N. Africa
Pennisetum americanum	Pearl millet	N. Africa
Voandzeia/Kerstingiella spp.	Bambara groundnuts	W. Africa
Ergrostis tef	Tef	E. Africa
Ensete edule	Ensete	Cameroon to E. Africa
Ensete ventricosa	Ensete	Ethiopian Highlands
Guitzotia abyssinica	Noog	E. African Highlands
Digitaria exilis/iburua	Fonio	N. Africa
Dioscorea rotundata	Yam	W. Africa
Cola nitida	Kola nuts	W. Africa
Citrullus colocynthis	Purgative	N. Africa
Aloe spp.	Glucosides	E. & S. Africa
Olea laperrinei	Wild olive	N. Africa
Butyrospermum parkii	Shea butter	N.W. Africa
Borassus aethiopicus	Sugar palm	N. Africa
Elaeis guineensis	Oil palm	African Rainforests
Lodoicea maldivica	Coco de Mer	Seychelles

e. Conservation Priorities for Insects

Little analysis has been done on the vast amount of data on distribution of African insects with any view to identifying conservation priorities. Insect diversity is closely associated with vegetation complexity and humidity. Most insect species are in the rainforest areas and the fate of these species rests with the fate of humid forests in Africa.

Two groups for which critical habitats have been identified are dragonflies and swallowtail butterflies. Dragonfiies are probably rather good indicators of conservation needs. They have complex life-histories bridging both land and water and often depend on complicated food chains. As such they are sensitive to disturbance and give a reasonable indication of environmental health. This is particularly true for the stenotopic families. Dragonflies have the advantage of being readily visible.

Droughts, drainage schemes, pesticide spraying and urban pollution are creating problems in many very widely spread areas. On the credit side, the damming of both seasonal and permanent rivers tends to create new habitats, thus increasing the diversity of Odonata species. Different types of dam favour different families.

Specific important dragonfly habitats being threatened include:- the Okavango Swamps (pesticide spraying, channel deepening, draining, extraction of water for irrigation), Mkuwadzi Forest (near Nkhota

Bay) in Malawi, Mt. Mulanje (felling) in Malawi and the remnants of natural forest in Nigeria and Cameroon.

Some species at risk include *Teinobasis malawiensis* (known only from Mkuwadzi Forest), *Oreocnemis phoenix* (known only from Mt. Mulanje), *Orthetrum rubens, Eccholorlestes nylephtha* and *N. peringueyi* (S.W. Cape Province of R.S.A). In addition Pinhey (1982) lists several other species which may be endangered.

An IUCN Red Data Book of Threatened Swallowtail Butterflies of the World has been produced (Collins and Morris 1985). This lists 13 African species, see below.

Graphium levassori	Grande Comore	vulnerable
Graphium aurivilliusi	Zaire	insuff.known
Graphium weberi	Cameroon	insuff.known
Papilio sjoestedti	N. Tanzanian volcanoes	rare
Papilio manlius	Mauritius	indeterminate
Papilio phorbanta	Reunion	vulnerable
Papilio aristophontes	Grande Comore	indeterminate
Papilio desmonditeita	Taita Hills	endangered
Papilio antimachus	All rainforests	rare
Papilio morondavana	W. Madagascar	vulnerable
Papilio grosesmithi	W. Madagascar	rare
Papilio leucotaenia	Kivu Highlands	vulnerable
Papilio mangoura	E. Madagascar	rare

Sites identified as important for conservation of these insect groups which are also found to be of special conservation importance for other taxa are listed as sites of enhanced conservation interest in Table 4.7.

f. **Conservation Priorities of Reptiles**

Conservation priorities for Afrotropical tortoises and crocodiles have been identified in the IUCN Amphibia-Reptilia Red Data Book, Part 1 (Groombridge, 1982), and by the relevant specialist groups of IUCN/SSC. In addition IUCN published a special report on the status of African crocodiles (Cott and Pooley, 1972).

Apart from the four endangered and one vulnerable sea turtles, the most threatened group of reptiles are the endemic tortoises of West Madagascar. The following species are threatened there:

Geochelone yniphora	Angonoka	endangered
Geochelone radiata	Geometric Tortoise	rare
Pyxis arachnoides	Madagascar Spider Tortoise	indeterminate
Pyxis planicauda	Madagascar Flat-tailed Tortoise	indeterminate
Erymnochelys madagascariensis	Madagascar Side-necked Turtle	indeterminate

Of these *Geochelone yniphora* is the most endangered with a population estimated at only 100-400 individuals around the Baly Bay, not included in a reserve. This species is top priority of the IUCN/SSC Tortoise Specialist Group and is currently the focus of a JWPT/IUCN/WWF project aimed at local captive breeding.

Other threatened tortoises include the Aldabra Giant Tortoise *Geochelone gigantea* found only on Aldabra Island in the Seychelles, which is a protected area, the Geometric Tortoise *Psammobates geometricus* a vulnerable species of the Cape unit and the little known Pancake Tortoise *Malacochersus tornieri* of East Africa.

Three crocodiles *Crocodylus niloticus* (vulnerable), *Crocodylus cataphractus* (indeterminate) and *Osteolaemus tetraspis* (indeterminate) are also considered as threatened. Importance for crocodile conservation is one of the components scored for wetland sites (see Table 4.1).

For marine turtles African priorities include effective protection of breeding grounds on Ascension Island, Tongaland in South Africa, Bioko, Seychelles (especially Cousin I.), Madagascar, Mauritius (especially St. Bradon Archipelago), Mozambique (especially Primeiras ans Querimba Islands) and Kenya.

Where sites of importance for reptile conservation are also known to be sites of particular importance for the conservation of other groups, they are listed in table 4.7 as sites of special conservation importance.

Table 4.7 List of Areas of Special Conservation Importance

Name	country	plants	birds	primates	others	crops	insects	reptiles	mammals	total	protected
West Madagascar	MD	*	*	*	*		*	*	*	7	part
East Madagascar	MD	*	*	*	*	*	*		*	7	part
Tai Forest	IC	*	*	*		*			*	5	yes
Simen Mts.	ET	*		*	*	*			*	5	yes
South Madagascar	MD	*	*	*					*	4	part
Gola Forests	SL	*	*			*			*	4	no
Sapo	LB			*		*			*	3	yes
Bale Mts	ET				*	*			*	3	yes
Korup	CM	*		*			*			3	yes
Dja	CM	*	*	*						3	yes
Mt. Mulanje	MW	*	*				*			3	no
Uzungwa Mts	TZ	*	*	*						3	prop
Arabuko Sokoke	KY	*	*	*						3	part
Aïr/Ténéré	NI	*				*			*	3	yes
Reunion Is	RE	*	*				*			3	part
North Madagascar	MD	*		*					*	3	part
Nyungwe	RW		*	*			*			3	yes
Loma Mts	SL	*				*				2	prop
Mt. Nimba	GU LB IC	* *	* *							2	part
Mt. Cameroon	CM	*	*							2	no
Taita Hills	KY		*				*			2	no
S.W. Mauritius	MA		*				*			2	?
Kibale	UG		*						*	2	part
Virunga	ZR RW UG			*					*	2	yes
Tana River	KY		*	*						2	part
Mahale Mts.	TZ			*			*			2	no
Comoros Is.	CO		*				*			2	
Aldabra	SY		*					*		2	yes
Ulugurus	TZ	*	*							2	prop
Usambaras	TZ	*	*							2	yes
Central Gabon	GA	*		*						2	part

g. **Conservation Priorities of Other Groups**

Other SSC Specialist Groups of IUCN/SSC have formulated Conservation Action Priorities for Africa as follows:

Wild Pigs – to protect the fragmented and isolated populations of the Great Forest Hog *Hylochoerus meinertzhageni,* particularly of the most threatened form *ivoriensis* in West Africa and the north eastern populations of *H.m. meinertzhageni* in S. Ethiopia and the Rift Highlands.

Equids – more effective conservation of Grevy's Zebra in Kenya, Ethiopia and Somalia. Status survey of Wild Ass populations in Sudan, Ethiopia and Somalia in order to initiate appropriate conservation action. Survey of Wild Asses in central Sahara to assess conservation requirements. Status survey of Hartmann's Zebra in Angola.

Hippos – population survey and conservation recommendations for the Pygmy Hippo. Survey of Common Hippo, especially in critical parts of its range.

Sirenians – conservation of West African Manatee along the Niger river in Mali, Niger, Nigeria and along the West African coast.

Seals – conservation of Monk Seals at Cap Blanc, Mauritania.

Antelopes – conservation of Saharan and sub-Saharan antelopes, especially the scimitar oryx *Oryx dammah,* addax *Addax nasomaculatus,* and endangered gazelles: *Gazella leptoceros, G. cuvieri,* and *G. dama.* The basic problem is to find and protect areas where viable populations of these species can be maintained. In the case of scimitar oryx, addax, and some subspecies of dama gazelle, reintroduction of captive-bred herds will probably be necessary.

– provision of effective parks and strict nature reserves to protect the endemic antelopes of

Somalia, notably the dibatag *Ammodorcas clarkei,* beira *Dorcatragus megalotis,* Speke's gazelle *G. spekei,* Hunter's antelope *Damaliscus hunteri,* and several species of dikdik *Madoqua.*

–improved protection and management to reverse the neglect and destruction of parks and reserves in Mozambique and Angola, particularly the Luando Reserve, Angola, home of the Giant sable.

–effective protection of the Kafue lechwe (*Kobus leche kafuensis*) against poaching, especially in Lochinvar National Park.

–survey the status of the western race of the Derby eland (*Taurotragus derbianus*), and establish secure reserves for this species.

–effective protection and management of Kenya's Shimba Hills National Reserve, where the remnant of Kenya's sable population *(Hippotragus niger roosevelti)* has been reduced over 60% in the last four years, due to deteriorating pasture conditions and poaching.

Canids – save the Simien Fox in Bale Mountains and Simen Mountains.

Cats – more research on cat distribution, status and population and habitat trends, especially for cheetah. Improvement of reserve management, control of poaching, and management of large cat/human conflicts.

Lagomorphs– research on habitat requirements of *Bunolagus monticularis* restricted to central Cape Province, South Africa, to determine the best site for land purchase to develop a reserve.

Elephants and Rhinos– saving of the Northern White Rhino in its last stronghold, Garamba, Zaire. Special consideration of the conservation needs of elephants and rhinos are discussed elsewhere in this section.

Birds of Prey– to protect the Cape Vulture *Gyps coprotheres,* Madagascar Sea Eagle *Haliaelus vociferoides,* Madagascar Serpent Eagle *Eutriorchis aster* and Mauritus Kestrel, *Falco punctatus.*

Hornbills – Conservation of West African forests harbouring *Ceratogymna elata.*

Cranes – protection of Sudd Wetlands, Sudan; Kafue Flats, Zambia; Okavango Delta, Botswana; Lake Chad, Nigeria and Niger Inland Delta of Mali.

Seabirds – many priorities exist to protect seabird colonies including: continuing present conservation efforts on Jackass Penguin and Damara Tern in South Africa and Namibia; survey of White-eyed Gull breeding populations on islands in Red Sea; effective conservation of world's largest population of Roseate Terns on Kiunga-Tenewe Islands, Kenya coast; prevention of persecution of wintering Roseate Terns on coasts of Ivory Coast, Ghana, Benin and Togo; continuing protection of large seabird colonies in Seychelles, Aldabra, Amirantes and Mascarenes; conservation of endangered Mascarene Petrel, now restricted to Reunion.

4.7 SPECIES COVERAGE BY RESERVES

The review has attempted to see how well the different vegetation types in different biogeographical units (phytochoria) of the realm are covered by the existing and proposed protected area systems. It is assumed that if adequate habitat is protected all the constituent species will be included. As a check we have examined the distribution of various indicator species of birds and mammals to see how well they are covered by a number of protected areas selected for their wide geographical spread and availability of suitable data.

Table 4.8 shows how the Coraciformes family of birds are covered by a selection of 30 protected areas. Figure 4.4 presents these results in histogram form to show that only 3 species are not recorded from any of the selected areas (2 being outside the geographical range of the selected areas) and that in total 90% of the species are known from more than one protected area and 55% from more than 5 protected areas.

Figure 4.5 presents the distribution data in the form of a dendrogram showing the degree of relationship between the bird communities of the different reserves. The dendrogram shows the close similarity between all the southern reserves. Most of the East African reserves also fall into a tight block with some regional variation to the north and east. The most distinctive community of the east and southern reserves is that of the peripheral Rwenzori Mts. The West Africa reserves fall into two main groups a fairly closely related rainforest group and a slightly more variable savanna/woodland group. Again the most distinctive reserve is an outlier – the Kibale forest of Uganda. This form of cluster analysis could be used for more reserves and different groups of indicator species to reveal the importance and relationships of individual reserves. The very distinct bird communities of Kibale and Rwenzori are emphasised by this method – two areas that are not adequately protected, yet are seriously threatened by encroachment and which have been rather neglected by conservation efforts.

Table 4.9 shows the occurrence of ungulates, diurnal primates and other threatened mammals in East African reserves. Again the analysis reveals that most species are well covered by the present reserve system. No species were not recorded from the 36 reserves included in the analysis. 14 species (18%) (mostly extralimital species) are known from only one reserve but over 53% of species are recorded from over 5 reserves. A histrogram of incidence frequencies is given in Fig. 4.6.

Analysis of mammal lists for West African reserves (Table 4.10) shows that many of the mammals of this region are not adequately protected by the existing reserve network. Two species (klipspringer and mountain reedbuck) are not recorded for any of the protected areas considered, one species (pygmy chimpanzee) is doubtful (in Salonga) and 22 species are known from only one reserve each. Only 42 species (39%) are recorded from more than 5 of the reserves considered. This less complete coverage may be partly a result of less complete data from the forest reserves but it also reflects the greater *real* differences between West African species communities and the weaker protection of forest habitat coverage. The increased community distinctiveness of the rainforest unit is apparent from dendrograms (see figs. 2.9 and 2.10 and fig. 4.5).

Table 4.11 shows the distribution of Madagascar lemurs in the Natural Reserves and National Parks of Madagascar. Again the coverage is relatively good but not complete. Three species are not recorded for any of the reserves, four are each known from only one (small) reserve; only 10 (35%) are known from 5 or more reserves. As with the West African (particularly rainforest) region there is a need for a considerable increase in the number and extent of protected areas in Madagascar, if large scale species losses are to be avoided.

Evaluation of species lists of individual protected areas across the Realm for selected animal groups indicates that most species are protected in the existing protected area network and that many species are present in several to many protected areas. There are, however, some species that are inadequately protected or not protected at all. Proposals have been made for additional protected areas to include these species.

The findings of this part of the review mirror those from evaluation of vegetation type coverage (section 3). Again, the areas where protection is weakest are the western rainforests, Madagascar, and isolated mountain and island communities. These are the areas where priority for further protected area development and other conseravtion action must be focused.

Table 4.8 Occurrence of African Coraciform Birds in Selected Reserves

Species name	Scngwe	Wankie	Nyika	Kasungu	Liwonde	Lengwe	Amboseli	Aberdare	Mt. Kenya	Mara	Meru	Nairobi	Tsavo	Benue	Waza	Azagny	Kibale	Bale Mts	Sapo	Korup	Tai	Sangabe	Comoe	Niokolo Koba	Mpassa	Lag Badana	Arbowerow	Kidepo	Ngorongoro	Rwenzori
Ceryle rudis	*	*		*	*		*	*	*	*	*	*	*	*	*	*		*	*			*	*	*	*	*	*		*	*
Ceryle maxima	*	*	*	*	*		*	*	*	*	*	*	*	*		*	*		*	*	*	*	*	*	*					*
Alcedo quadribrachys		*															*		*	*	*		*	*	*					*
Alcedo cristata	*	*		*	*	*	*	*		*	*	*	*	*	*	*	*				*	*	*	*	*	*	*		*	*
Alcedo semitorquatus					*								*																*	
Alcedo leucogaster																			*	*					*					
Myioceyx lecontei									*											*					*					*
Ispidin a picta	*	*		*		*	*			*	*	*	*				*	*		*	*		*	*	*	*	*		*	*
Halcyon badia																				*					*					*
Halcyon leucocephala	*	*	*	*	*	*	*		*	*	*	*	*	*	*		*					*	*	*	*	*	*	*	*	*
Halcyon senegalensis	*	*		*	*	*				*				*	*		*		*	*	*		*	*	*					*
Halcyon senegaloides																												*	*		
Halcyon malimbica																	*		*	*	*	*	*	*	*					*
Halcyon albiventris	*	*	*		*	*				*	*		*																	
Halcyon chelicuti	*	*		*	*	*	*			*	*	*	*	*									*	*						
Merops gularis																	*			*	*				*					
Merops muelleri																	*			*	*				*					
Merops bulocki														*	*								*	*						
Merops bullockoides	*	*		*	*					*		*																		
Merops pusillus	*	*	*	*	*	*	*			*	*	*	*	*	*	*	*					*	*	*				*	*	*	*
Merops variegatus																									*					*
Merops oreobates									*	*	*		*																	*
Merops hirundinaceus	*	*		*	*	*																	*	*				*	*	
Merops brewen																														
Merops reviolii											*																	*		
Merops albicollis							*			*	*	*	*			*			*	*	*		*		*	*	*		*	*

	Scngwe	Wankie	Nyika	Kasungu	Liwonde	Lengwe	Amboseli	Aberdare	Mt. Kenya	Mara	Meru	Nairobi	Tsavo	Benue	Waza	Azagny	Kibale	Bale Mts	Sapo	Korup	Tai	Sangabe	Connoe	Niokolo Koba	Mpassa	Lag Badana	Arboverow	Kidepo	Ngorongoro	Rwenzori
Merops orientalis																								*						
Merops boehmi					*																							*		
Merops superciliosus	*	*		*	*	*	*			*	*		*	*											*	*	*		*	*	
Merops apiastur	*	*	*	*	*	*	*	*	*	*	*	*	*		*			*		*				*	*		*		*	*
Merops malimbicus																														
Merops nubicus	*	*		*	*	*							*	*	*							*	*	*		*	*		*	
Coracias abyssinica														*	*								*	*				*		
Coracias caudata	*	*	*	*	*	*	*	*		*	*	*														*	*		*	
Coracias spatulata	*	*		*	*	*																							*	
Coracias naevia		*				*	*			*	*	*	*	*									*	*		*	*	*	*	
Coracias garrulus	*	*	*	*	*	*	*	*	*	*	*	*	*												*	*	*	*	*	*
Coracias cyanogaster														*								*	*	*						
Eurystomus glaucurus	*	*	*	*	*	*	*			*	*	*	*	*		*	*		*				*	*		*	*	*	*	*
Eurystomus gularis																*	*				*				*					*
Upupa epops	*	*	*	*	*	*	*			*	*	*	*	*	*			*					*	*		*	*	*	*	*
Phoeniculus purpureus	*	*		*	*	*	*			*	*	*	*	*	*		*						*	*			*	*	*	*
Phoeniculus damarensis											*		*																	
Phoeniculus granti																														
Phoeniculus bollei								*	*	*		*					*													
Phoeniculus castaneiceps																	*													
Phoeniculus aterrimus																						*		*						
Rhinopomastus minor							*			*	*	*	*													*	*	*		
Rhinopomastus cyanomelas	*	*		*	*	*	*			*	*		*														*		*	*
Tockus fasciatus																*	*		*	*	*	*	*		*					
Tockus alboterminatus	*	*	*	*	*	*	*	*	*	*	*	*	*				*										*		*	*
Tockus bradfieldi	*																													
Tockus pallidirostris				*																									*	
Tockus nasutus	*	*		*	*	*	*			*	*	*	*	*	*							*	*	*		*	*	*	*	*
Tockus hemprichi																														
Tockus hartlaubi																				*					*					
Tockus camurus																*			*	*					*					
Tockus erythrorhynchus		*			*		*			*	*	*	*	*	*				*					*		*	*	*		
Tockus flavirostris		*				*	*				*		*														*			
Tockus deckeni							*			*	*	*	*													*	*			
Tockus jacksoni																												*		
Berenicornis albocristatus																*			*	*	*	*			*					
Bycanistes bucinator	*	*	*		*	*							*			*				*	*	*	*		*			*		
Bycanistes cylindricus																*				*	*	*	*		*					
Bycanistes subcylindricus										*							*				*		*		*					*
Bycanistes brevis	*	*	*					*	*			*	*					*												
Ceratogymna atrata																			*	*	*	*			*					
Ceratogymna elata																			*	*	*	*	*							
Bucorvus abyssinicus							*	*		*			*	*	*			*					*	*				*	*	
Bucorvus leadbeateri	*	*	*	*	*	*																								

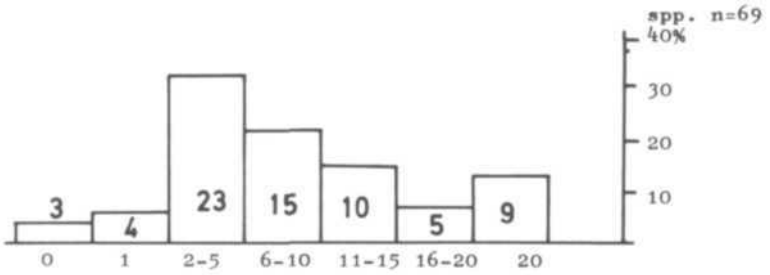


Figure 4.4 *Histogram of incidence of Coraciform bird species in a sample of 30 African reserves.*

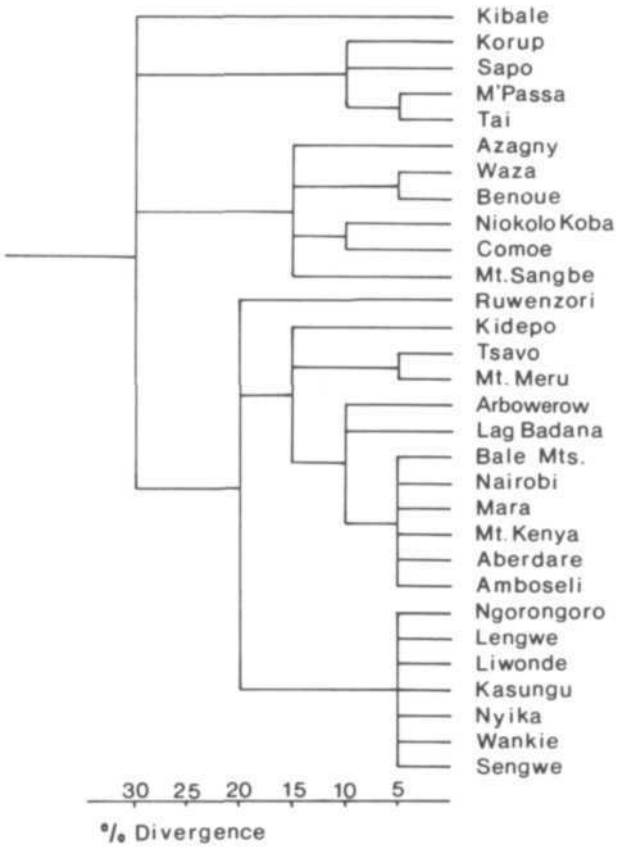


Figure 4.5 *Dendrogram of Relationships among Coraciform bird fauna of selected reserves in Africa.*

Table 4.9 Occurrence of Selected Mammals in East African Reserves

Species name	Reserve	Aberdare	Amboseli	Mt. Elgon	Mt. Kenya	Mara	Meru	Nairobi	Lake Nakuru	Tsavo	Marsabit	Samburu	Shimba Hills	Lake Bogoria	Tana River	Lake Manyara	Mikumi	Ngorongoro	Arusha	Ruaha	Serengeti	Tarangire	Kilimanjaro	Gombe Stream	Selous	Ngorongoro	Kibale	Kabalega	Rwenzori	Kidepo Valley	Kigezi	Bale Mts.	Gambella	Awash	Simen Mts.	Omo	Dinder
Cercocebus albigena														*													*										
Cercopithecus aethiops		*	*			*	*	*	*	*	*	*	*	*		*	*	*	*	*	*		*	*			*	*	*			*	*		*	*	
Cercopithecus mitis		*	*	*	*	*	*	*	*	*	*	*	*			*			*	*	*		*	*		*	*		*		*	*					
Cercopithecus ascanius																										*	*										
Cercopithecus neglectus				*																												*					
Cercopithecus l'hoesti																											*										
Cercopithecus nictitans						*																		*				*	*								
Erythrocebus patas						*	*				*									*							*		*								
Theropithecus gelada																																			*			
Papio anubis		*		*	*	*	*	*	*		*	*		*		*		*	*		*	*				*	*	*	*		*		*		*	*	
Papio hamadryas																																		*	*			
Papio cynocephalus			*							*			*							*					*												
Colobus polykomos		*		*	*	*		*	*		*		*						*				*				*	*		*	*		*				
Colobus guereza																											*										
Colobus badius																				*				*			*		*								
Pan troglodytes																								*			*	*	*								
Gorilla gorilla																																*						
Canis simensis																															*			*			
Lycaon pictus		*	*		*	*	*	*	*	*	*	*						*		*	*	*						*	*								
Acinonyx jubatus			*			*	*	*	*	*	*	*		*				*		*	*	*								*			*	*			*	
Panthera pardus		*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*
Loxodonta africana		*	*	*	*	*	*			*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			*			*	*	
Diceros bicornis		*	*	*	*	*	*	*		*	*	*			*	*	*	*	*	*	*	*	*		*	*				*		*						
Ceratotherium simum							*																															
Equus grevyi							*			*	*																						*					
Equus burchelli			*		*	*	*	*	*	*		*				*	*	*	*	*	*					*				*							
Hippopotamus amphibius			*			*	*	*	*			*				*	*	*	*	*					*	*		*	*				*					
Hylochoerus meinertzhageni		*		*	*	*												*	*								*		*		*							
Phacochoerus aethiopicus			*			*	*	*		*	*	*	*	*		*	*	*	*		*					*	*	*	*	*		*	*	*		*		
Polamochoerus porcus		*		*	*	*	*			*	*	*	*			*	*		*	*							*	*	*			*	*					
Giraffa camelopardalis			*			*		*	*	*			*			*	*	*	*	*	*	*	*		*			*		*			*					*
Giraffa reticulata							*				*	*																										
Alcelaphus buselaphus			*			*	*	*		*				*		*				*	*						*		*				*				
Alcelaphus lichtensteinii																			*					*														
Connochaetes taunnus			*			*		*								*	*			*	*			*													
Damaliscus hunteri										*					*																							
Damaliscus lunatus																									*								*	*			*	*
Damaliscus korrigum						*														*								*									
Cephalophus callipygus																																						
Cephalophus harueyi			*		*	*				*		*	*			*	*		*		*							*	*								
Cephalophus nigrifrons				*	*																																
Cephalophus sylvicultor																													*								
Cephalophus spadix																						*															
Cephalophus monticola		*				*	*			*		*	*						*		*						*	*	*								
Cephalophus natalensis																											*										
Sylvicapra grimmia		*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*		*		*	*	*	*	*		*		*				
Oreotragus oreotragus		*	*		*	*		*	*	*	*	*		*		*		*	*				*						*		*	*					
Neotragus moschatus		*		*	*	*	*	*		*	*		*			*		*		*																	
Ourebia ourebi						*	*													*						*		*		*			*					*
Raphicerus campestris		*	*			*	*	*	*	*		*		*						*	*																
Rhynchotragus kirkii			*			*	*	*	*	*		*		*				*	*	*	*								*								
Rhynchotragus saltiana																																		*				
Rhynchotragus guenlheri											*	*																										
Kobus kob																											*	*	*								
Kobus ellipsiprymnus		*	*				*	*		*		*				*	*	*		*	*	*				*	*						*	*			*
Kobus defassa						*		*	*											*				*				*	*	*				*				
Kobus leche																																						
Redunca redunca		*	*			*	*	*	*	*				*		*	*	*	*	*	*	*						*	*	*		*					
Redunca arundinum																										*												
Redunca fulvoruful a		*			*			*	*					*						*										*			*				
Aepyceros melampus		*	*			*	*	*	*	*		*		*		*	*	*	*	*	*				*	*											
Gazella soemmeringi																																		*				*
Gazella thomsonii			*		*	*		*	*								*			*										*							

	Aberdare	Amboseli	Mt. Elgon	Mt. Kenya	Mara	Meru	Nairobi	Lake Nakuru	Tsavo	Marsabit	Samburu	Shimba Hills	Lake Bogoria	Tana River	Lake Manyara	Mikumi	Ngorongoro	Arusha	Ruaha	Serengeti	Tarangire	Kilimanjaro	Gombe Stream	Selous	Akagera	Kibale	Kabalega	Rwenzori	Kidepo Valley	Kigezi	Bale Mts.	Gambella	Awash	Simen Mts	Omo	Dinder
Gazella granti		*			*	*	*	*	*	*	*					*			*	*	*																
Gazella rufifrons																																					*
Litocranius walleri		*				*			*	*	*		*																							
Hippotragus equinus					*						*							*	*				*				*				*					*
Hippotragus niger											*				*			*					*													
Oryx gazella																															*	*		*			
Oryx beisa		*				*			*	*	*								*	*												*				
Boocercuseurycerus	*			*																																
Tragelaphus buxtoni																													*							
Tragelaphus spekei																							*	*							*					
Tragelaphus scriptus	*	*	*	*	*	*	*	*	*	*	*	*			*	*	*	*	*	*	*			*		*	*	*	*	*	*	*	*	*		*
Tragelaphus strepsiceros									*			*			*			*					*				*				*			*		*
Tragelophus imberbis		*				*			*	*	*							*	*	*							*				*			*		
Taurotragus oryx	*	*			*	*	*	*	*		*				*			*	*	*	*		*	*			*							*		
Syncerus coffer	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*			*			*	*	
Capra walie																																	*				

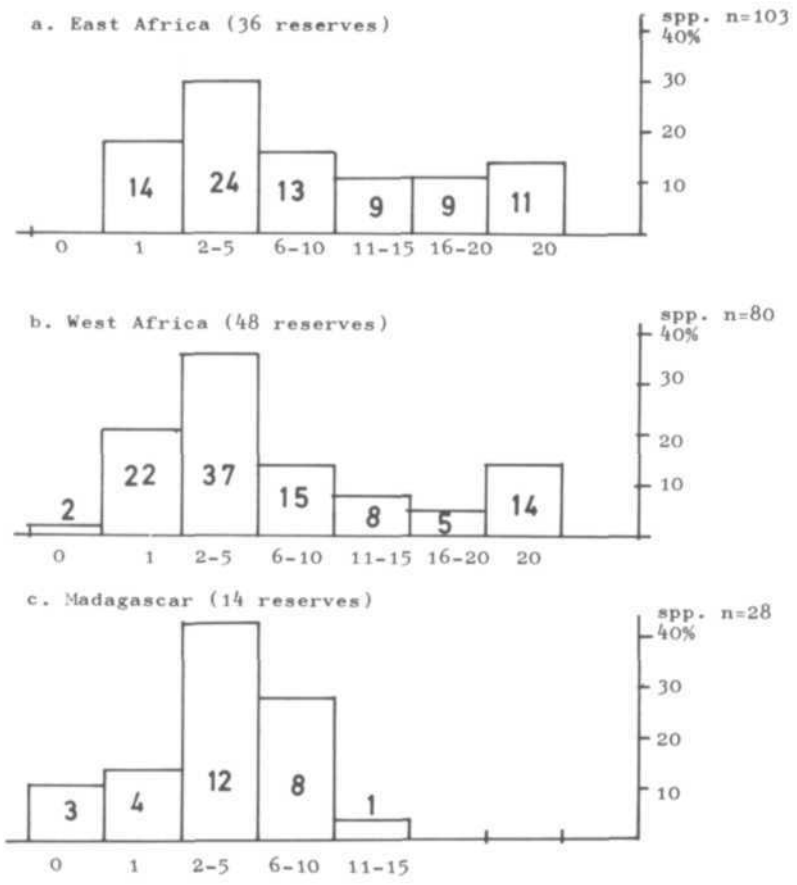


Figure 4.6 *Histogram of incidence of selected mammal species in African reserves.*

Table 4.10 Occurrence of Selected Mammals in West African Reserves

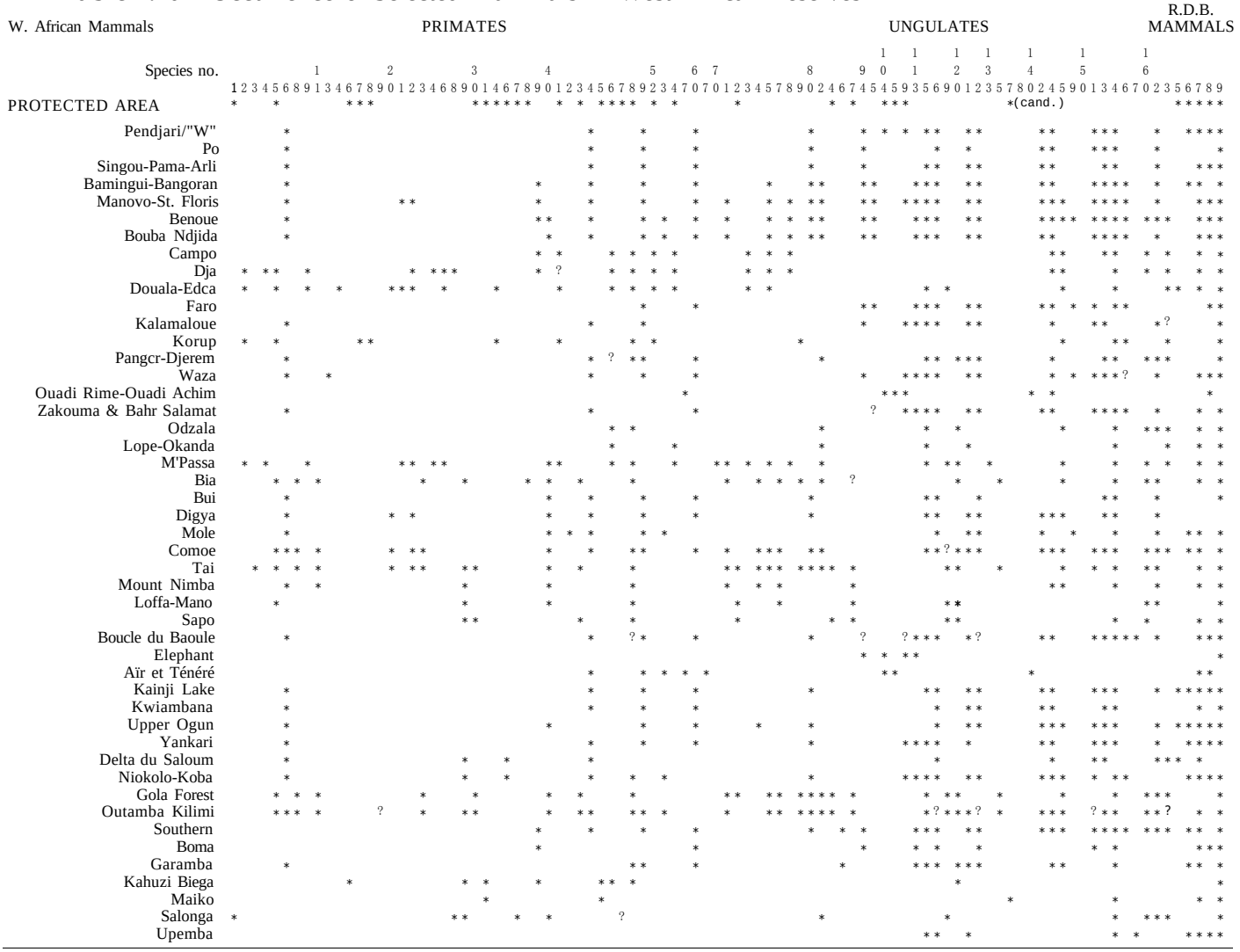


Table 4.10 Key to Mammal List for West African Reserves

No	Latin name	
1*	Allenopithecus nigroviridis	Blackish-green Guenon
2	Cercocebus albigena	Grey-cheeked Mangabey
3	Cercocebus aterrimus	Black Mangabey
4	Cercocebus galeritus	Crested Mangabey
5*	Cercocebus torquatus	White-collared Mangabey
6	Cercopithecus aethiops	Vervet/Green Monkey
8	Cercopithecus campbelli	Campbell's Monkey
9	Cercopithecus cephus	Moustached Monkey
11	Cercopithecus diana	Diana Monkey
13	Cercopithecus erythrogaster	Red-bellied Guenon
14	Cercopithecus erythrotis	Russet-eared Guenon
16*	Cercopithecus hamlyni	Owl-faced Monkey
17*	Cercopithecus l'hoesti	L'Hoest's Monkey
18*	C. l'hoesti preussi	Preuss's Monkey
19	Cercopithecus mitis	Blue Monkey
20	Cercopithecus mona	Mona Monkey
21	Cercopithecus neglectus	De Brazza's Monkey
22	Cercopithecus nictitans	White-nosed Guenon
23	Cercopithecus petaurista	Lesser White-nosed Guenon
24	Cercopithecus pogonias	Crowned Guenon
26	Cercopithecus talapoin	Talapoin
28	Colobus angolensis	Angolan Black and White Colobus

29	Colobus badius	Red Colobus
30*	C. badius badius	Bay Red Colobus
31*	C. badius ellioti	Elliot's Red Colobus
34*	C. badius preussi	Preuss' Red Colobus
36*	C. badius temmincki	Western Red Colobus
37*	C. badius tholloni	Thollon Red Colobus
38*	C. badius waldroni	Miss Waldron's Bay Colobus
39	Colobus guereza	Guereza
40	Colobus polykomos	Western Black and White Colobus
41*	Colobus satanas	Black Colobus
42	Colobus vellerosus	
43*	Colobus verus	Olive Colobus
44	Erythrocebus patas	Patas Monkey
45*	G. gorilla beringei	Mountain Gorilla
46*	Gorilla gorilla	Gorilla
47*	Pan paniscus	Pygmy Chimpanzee
48*	Pan troglodytes	Chimpanzee
49	Papio anubis	Olive Baboon
52*	Papio leucophaeus	Drill
53	Papio papio	Guinea Baboon
54*	Papio sphinx	Mandrill
57	Addax nasomaculatus	Addax
60	Alcelaphus buselaphus	Kongoni
67	Capria lervia	Barbary sheep
70	Cephalophus callipygus	Peter's Duiker
71	Cephalophus dorsalis	Bay Duiker
72*	Cephalophus jentinki	Jentink's Duiker
73	Cephalophus leucogaster	White-bellied Duiker
74	Cephalophus maxwelli	Maxwell's Duiker
75	Cephalophus monticola	Blue Duiker
77	Cephalophus niger	Black Duiker
78	Cephalophus nigrifrons	Black-fronted Duiker
79	Cephalophus ogilbyi	Ogilby's Duiker
80	Cephalophus rufilatus	Red-flanked Duiker
82	Cephalophus silvicultor	Yellow-backed Duiker
84*	Cephalophus zebra	Banded Duiker
86*	Ceratotherium simum cottoni	Northern White Rhinoceros
87*	Choeropsis liberiensis	Pygmy Hippopotamus
94	Damaliscus korrigum	Topi
95	Diceros bicornis	Black Rhinoceros
104*	Gazella dama	Dama Gazelle
105*	Gazella dorcas	Dorcas Gazelle
109*	Gazella rufifrons	Red-fronted Gazelle
113	Giraffa camelopardalis	Giraffe
115	Hippopotamus amphibius	Hippopotamus
116	Hippotragus equinus	Roan Antelope
119	Hyemoschus aquaticus	Water Chevrotain
120	Hylochoerus meinertzhageni	Giant Forest Hog
121	Kobus defassa	Waterbuck
122	Kobus kob	Kob
133	Neotragus batesi	Bates' Dwarf Antelope
135	Neotragus pygmaeus	Royal Antelope
137*	Okapia johnstoni	Okapi
138	Oreotragus oreotragus	Klipspringer
140	Oryx dammah	Scimitar-horned Oryx
142	Ourebia ourebi	Oribi
144	Phacochoerus aethiopicus	Warthog
145	Potamochoerus porcus	Bush Pig
149	Redunca arundinum	Southern Reedbuck
150	Redunca fulvorufula	Mountain Reedbuck
151	Redunca redunca	Bohor Reedbuck
153	Sylvicapra grimmia	Bush Duiker
154	Syncerus caffer	African Buffalo
156	Taurotragus derbianus	Giant Eland
160	Tragelaphus euryceros	Bongo
162	Tragelaphus scriptus	Bushbuck
163	Tragelaphus spekei	Sitatunga
165*	Trichechus senegalensis	West African Manatee
166*	Lycaon pictus	Hunting Dog
167*	Panthera pardus	Leopard
168*	Acinonyx jubatus	Cheetah
169*	Loxodonta africana	African Elephant

*listed as candidate for Mammal Red Data Book (Thornback 1984).

Table 4.11 The Distributions of Lemur Species in the Natural Reserves and National Parks of Madagascar

	Reserve														
Species	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*Total*
Allocebus trichotis															0
Cheirogaleus major	*	*	*	*							*	*			6
Cheirogaleus medius	?						*	*	*	*	*			?	5
Microcebus murinus		*				*	*	*	*		*				6
Microcebus rufus	*		*		*	*	*				*	*		*	8
Microcebus coquereli									*	*					2
Phaner furcifer	*	*		*					*	*	*			*	7
Lepilemur dorsalis						*	*								2
Lepilemur edwardsi							*	*	*						3
Lepilemur leucopus										*	*				2
Lepilemur microdon					*										1
Lepilemur mustelinus	*		*								*				3
Lepilemur ruficaudatus							*			*	*				3
Lepilemur septentrionalis														?	0
Hapalemur griseus	*	*	*	*				*	*		*	*		*	9
Hapalemur simus															0
Lemur catta					*					*	*		*		4
Lemur coronatus														*	1
Lemur fulvus	*	*	*	*	*		*	*	*		*	*	*	*	12
Lemur macaco				*		*									2
Lemur mongoz							*								1
Lemur rubriventer				*											1
Varecia variegata	*	*	*		*										4
Indri indri	*		*												2
Avahi laniger	*	*	*				*	*			*				6
Propithecus diadema	*	*	*	*	*						*	*		*	8
Propithecus verrauxi							*	*	*	*	*		*		6
Daubentonia madagascarensis	*	?	?						?		*			?	2
Totals	1 1	8	9	7	6	4	10	7	8	7	15	5	3	6	*28*

Reserves: 1 Betampona; 2 Masoala; 3 Zahamena; 4 Tsaratanana; 5 Andringitra; 6 Lokobe; 7 Ankarafantsika; 8 Tsingy de Namoroka; 9 Tsingy de Bemaraha; 10 Tsimanampetsotsa; 11 Andohahela; 12 Marojejy; 13 Isalo; 14 Montagne d'Ambre.

4.8 PROTECTED AREAS AS REFUGES FOR ELEPHANTS

prepared by Anne Burrill, Iain Douglas-Hamilton and John MacKinnon from data collected by Iain Douglas-Hamilton

In the course of the present review, emphasis has been placed on determining whether the different vegetation types of Africa are adequately covered in the existing protected areas system. This approach is based on the expectation that if the habitat is intact the constituent species of that habitat will be protected. This expectation is particularly weak for those species which are threatened by direct human pressures such as hunting, poaching, overharvesting or persecution rather than habitat loss or habitat degradation. As a check, the distribution patterns of various selected groups of species have been examined to see if the system of protected areas does indeed provide sanctuary for the full range of species and in particular those species known to be rare or threatened—see above.

Whether the protected areas will be able to maintain their present species composition over time can be only roughly predicted given the current state of understanding of local extinction phenomena. The fate of individual species of concern must be monitored by long-term sampling and re-inventory. Such data are not available for most species but we do have continent-wide information on the status of elephants, collected by Iain Douglas-Hamilton (1976-1979) as part of the African Elephant Survey and Conservation Programme, and since 1982 by the African Elephant and Rhino Specialist Group (AERSG). In this section we therefore intend to analyse the long-term and current trends in elephant populations to throw further light on the effectiveness of the existing protected area system of the realm.

The elephant makes a particularly suitable indicator species because it is large and conspicuous, and data on its distribution can be easily collected from both ground and aerial surveys. Long-term data are available from some areas in the form of registered kills, tusk exports etc. Both living and dead elephants

can be counted with fair reliability from aerial survey (Douglas-Hamilton, 1984). The health of an elephant population reflects both the adequacy of habitat and the adequacy of anti-poaching measures. In addition to these advantages, the elephant is the large mammal species with the broadest habitat range in the realm. Elephants can live in all types of vegetation from sea level to high mountain slopes, from the wettest rainforests to some of the most arid semi-deserts. It was only in the extremely arid regions of North Africa and the Namib/Kalahari deserts that elephants were not seen and reported by the earliest European explorers to the continent.

Today, however, the elephant's range has been drastically reduced, to about one third of its former extent. There are now large parts of Africa where elephants have not been seen for decades. The elephant's range declines as the natural ecosystems of which it is a part also decline. We have used elephant range as an indicator of conservation condition by measuring the percentage of each sub-Saharan vegetation zone and biogeographic unit which is still elephant range.

By 1979 Douglas-Hamilton had collected a large volume of data concerning the status and distribution of the African elephant. A map of elephant range (Fig. 4.7) was made from this data and overlaid on the UNESCO vegetation map of Africa (White, 1983). The amount of current elephant range and the total area were measured for each vegetation zone within each biogeographic unit (phytochorion), excluding the parts of the Kalahari and Namib deserts where elephant are believed to have never occurred. These vegetation areas, equivalent to present and original elephant range, were then scored for each region. Protected areas were also plotted on the overlaid maps to determine the percentage of remaining elephant range which is protected in each region.

The status of the African elephant was first considered on a continental scale by biogeographic phytochoria (Table 4.12). Only two of the 14 units (I – Guinea-Congolian and X – Guinea-Congolia/ Zambezia transition) showed 50% or more elephant range remaining. Of the other units, seven had less than 20% elephant range. Some of these areas of low remaining elephant range have already been the target of conservation measures. The Tongaland-Pondoland region (XV), for example, has 38% of its remaining elephant range protected. However, other areas with low amounts of remaining elephant range have very little protected and require further conservation action to protect elephants. Units most underprotected include: VI (Karoo-Namib), XI (Guinea-Congolia/ Sudania Transition), and XIV (Kalahari Highveld). Each of these biogeographic units has less than 25% of its original elephant range remaining and less than 10% of that is protected. Other units with limited elephant range and limited protection in these areas are VIII (Afromontane) and XVI (Sahel). All of these units are in danger of losing their elephant populations.

Table 4.12 Remaining and Protected Areas of Elephant Habitat by Biogeographic Units

Biogeographic Unit		Area (1000 km^2)	Natural Habitat % elephant range	% Natural Habitat Protected
I	Guineo-Congolian	28155	70	less than 5%
II	Zambezian	39326	41	21–30
III	Sudanian	35671	48	11–20
IV	Somalia-Masai	19899	24	21–30
V	Cape	752	0	-
VI	Karoo-Namib	4739	14	less than 5%
VIII	Afromontane	6453	16	11–20
X	Guinea-Congolia/Zambezia Transition	7662	62	5–10
XI	Guinea-Congolia/Sudania Transition	12479	20	5–10
XII	Lake Victoria Mosaic	2074	21	21–30
XIII	Zanzibar Inhambane	3798	32	less than 5%
XIV	Kalahari-Highveld	9525	13	5–10
XV	Tongaland-Pondoland	1474	12	21–30
XVI	Sahel	24368	6	31–40

Next in priority for additional protection are those units which still have large areas of elephant range, but where very little is protected. Without adequate protection, the natural habitat in these units may diminish until they too become threatened or their elephant populations are eliminated by uncontrolled poaching. Biogeographic units falling into this category include I (Guineo-Congolian), X (Guinea Congolia/Zambezia transition), and XIII (Zanzibar Inhambane).

Figure 4.7 *Distribution of African Elephants in 1979. (Source: Douglas-Hamilton 1979)*

The units with relatively high percentages of elephant range remaining and much of this range protected, such as phytochoria II (Zambezian) and IV (Somalia-Masai), clearly have the lowest priority for additional protected areas, though protective measures or management in protected areas may need improvement.

The same data were also analysed to evaluate the status of elephants on the basis of vegetation (Table 4.13). Vegetation types were grouped into biome classes such as forest, woodland, bushland etc., but could also be considered individually. The priorities for increased protection within vegetation zones, as for biogeographic units, are here based on the amount of natural elephant range remaining and the extent of its protection.

Table 4.13. Remaining and Protected Areas of Elephant Range by Vegetation Type

Vegetation Zone	Area (1000 km^2)	Natural Habitat (% elephant range)	% Natural Habitat Protected
Forest	26512	72	less than 5%
Forest/Grassland Transition	27726	35	5–10
Woodland	62672	38	21–30
Woodland/Grassland Transition	8161	62	5–10
Bushland	29447	21	21–30
Bushland/Grassland Transition	4126	29	31–40
Grassland	5219	44	5–10
Montane	6086	14	11–20
Arid and Semi-Arid	22584	4	less than 5%
Aquatic	2396	54	11–20
Halophytic	501	74	11–20
Mangrove Swamps	855	20	less than 5%

Vegetation types with less than 20% elephant range remaining are montane and arid areas. Both of these types also have only small amounts of their original elephant range protected. Thus remaining elephant range in these types should be a high priority for additional protection.

Additional protection is also needed for those vegetation types with higher percentages of remaining elephant range but low proportional protection. The most critical regions in this category are forests and mangroves (probably not essential for elephants), each of which have less than 5% of their remaining elephant habitat protected. Also somewhat underprotected are remaining elephant ranges in the woodland/grassland transition zones and grassland biomes.

Woodlands, bushland and bushland/grassland transition zones are the vegetation types in least need of additional protection on the continental scale. In each case over 20% of the vegeration zone is still inhabited by elephants and a relatively large amount of this habitat is protected.

Priorities for extra protection can also be established by vegetation type within each biogeographic unit. Elephant range in unit XII (Lake Victoria Regional Mosaic), for instance, is fairly well-protected on the continental scale, but some vegetation types within the unit are underprotected e.g. natural forest and the forest/grassland transition zone.

Phytochorion XIV (Kalahari-Highveld) is, in contrast, a priority unit for extending protection of elephant range but within the unit there is already a relatively large amount of protected natural bushland. Efforts to increase protection in this region should be focused on the woodland/grassland transition zone.

Declaring an area protected is the first step in maintaining the natural ecosystem. It has been shown (Douglas-Hamilton, in prep.) that in a sample of protected areas examined, large mammal densities were consistently higher within park boundaries than immediately outside. Moreover the national figures collected in 1979 by ID-H indicate that mean densities of elephants inside protected areas were on average 6.8 times higher than in remaining elephant habitat outside protected areas. Already by 1979 51% of Africa's elephants were found within protected areas although these areas accounted for only 14% of total remaining elephant range (Douglas-Hamilton, in prep). However, protected areas vary considerably in the actual degree of protection afforded to the natural ecosystems they include and some protected areas have failed to protect their elephant populations.

We have used elephant data to evaluate the characteristics of a sample of 20 protected areas in an effort to determine how various factors affect their conservation success. These 20 areas (Ruaha, Luangwa, Manyara, Queen Elizabeth, Tsavo, Murchison Falls, Bamingui, Wankie, Kruger, Niokola-Koba, Addo,

Garamba, Yankari, Chobe, N.E. Selous, Serengeti, Manovo-Gounda-St.Floris, Kasungu, Virunga and Shambe) were chosen to give a sample from across the continent and also on the availability of data indicating the change in elephant densities over a three or four year period ending about 1980. The change in densities (trend) was used as a basis for comparison rather than absolute densities which might reflect differences based strictly on habitat. The average annual change was correlated with each of several factors which we thought might have an impact on the wildlife numbers in the park. These factors included scores for: administrative and law enforcement capacity, political climate, land pressures, poaching threat, economic conflict in land use, conservation importance and investment, economic potential of wildlife, scientific facilities and tourist facilities.

Of these, the most significant factor affecting the trend in elephant numbers was the poaching threat (Figure 4.8). Only one protected area with a moderate or high poaching threat (Chobe) showed an increase in elephant numbers. In contrast, over half of those with little or no poaching showed an increase or no change. All but one of the protected areas with poaching problems were ranked as having limitations in either manpower and/or equipment provided to combat poaching. The protected areas which were ranked as being fully equipped and appropriately staffed to perform anti-poaching operations showed an average increase in elephant numbers of 9% per annum, compared to a decrease of 7% per annum for the other protected areas.

Since all of the protected areas in this study had some form of anti-poaching unit, it is clear that the mere presence of an anti-poaching unit is not enough to guarantee its effectiveness. In order to have results, the anti-poaching unit must be adequately funded to hire a motivated staff and purchase adequate equipment. An effective anti-poaching unit appears to be the single most important factor influencing the trend in elephant numbers in the protected areas examined.

The presence of highly developed tourist facilities also corresponded with good conservation although the trend was not statistically significant from this small sample. The protected areas with highly developed tourist facilities showed an overall drop of 0.7% in elephant population compared to a drop of 4.6% for the other protected areas. This trend may simply reflect the fact that tourists are more likely to visit protected areas in which the wildlife is thriving but knowledge of some case histories suggests that tourism docs help conservation. Elephants and other wildlife respond quickly to the increased security and vigilance that come with tourist developments and significant game populations have now built up around new tourist complexes in the Mara, Tsavo and other parks in sites that were formerly not exceptional for wildlife.

The presence of scientific research facilities in the protected areas also corresponds with improved elephant trend, possibly because elephants (and other wildlife) learn it is safe in areas where research is going on. But there is also a good correlation with the development of tourist and research facilities and overall good management of protected areas. Both research and tourism development indicate that the administration takes conservation seriously and is prepared to invest money in wildlife conservation.

Land pressure from the surrounding rural population did not appear to have a significant impact on elephant numbers. In fact, contrary to expectations, protected areas with dense and expanding populations nearby had a slightly lower decline in elephant numbers than did areas surrounded by few

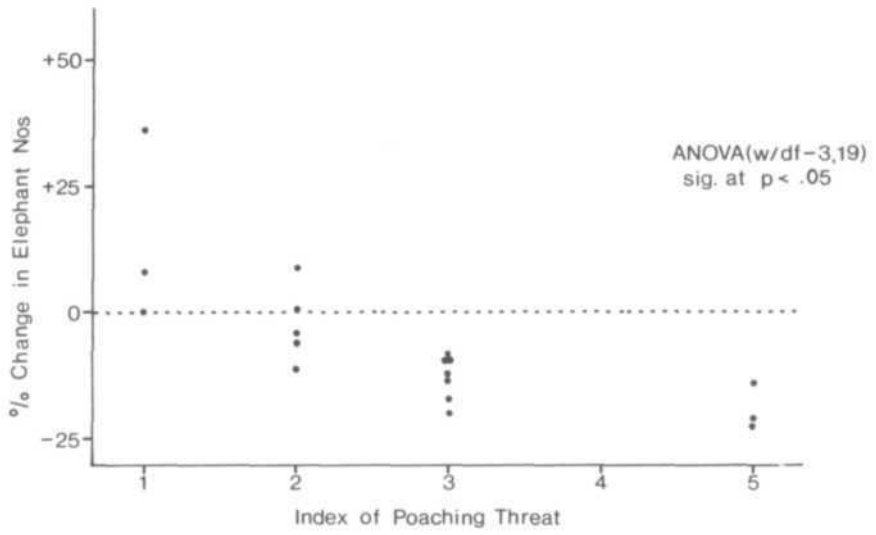


Figure 4.8 *Relationship between poaching threat and change in elephant numbers.*

settlements. (-2.7% for areas with dense and expanding human populations vs. -3.6% for sparse human populations.) There are possibly two reasons for this. First, there may be a time lag in that elephants are still being driven out of surrounding lands and finding refuge in protected areas thus boosting park numbers in areas of high land pressure. Second, poachers prefer to operate in very remote areas, not in places where too many people will notice their activities.

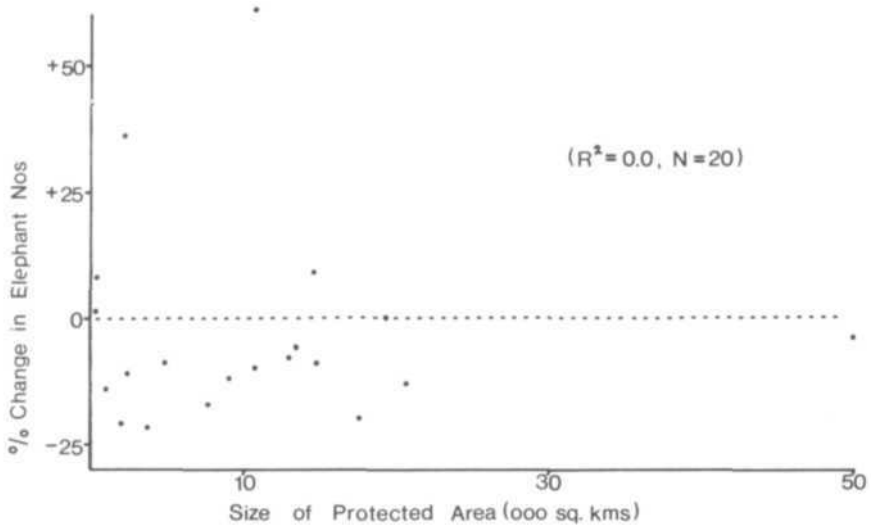


Figure 4.9 *Relationship between protected area size and change in elephant numbers.*

There appeared to be no significant relationship between size of the protected area and elephant trends (Figure 4.9). It would seem that any effect of size of the reserve is entirely masked by the effect of poaching threats on the population and the ability of the park's anti-poaching forces to repel the threat. The immediate advantages of large size of parks are discounted by the increasing difficulty of patrolling and protecting them effectively.

The trend in conservation effectiveness in an established protected area will be largely determined by the factors directly affecting the area, notably the poaching threat. However, national factors must also be considered in evaluating the status of conservation. Some African countries still have large areas of natural habitat while others have almost none. In some countries, wildlife is disappearing rapidly; in others animal numbers are stable or increasing. We therefore considered a variety of national factors in relation to the amount of remaining elephant range in each country and the respective trends in elephant numbers.

The national trends in elephant numbers, as derived from the AERSG Elephant Action Plan, were taken as a score of the general short-term trend in elephant conservation and the amount of elephant range remaining in each country was used as a score of long-term historical conservation success. It has already been seen that the percentage of elephant range varies considerably among different biogeographic and vegetation areas. The percentage of elephant range remaining in each country was therefore corrected so that it reflected the loss of range in relation to the continental means for those biogeographic units and vegetation types, and a national score was derived.

National scores were then regressed against a variety of social, political and economic variables thought to be potentially relevant. These variables included scores for country size, population density, population growth, proportion of closed forest remaining, proportion of land under permanent agriculture or pasture, debt per capita, rate of forest clearance, political stability (an index scored from 1–5 on the basis of the number of political changes and coups in the country), civil order (an index scored from 1–5 on the basis of the level of civil disorder, guerrilla activity, lack of communications etc), proportion of land protected, size of UNDP aid programme, armament expenditures, rates of change in armament expenditure, GNP per capita, literacy rate, medical expenditure per capita, infant mortality, life expectancy, scientific investment in conservation and other social factors.

The trend scores correlated most closely to an index of civilian disruptions in the country (Fig. 4.10). The countries with high indices of political instability similarly showed low scores for elephant conservation. This result parallels the results reported above for protected areas. Conditions in countries with frequent civilian disruptions and severe political instability would be likely to foster increases in poaching. Civilian and political disturbances increase the general state of lawlessness in a country, which would encourage poaching; under such conditions the government's priorities would naturally focus on

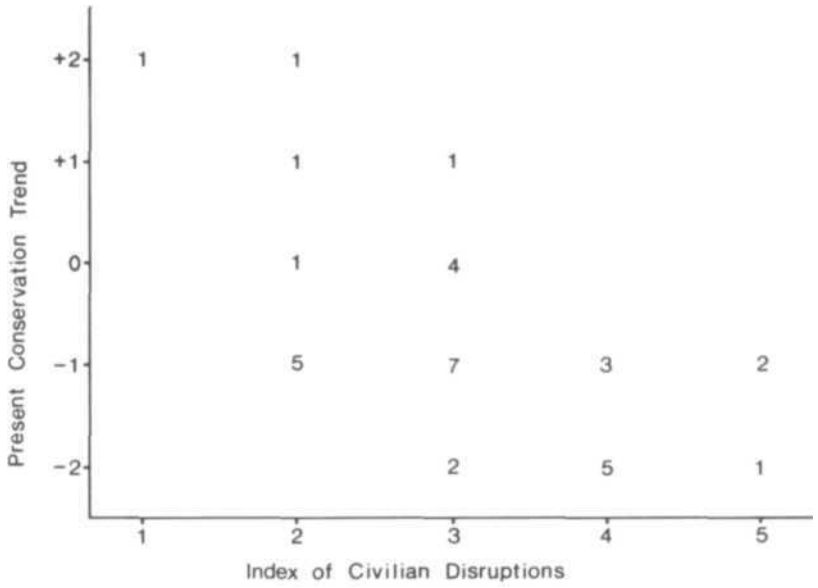


Figure 4.10 *Relationship between Civil Disruption Index and Current Trend in Elephant Conservation.*

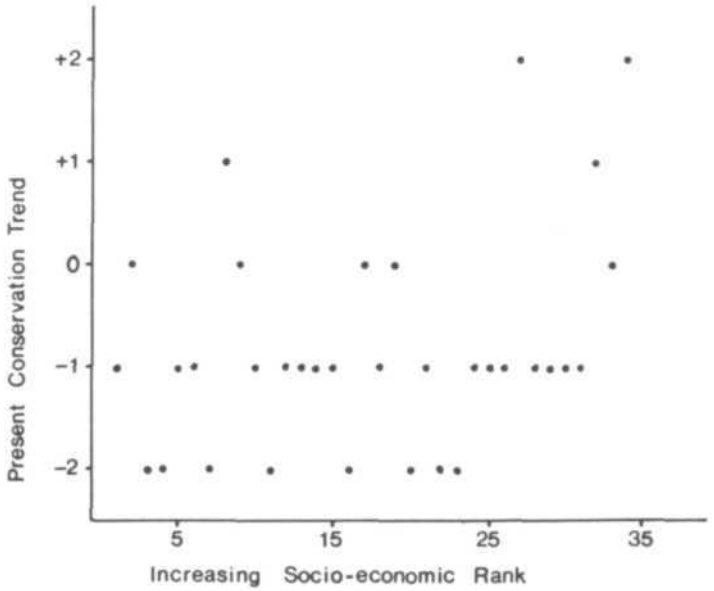


Figure 4.11 *Relationship between Socio-economic rankings and Current Trend in Elephant Conservation.*

securing its power base, not on protecting the nation's natural heritage. Disruptions most often also involve an increased distribution of arms among the population, providing means of intensified poaching, both within and outside protected areas. This correlation is further supported by the protected areas' data. The protected areas in countries with stable political conditions showed an average increase in elephant population of 2.5% per annum; in the other protected areas, there was an average decrease of 16% per annum.

The short-term trend in conservation also correlated with a variety of socio-economic indicators. Countries with better socio-economic conditions tended to score better on conservation trend (Fig. 4.11). The trend showed a positive correlation to the percentage of children in school, the literacy rate and the average calorific intake. Conversely, it showed a negative correlation with infant mortality. Since these socio-economic conditions often affect the stability of a country, it is clear how they could affect the trend in conservation. Countries with depressed socio-economic conditions are likely to be the scene of frequent civilian disturbances by a disgruntled populace. They are also more likely to experience political turmoil. Also if countries do not have the resources for improving socio-economic conditions they will not be bothering much with conservation. Efforts to improve socio-economic conditions often take years to show results; however, these efforts should not be seen as entirely unrelated to the goals of improving conservation.

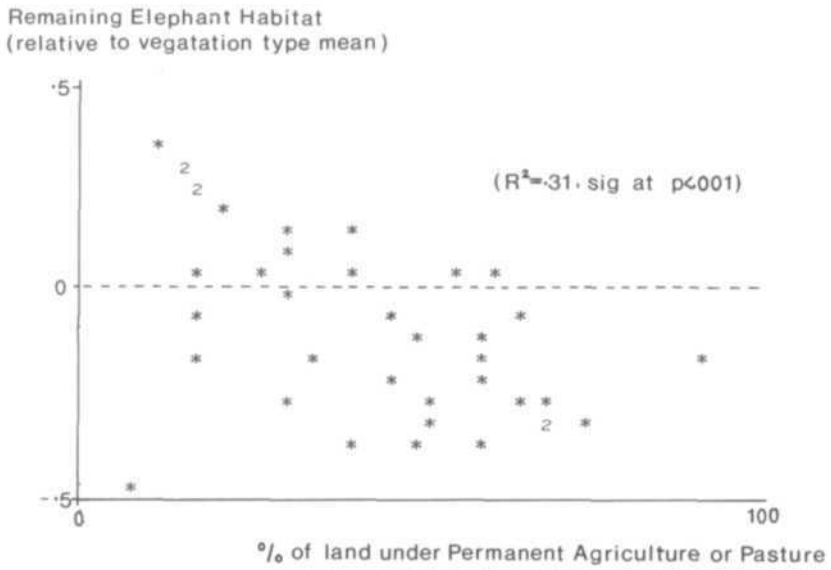


Figure 4.12 *Relationship between the amount of elephant habitat remaining (in relation to the mean for that vegetation type) and the percentage of land under agriculture or permanent pasture.*

The long-term scores in conservation were most closely related (negatively) to the percentage of land under permanent agriculture or pasture (Fig. 4.12). Countries with large amounts of land under permanent agricultural or pastoral use are those least likely to have large areas of remaining natural habitat. Similarly, the population density and population growth rate showed a significant negative correlation with the amount of natural habitat. None of these indicators showed a correlation with the short-term trend. Short-term trend did, however, correlate with the crudely scored ratings for scientific investment.

In an effort to clarify some of these inter-related effects 17 variables (elephant trend, elephant range corrected for vegetation, area of country, population density, proportion of land under permanent use, proportion of closed forest, rate of forest clearance, debt per capita, civil stability index (a combination of civil order and political stability), UNDP budget, % of land protected, military expenditure per capita, rate of population growth, % of children schooled, life expectancy, % of population urban and scientific investment) were used in a stepwise multiple regression analysis (Microstat 2.0). From this regression the three factors most predictive of the trend of elephant populations were the index of civil stability (regression coefficient = -0.2443), armament expenditure per capita (regression coefficient = 0.0226) and the proportion of land under permanent use (regression coefficient = 0.0140) in total explaining 72% of the observed variation. The three factors most predictive of the amount of elephant range remaining in relation to vegetation means were the rate of forest clearance (regression coefficient = -0.0562), the proportion of land under permanent use (regression coefficient = -0.0031) and the area of the country (which was a non-directional or irrelevant factor with a regression coefficient of 0.0000) in total explaining 71% of the observed variation.

Thus, not surprisingly, the data show that the most developed countries tended to have lost the highest proportion of their original wildlife resources but were on average doing a better job now of preserving what little wildlife is left.

The negative correlation between the amount of UNDP aid received by countries and their current trend in elephant conservation need not be interpreted as further evidence of the deleterious effects well-meaning aid programmes have had on the African environment (cf. introduction of rinderpest, tsetse eradication programmes, veterinary fencing for cattle disrupting animal migration routes, opening of waterholes in arid regions, medical assistance without birth control etc.). UNDP inputs correlate with resource loss because it is the poorer countries that are losing their resources fastest and the UNDP budget is determined by a formula that combines population size of a country with its standard of living.

The positive correlation between armament expenditure and trend figures per country is surprising. In an earlier paper Douglas Hamilton (1984) has shown that the continental collapse of elephant populations correlates closely in time with the continental expenditure on armaments. Our figures would indicate that armaments listed in national purchase statistics are primarily used for law enforcement within those countries and/or that the arms doing the poaching damage are either unrecorded or cross national frontiers. Despite the negative correlation we feel that the overall increase in firearms in Africa

has greatly increased the poaching threat for elephants and other game.

How well we succeed in protecting elephants within the Afrotropical protected area systems will be a good measure of the success of conservation efforts in general. What happens to elephants today is likely to befall other wildlife, especially large mammals, tomorrow. Indeed it was because of concern over elephant poaching in the early seventies, and through monitoring of elephant populations, that the threat to rhinos was first appreciated as a general phenomenon in East Africa.

Throughout Africa human population growth will be a major factor in reduction of natural lands. Countries with large and increasing populations therefore need to pay particular attention to incorporating protected areas into national land-use plans now, and to implementing appropriate conservation and land-use measures (eg. establishment and protection of reserves). They also need to come to grips with the politically difficult problem of containing population growth. Long-term measures, however, will be in vain if the short-term trend in conservation remains negative. On a national scale, stability seems to be the key to positive conservation trends. At the park level this corresponds with the ability to enforce anti-poaching regulations.

Part Five
COUNTRY ACTION REQUIREMENTS

Part Five – COUNTRY ACTION REQUIREMENTS

Traditionally African reserves and parks have been created to protect spectacular species (high profile species) or large concentrations of game. The current system of protected areas in the Realm still reflects this bias and there are many areas of special biological richness as yet with little or no protection. To remedy this situation requires the establishment of additional protected areas but it is difficult to justify such new requests while standards of protected area management in most countries remain so low. Improving the levels of management in parks and protected areas is the greatest conservation priority in the Realm today. To do this will require substantial increases in park budgets and levels of trained staff in most countries of the region. Even in South Africa and Zimbabwe, countries with some of the finest and best managed parks in the Realm, maintenance of high standards will require continued commitment to conservation and increasing budgets for protected areas.

Throughout the Realm the need to improve staff training is paramount. The Wildlife Management Colleges at Mweka, Tanzania, and Garoua, Cameroon, do a fine job in training park managers, from English-speaking and French-speaking countries respectively, and there should be continued international assistance to support this training. It would be useful if the college curricula could be extended to provide refresher courses for senior parks staff. There is also a need for more training for junior staff and it is encouraging that several countries, including Nigeria and Central African Republic, already have game guard training schools. Ideally all countries throughout the Realm should establish such facilities.

Poaching, particularly of elephants and rhino, is a serious problem throughout the Realm. Improved protection and management of reserves may go some way to ameliorating this problem but even some of the best managed areas lose animals to poachers with real or assumed grudges against the park's administration (Western, 1984) or to poachers crossing national boundaries. Anti-poaching measures need to be improved in many countries of the region and guards need to be well-trained and equipped with firearms, vehicles and radios. Increased international cooperation will be required to stop cross-border poaching and smuggling of wildlife (particularly rhino horn and ivory and, to a lesser extent, bushmeat and primates). Simultaneously public education campaigns should be launched to make local communities more aware of the value of wildlife and hostile to poachers and their illegal activities.

Implementing the above measures will require a changed attitude to wildlife on the part of both the general public and government decision makers. Conservation education programmes should be established in reserves and country-wide to increase public awareness of the benefits of national parks and protected areas and the value of wildlife. Arguments based on the reserves' tourist potential alone are weak; the community at large should be apprised of the value of protected areas for watershed and soil protection, for stock for re-afforestation programmes and as a reservoir of valuable wildlife resources important to local economies. Several African countries, including Tanzania, Malawi, Zambia, Zimbabwe and South Africa, already have considerable expertise in the field of conservation education and other countries could profit by adapting some of their most successful programmes to suit their own needs.

Another major priority throughout the Realm must be to develop and implement national conservation strategies and to develop landuse plans taking into account the needs of rural communities living adjacent to national parks and other protected areas. It is essential to reduce conflict between local communities and conservation interests since the problems and costs of conservation are proportional to the extent of this conflict.

In all countries of the Realm there is a need to continue to support research on wildlife populations both within and outside reserves. International conservation agencies funding such research should ensure that it is management-orientated. Since much of Africa's wildlife estate exists *outside* protected areas sensible management of rangelands, wetlands, forest reserves and other critical habitats is necessary; successful management for the benefit of both people and wildlife is only possible with the cooperation of local communities.

Throughout Africa wild plant and animal resources play an important role in local economies. Community dependence on such resources needs to be emphasised to government decision makers. Where practicable, inventories should be made of economically important natural resources; such inventories

may have global as well as national importance with some resources having potential for widespread commercial or pharmaceutical use.

Many African countries need to revise their legislation or implement new laws to allow the establishment of national parks and give better protection to reserves and wildlife. All countries should become signatories to, and ratify, the African Convention of Nature and Natural Resources, 1968, the Convention on International Trade in Endangered Species of Wild Flora and Fauna, 1975, (CITES) and the World Heritage Convention, 1972.

Several African problems are regional rather than continental in scale – for instance the problems of desertification. Such problems have arisen as a result of harmful agricultural and pastoral practices but have been compounded by well-meaning, but environmentally disastrous, aid-funded development projects. Throughout Africa there is a need for more small-scale ecodevelopment programmes designed in cooperation with local communities to fulfil their needs. Environmental impact assessments should also be made as a matter of course before implementing any major irrigation or dam projects.

Recommendations, particularly for extending the reserve system to give more representative coverage and better protection to all major habitat types, have already been given in chapter 3 under the appropriate biogeographical unit. Recommendations for national action are given below under country headings; where appropriate we have mentioned the relevant agencies to be responsible for such actions.

ANGOLA

Area (km^2)	:1,246,700
Population 1980 (UN Projection)	:7,181,000
Population density/sq.km.	:5.8
% Permanent agriculture/pasture	:25 %
% Closed forest cover	:2.3%
Phytochoria	:I, II, VI, VIII, X,

COUNTRY OVERVIEW

Angola spans five phytochoria or biogeographical units and is an area of great biological richness.

HABITAT COVERAGE FOR ANGOLA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	157600	50	0	0.0	0	0.0
14	51700	60	0	0.0	0	0.0
15	1100	80	0	0.0	0	0.0
19A	1900	80	0	0.0	1500	78.9
2	3700	50	0	0.0	0	0.0
21	64100	79	600	0.9	0	0.0
22A	131800	50	900	0.6	11000	8.3
25	375600	55	6000	1.5	11280	3.0
28	68300	60	1000	1.4	2600	3.8
29C	66100	45	9960	15.0	1400	2.1
36	16900	30	0	0.0	0	0.0
47	155900	90	0	0.0	5150	3.3
51	44000	80	4000	9.0	11000	25.0
6	2600	50	0	0.0	0	0.0
60	95100	72	0	0.0	1245	1.3
64	2400	80	0	0.0	400	16.6
74	5700	80	450	7.8	4150	72.8
77	2200	50	0	0.0	0	0.0
Totals	1246700	61	22910	1.8	49725	3.9

Although a few vegetation types are well-represented in the current reserve system (see table above) several biomes are not represented at all. Principal gaps in the protected area system are the lack of any reserves to protect the unique relict forests of the Angolan escarpment zone and the Angolan Afromontane forests. The most striking species conservation problem is the saving of the Giant Sable.

In recent years Angola has suffered considerable internal turmoil during the war of independence and subsequent civil strife and guerilla action. Because of the civil wars and general instability there has been a breakdown in effective management and protection of existing parks. Some reserves have also suffered as a result of being in the war zones.

Priority A protected areas include Iona N.P., and the proposed reserves of Amboim/Gabela and Humbe/Bailundu.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Establish a new reserve (category 4) to protect relict patches of forest and endemic species found on Mt Moco.

2. Create a new reserve to protect relict patches of the Angolan escarpment forests which contain a high proportion of endemic forms, particularly at Amboim/Gabela.

3. Form a Giant Sable national park by joining Kangandala with Luando River to create a large viable ecosystem covering the main existing range of this species. The heavily populated parts of Luando R. should be excluded from the park as should other areas of intensive cultivation and human and livestock encroachment. Include and conserve outstanding examples of major habitat types within this new park e.g. floodplain for lechwe, riverine habitat for hippo and crocodiles, and scenic stretches of the Cuanza and Luando rivers.

4. Extend Kisama N.P. to include both banks of the Cuanza and Longa rivers with complete protection for all mammals and avifauna.

5. Survey remaining lowland forests in the Cabinda enclave to identify a suitable area for a reserve for the endangered lowland gorilla and chimpanzee whose forest habitat is being destroyed for timber.

6. Establish a new reserve in the 'Anharas do Alto' of the provinces of Huambo and Benguela.

7. Establish and develop a network of protected areas as identified by Huntley (1973) and Horsten (1982). Horsten recommended 10% of Angola should be protected as national parks and nature reserves and the establishment of regional parks in the provinces.

b: **Improving management and protection of existing reserves**

1. Improve administration, management and protection of all existing reserves. At present there is a serious lack of staff, funds and resources in the existing reserves. The situation in southern Angola can only improve after resolution of the civil conflict there.

c: **Other conservation action**

1. Prepare a National Conservation Strategy for conservation, development and wise utilisation of the country's natural resources. Prior to Independence (1976) reserves were areas considered to be of little economic value. There should be a large scale conservation education programme to increase public awareness of the value of the country's natural resources.

2. Prepare a plan to develop tourism based on the attractions of the national parks. Angola could reap economic rewards from conservation.

3. The Directorate of Nature Conservation should be moved to a ministry more directly concerned with conservation e.g. Natural Resources or Tourism.

4. Revise laws and regulations governing hunting, open and closed seasons, protected species and protected areas. In particular the giant sable should be legally protected even outside present park boundaries.

5. Angola should become signatory to, and ratify, the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES).

NEED FOR INTERNATIONAL ASSISTANCE

Angola needs outside assistance to help protect its unique flora, fauna and spectacular scenery. International, national and private conservation organisations should be asked to provide technical and material aid for developing and implementing a conservation master plan and improving the reserve network.

BENIN

Area (km^2)	:112,622
Population 1980 (UN Projection):	:3,534,000
Population density/sq.km	:31.4
% Permanent agriculture/pasture	:60%
% Closed forest cover	:0.42%
Phytochoria	:I, III, XI

COUNTRYOVERVIEW

One of the most densely populated countries of West Africa, Benin had a history of political instability since independence from France in 1960 until 1972 when the present regime came to power. Without significant mineral resources, Benin stresses the need for self-sufficiency through improved agricultural production and much of the country's natural vegetation has been cleared to make way for agriculture.

HABITAT COVERAGE FOR BENIN

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	16000	20	0	0.0	0	0.0
2	800	20	0	0.0	0	0.0
27	74500	40	0	0.0	0	0.0
29A	22300	60	8435	37.8	0	0.0
30	2200	40	0	0.0	0	0.0
Totals	115800	40	8435	7.2	0	0.0

The national system of protected areas covers 7.2% of the land area of the country but almost all the protected areas occur in the north and in the same vegetation type. Other vegetation types are substantially degraded and there are probably few opportunities to create new reserves. Benin is a very poor country and the foresters whose job it is to protect wildlife are ill-equipped. The north, however, is relatively undeveloped compared to the rest of the country and this gives some protection to wildlife.

The only Priority A protected area is the "W" national park, a transnational park overlapping three countries including Benin and in total one of the most important parks in West Africa.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Carry out, in collaboration with the EEC, a national inventory to identify areas important for wildlife and suitable for new reserves. Some of the forest reserves in central Benin may merit upgrading to higher protection status.

2. Extend Pendjari N.P. from 275,500 ha to 295,000 ha by extending the park southwards. This would protect some extra species of birds and mammals, especially monkeys.

b: **Improving management and protection of existing reserves**

1. Increase staffing, resources and equipment for protected areas. Benin is a very poor country and will need international assistance to upgrade park management and to train personnel.

2. Create a new department with responsibility for protecting wildlife; at present parks are the responsibility of the Forestry Department.

3. Determine management priorities based on the biological richness and scientific interest of individual parks.

c: **Other conservation action**

1. The government demonstrated its concern for Benin's dwindling wildlife populations by banning all hunting in 1977 but these laws need better implementation.

2. The Benin parks have great tourist potential but there will need to be considerable investment in tourist facilities.

NEED FOR INTERNATIONAL ASSISTANCE

The "W" and Pendjari national parks, as part of one of the most extensive and important protected areas in West Africa, deserve continued international assistance for their management and development for tourism. Both have management plans prepared by FAO. Benin will also require continued assistance with identification of new conservation areas, preparation and implementation of systems and management plans, provision of equipment and personnel training.

BOTSWANA

Area (km^2)	:581,370,
Population 1980 (UN Projection):	:795,000
Population density/sq.km	:1.4
% Permanent agriculture/pasture	:15%
% Closed forest cover	:0
Phytochoria	.II, XIV,

COUNTRY OVERVIEW

HABITAT COVERAGE FOR BOTSWANA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
22A	11500	50	3000	26.0	0	0.0
28	97700	50	4300	4.4	0	0.0
29C	600	50	0	0.0	0	0.0
29D	1600	50	0	0.0	0	0.0
35A	184600	31	18390	9.9	0	0.0
44	218100	40	55632	25.5	0	0.0
56	22800	60	13400	58.7	0	0.0
75	25900	90	2370	9.1	0	0.0
76	10500	90	1140	10.8	0	0.0
PAN	12100	100	2000	16.5	0	0.0
Totals	585400	44	100232	17.1	0	0.0

Overall Botswana has an adequate system of parks and reserves with more than 17% of the country's land area included within existing national parks and game reserves. The present reserve system could be extended to include other ecotypes not as yet represented. Although these areas do not harbour significant wildlife populations they are of general botanical, geological, historical or cultural significance.

The value of wildlife to the economy is considerable with most of the Botswana tourist industry based on safaris and sport hunting. Although several areas have good tourist developments, overall protection and management are poor. The greatest problem is to combat poaching. Other threats to wildlife are increasing pressure on land, artificial drainage of lakes and wetlands, the use of dangerous insecticides and cordon fences which block traditional wildlife migration and watering routes.

Priority A protected areas in Botswana include Moremi, Central Kalahari and Gemsbok national parks.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Extend Chobe N.P. to include the forest reserve (FAO, 1977)

2. Establish Lake Ngami (6500 ha) as a nature reserve. Lake Ngami is a very important wetland habitat in southern Africa. It is one of the few breeding sites for pelicans in southern Africa, a seasonal feeding

ground for flamingoes and an important wintering site for inter-tropical and Palaearctic migrants. The entire lake should be designated as an important wetland under the Ramsar Convention as should parts of the Okavango Delta.

3. The following areas should receive formal conservation status as recommended by FAO (1977):

Okavango River Front	10000 ha
Tsodilo Hills	9000 ha
Aha Mountains	100000 ha
Kwebe Hills	10000 ha
Tamafupa/Jari Pan Complex	120000 ha
Pataletsabe Hill	6000 ha
Shashe Elephant Reserve	45000 ha
Lepakola Hills	10000 ha
Tswapong and Mabeleapodi Hills	20000 ha
Shoshong Hills	10000 ha
Mokwane Hills	10000 ha
Notwane-Limpopo Area	10000 ha

4. Protect the Tsodilo Hills and Drotsky's Caves in western Ngamiland as national monuments of historical and cultural significance.

5. Redesignate some game reserves as nature reserves or national parks and upgrade their management.

b: **Improving management and protection of existing reserves**

1. Within the Department of National Parks and Wildlife there is a general shortage of manpower, funds and equipment. Protection and management need to be improved in all reserves but especially in Gemsbok N.P. (at present adequately protected only on the South African side) and Moremi G.R. which are sites of international importance.

2. National parks and game reserves should be zoned for different uses to avoid conflicts between wildlife and tourism. Visitor use should be spread over a wide area and monitored to avoid local overuse and habitat destruction.

c: **Other conservation action**

1. Monitor the effects of veterinary fences which block traditional migrating and watering routes of local wildlife and take action to ameliorate their effects. Some artificial waterholes have already been created for wildlife.

2. Consider commercial culling of large herbivore populations which must be reduced for management purposes.

3. At present conservation in Botswana is hampered by the serious inadequacy of the nation's two major wildlife laws enacted in 1961 and 1972; the most harmful provisions are those permitting transfer of hunting licences and allowing unlicensed people to 'assist' hunters. These laws require major revision.

NEED FOR INTERNATIONAL ASSISTANCE

Botswana is already receiving considerable EEC inputs to its national parks programme but may need further international assistance with the development of a national conservation strategy and parks planning programme and for training.

BURKINA FASO

Area (km^2)	:274 200
Population 1980 (UN Projection)	:6,774,000
Population density/sq.km.	:24.7
% Permanent agriculture/pasture	:70%
% Closed forest cover	:0
Phytochoria	:III,XVI

COUNTRY OVERVIEW

HABITAT COVERAGE FOR BURKINA FASO

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
27	40500	20	63	0.1	2800	6.9
29A	203400	20	6596	3.2	4045	1.9
30	4300	20	0	0.0	0	0.0
43	25600	30	0	0.0	16000	62.5
Totals	273800	20	6659	2.4	22845	8.3

Lying south of the Sahara, in the Sahel zone, Burkina Faso has recurrent problems of drought. Biologically the country is interesting; of the 62 large mammals of West Africa several species are here at the limit of their distribution. Traditionally this wildlife has been overexploited. Only 2.4 % of the country lies within established protected areas and most of this is in one vegetation type 29A. A further 1%, Sudanian woodland, has been proposed for protection and another 7.3% is already included within partial faunal and hunting reserves. The most valuable wildlife areas are Po-Nazinga, Komoe-Leraba, "W" national park and its environs and Deux Bales Forest. Both Po and "W" are already national parks and Komoe-Leraba is a proposed national park; the Deux Bale forests at present lie within a forest reserve but should be upgraded.

Standards of management and protection are low due to lack of manpower, equipment and resources. It is important that Burkina Faso rationalises the way that wildlife is used. Bushmeat is an important source of protein for local peoples but traditionally wildlife has been overexploited. For continued availability of this valuable resource there must be areas of complete protection for wildlife to safeguard a base stock.

Priority A protected areas include "W" N.P. and Komoe-Leraba.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Arli is the best site for a national park in Burkina Faso with the greatest densities of wild animals. The proposed national park (76,000 ha in Total Faunal Reserve and 130,000 ha of Partial Faunal Reserve) could be extended to 1,580,000 ha by including a zone to the north-east of the present faunal reserves to connect with Kourtiago. Pagou and S.E. Gobnangou should also be included in the protected zone. The park should include most of the basins of the rivers Doubodo and Pantaini and the flood basin of the Pendjari (FAO 1978).

2. Declare the proposed national park of Leraba (280000 ha) in the Komoe-Leraba area. This should be developed at the expense of poorer faunal zones – the partial faunal reserves of Nabere and Bontioli.

3. Deux Bales F.R. should be made a national park.

4. Establish the proposed Sahel (Seno-Mango) reserve with revised boundaries to include only the north-west corner of the existing Biosphere Reserve and excise all densely settled and grazed areas. Only the relatively small, untouched area of Sahel vegetation with its remaining Sahelian fauna is worth conserving (Spinage and Souleymane, 1984).

5. Establish the proposed ornithological reserves of Beli and Mare d'Oursi.

Improving management and protection of existing protected area system

1. Government should establish fully protected areas and also zones of multiple use; animals will migrate from the protected zones into surrounding hunting zones to the direct benefit of local people.
2. Stop poaching and illegal fishing in fully protected areas.
3. To decrease human/wildlife conflicts park boundaries should follow geographical features other than rivers and waterholes if possible.
4. Create buffer zones around Po and "W" national parks and exclude agricultural settlements from within park boundaries. Compensate with village development assistance.

Other Conservation Action

1. To decrease human/wildlife conflicts parks should be developed to afford benefits to local communities: for recreation, employment and food supply. Develop interpretation programmes and educational programmes to promote local awareness of the valuable role of the parks.
2. Burkina Faso should become a signatory of CITES.

NEED FOR INTERNATIONAL ASSISTANCE

Burkina Faso has already received considerable assistance from FAO with parks planning and the preparation of management plans. The country still needs further international aid in the form of technical assistance for implementing management.

BURUNDI

Area (km^2)	:27,834
Population 1980 (UN Projection)	:4,288,000
Population density/sq.km.	:154
% Permanent agriculture/pasture	:80%
Closed for	:0
Phytochoria	:VIII, XII

COUNTRY OVERVIEW

HABITAT COVERAGE FOR BURUNDI

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
19A	10000	10	379	3.7	0	0.0
25	2800	5	0	0.0	0	0.0
4	600	5	0	0.0	2	0.3
45	12300	20	0	0.0	486	3.9
Totals	25700	14	379	1.4	488	1.8

Burundi is one of the most densely populated countries in Africa with more than 300 people/sq.km in some areas. Only 1.4% of the country is protected at present, all montane habitat. Another 1.8% is proposed to protect vegetation types 4 (transitional rainforest) and bushland 45 (Ruvubu and Rusizi). The reserves have only recently been established and many have human settlements within their boundaries as well as illegal farming, fishing, grazing and logging. Although the government is trying to encourage people to move by offering them alternative areas this will be a difficult and costly exercise with 3000 families to move from the proposed Ruvubu N.P. alone. Park management is poor because of he lack of personnel, expertise and funds.

Although the reserves are of national significance they are all priority C and not important on a regional scale. They do not merit international aid.

RECOMMENDATIONS FOR ACTION

a: Extending the protected area system

1. Gazettement of the proposed Ruvubu N.P. and Rusizi R. will double the extent of "protected areas" within Burundi. With so much competition for land from the large and expanding human population it is unrealistic to expect further extensions of the reserve system.

b: **Improving protection and management of the reserve system**

1. Increase staff, funding and resources for the protection of reserves. Train parks staff in management principles and activities.
2. Stop human settlement and encroachments within protected areas.

c: **Other conservation action**

1. Develop an education and extension programme to increase public awareness of the benefits of national parks and protected areas by protecting watersheds and as reservoirs of natural resources.
2. Develop tourism facilities in the national parks to encourage both domestic and international visitors.
3. Burundi should become a signatory of CITES.

CAMEROON

Area (km^2)	:475,442
Population 1980 (UN Projection)	:8,088,000
Population density/sq.km.	:17
% Permanent agriculture/pasture	:30%
% Closed forest cover	:37%
Phytochoria	:I, III, VIII, XI, XVI

COUNTRY OVERVIEW

Cameroon is a country of great biological richness which is reflected by its high levels of plant and animal species diversity. For instance it has 28 species of primates, more than any other African country after Zaire.

HABITAT COVERAGE FOR CAMEROON

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	126900	32	4476	3.5	4000	3.1
19A	16300	40	0	0.0	100	0.6
1A	115900	50	6837	5.8	100	0.0
2	78600	50	800	1.0	400	0.5
27	38500	30	5250	13.6	0	0.0
29A	34800	30	2800	8.0	0	0.0
3	17800	60	0	0.0	0	0.0
33	4900	20	0	0.0	0	0.0
43	500	20	0	0.0	0	0.0
62	2400	20	0	0.0	0	0.0
63	10600	30	900	8.4	0	0.0
75	800	20	0	0.0	0	0.0
77	8100	60	600	7.4	0	0.0
8	13300	50	430	3.2	1000	7.5
Totals	469400	41	22093	4.7	5600	1.1

The national system of protected areas in the country is both extensive (4.7% excluding Forest Reserves) and continuing to grow and it represents most of the major biotic communities of the region. Standards of management tend to be low due to lack of manpower and low priority in budgeting and difficulties of logistics. Standards are best in the national parks which tend to be in the northern, less forested, parts of the country.

Priority A protected areas include Waza, Benoue, and Korup.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. There is a need to establish national parks in the forested areas. This will mean resolving the legal dilemma of either accepting small enclaves of human settlements inside national parks or finding acceptable ways and means to move people out of reserves.

2. Some new protected areas should be established in the Afromontane forests which are currently under-represented in the protected area system. It is not feasible to protect the entire Mt. Cameroon area but it would be useful to increase the protection status of the Bambuko Forest Reserve and also to establish a protected area to the south of Mt. Cameroon, including the peak of Little Mt. Cameroon, Etinde.

3. Other montane areas of interest are Mt Kupe and Mt Oku in the Bamenda highlands. The Mt Oku forests (which have several endemic bird species) are included in the proposed Lake Oku reserve. The Lake Balambi Mbo area near Kumbe is also of interest (the lake itself has 12 endemic species of fish). In addition the value of Faro National Park would be greatly enhanced if it could be extended higher into the mountains.

4. Of particular priority is the declaration of the proposed Korup National Park which is the least disturbed rainforest in the country with a great richness of species (over 500 trees recorded) and high levels of local endemism (20-30 new species of tree). It is a unique lowland forest refuge of a distinct type. The area needs more protection and the development of adequate buffer zones.

5. The existing Pangar-Djerem Game Reserve has been whittled away by agricultural encroachment and is seriously threatened by poaching, made easy by railway access through the reserve. The proposal to establish an alternative national park in the adjacent Mbam-et-Djerem area is strongly supported. These areas are the only protected examples in the country of the Guinea-Congolian/ Sudanian Transition Zone.

6. A useful addition to the protected area system would be part of the swamp forests of the Nyong/Long river near the town of Abang Mbang; this is a unique and currently unprotected vegetation type in the country.

7. An assessment should be made of the status of flora and fauna of the Takamanda Forest Reserve and protection and management improved to conserve its wildlife. This area is important as the main refuge of the isolated northern gorilla population which may be a distinct race, as well as being important for leopard, elephants and other valuable wildlife.

8. Areas for possible marine parks should be surveyed. One possible site is the Rocher du Loup area of the Campo Game Reserve.

9. From a continental scale of evaluation, the national system of protected areas seems fairly comprehensive but for national needs it is recommended that the adequacy of coverage is viewed against the best available national vegetation map of Letouzey (1968) and supplementary small reserves added to protect distinct sub-classes of vegetation. A National Protected Areas System Plan should be formulated and could usefully be integrated into a National Conservation Strategy.

b: **Improving protection and management of the reserve system**

1. The main priority for improving conservation effectiveness should be in developing manpower and increasing budget allocations which will require increasing environmental awareness at both public and senior governmental level. Simultaneously there must be better enforcement of existing legislation.

2. Anti-poaching operations are important in many reserves, particularly the Benoue and Bouba Ndjidah national parks which have the only remaining black rhinos in the country. Benoue is also a high priority for the protection of the Lord Derby eland.

c: **Other conservation action**

1. There is a need to conduct environmental impact assessments and to establish better inter-ministerial coordination in planning major developments in the vicinity of protected areas. The barrage on the Keleo river, for instance, has reduced floodwater flow onto the grasslands of the Waza National Park with serious deleterious effects on both vegetation and wildlife.

2. The conservation importance of the various forest reserves in the country should be assessed and taken into account by the Ministry of Agriculture when planning their exploitation and future use. Some coordination between the Ministries of Agriculture, Tourism and Higher Education will be needed for such an assessment.

3. The mangrove resources of the country are not yet seriously threatened but should be constantly monitored, particularly in the Bakassi area.

4. Studies should be continued into the causes and effects of desertification in the northern parts of the country. In particular, experiments should be made, with local rather than exotic species, at planting green barriers to check desertification.

NEED FOR INTERNATIONAL ASSISTANCE

International support for conservation in Cameroon is most needed in the areas of overseas training, funds and equipment. Cameroon also needs experts to conduct environmental impact assessments and to assist with park and land-use planning. There should be continued support for the international training school at Garoua and sponsorship into research on the economic values of forest plants (for drugs, domestication etc.). Programmes should also be established to develop alternative sources of protein and rationalise utilisation of forest resources.

CENTRAL AFRICAN REPUBLIC

Area (km^2)	:622,984
Population 1980 (UN Projection)	:2,004,000
Population density/sq.km.	:3.2
% Permanent agriculture/pasture	:30%
% Closed forest cover	:0.44%
Phytochoria	:I, XI, III

COUNTRY OVERVIEW

Central African Republic lies in an area of great biological richness and spans two important phytochoria. It has a great primate diversity with at least 20 species of primates, including chimps and gorillas. Unfortunately due to serious poaching activities the picture for wildlife in CAR is grim.

HABITAT COVERAGE FOR CENTRAL AFRICAN REPUBLIC

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Frop.area	Prop.%
11A	295300	40	0	0.0	0	0.0
1A	2000	50	0	0.0	0	0.0
2	26200	49	0	0.0	2000	7.6
27	272700	50	33340	12.2	18300	6.7
29A	25800	40	5700	22.0	0	0.0
8	1000	70	0	0.0	650	65.0
Totals	623000	44	39040	6.2	20950	3.3

6.2 % of CAR land area is gazetted as reserves but most of these lie in the northern plains. Another 3% is included in faunal reserves (where hunting is allowed) and proposed reserves. In general management and protection of reserves are poor. This is a region of Africa where wildlife numbers and diversity have suffered a precipitous decline ; the elephant population, for instance, has declined by some 60% in recent years. The government of CAR is seriously concerned by these developments but an increase in anti-poaching units is essential to safeguard the country's wildlife.

Priority A protected areas in CAR are the national parks of Bamingui-Bangoran and Manovo-Gounda-St Floris. Several of the country's other parks protect important ecosystems.

RECOMMENDATIONS FOR ACTION

a: **Extending the present reserve system**

1. Select an area for a national park in the dense forest zone of the south-west to protect forest animals such as gorilla, chimp, bongo, buffalo and elephant. Such an area could be developed for tourism as a contrast to the northern plains.

2. Establish the proposed Zanga (Bongos) reserve.

b: **Improving protection and management of existing reserves**

1. Poaching is the main problem for wildlife in Central African Republic; the military are some of the worst offenders. Anti-poaching patrols should be strengthened with well-trained and equipped guards with arms, vehicles and radios. In Manovo-Gounda-St Floris rhinos have been eliminated and the elephant population has been reduced by 75%.

2. Wildlife conservation and development is currently concentrated in two parks : Bamingui-Bangoran and Manovo-Gounda-Saint Floris. Both parks need better protection with increased numbers of staff, transport and equipment.

3. There should be no attempt to declassify part or all of the Bamingui-Bangoran area. It should retain its present status as national park and reserves. The area should be proposed as a Man and the Biosphere Reserve.

4. Enforce legislation to stop illegal fishing and burning in reserves. Even outside reserves burning should not be allowed near dry forest.

c: **Other conservation action**

1. Enforce new legislation passed to give better protection to wildlife, national parks and protected areas. Although local hunters are required to have permits for other than traditional hunting, at present there is no adequate control.

2. Stop illegal hunting of elephant. Introduce new legislation to control possession of ivory. Elephants are killed by Sudanese poachers using huge spears. In recent years elephant populations have been reduced by 60-70% due to poaching (Douglas-Hamilton et al., 1980) and black rhinos declined in numbers from an estimated 3000 in 1980 to 170 in 1984 (Western and Vigne, 1985).

3. Develop a wildlife tourism industry and facilities. However the northern plains have only a short tourist season from late December to May.

NEED FOR INTERNATIONAL ASSISTANCE

Although the government recognises the need for national parks CAR is a very poor country. CAR has already benefited from several FAO programmes and the EEC has recently approved funding for more conservation-orientated projects including management of protected areas and wildlife utilisation.
Central African Republic would also benefit from technical assistance with preparation and implementation of a National Conservation Strategy.

CHAD

Area (km^2	:1,284,000
Population 1980 (UN Projection)	:4,473,000
Population density/ sq.km.	:3.5
% Permanent agriculture/pasture	:40%
% Closed forest cover	:0.39%
Phytochoria	:III, XVI

COUNTRY OVERVIEW

Only part of Chad falls within the Afrotropical Realm; the northern part of the country extends into the Sahara and has not been considered in this review.

Like other countries of the Sahel, Chad has tremendous problems of drought, desertification and environmental degradation and concern for wildlife and conservation have been of low priority in the past. There are now encouraging signs that the government is becoming aware of the need to conserve its natural resources.

HABITAT COVERAGE FOR CHAD

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
27	44600	20	0	0.0	0	0.0
29A	247800	20	1140	0.4	24710	9.9
43	134600	30	0	0.0	10000	7.4
54A	217600	30	0	0.0	42110	19.3
62	17400	20	0	0.0	0	0.0
63	52200	20	0	0.0	6980	13.3
75	6600	10	0	0.0	0	0.0
Totals	720800	24	1140	0.1	83800	11.6

Only 0.1 % of Chad's land area within the realm has been designated as national parks. Another 11.6% of the unit is included within conservation areas of category 6 (here classed as areas proposed for greater protection). Important omissions from the reserve system are Sudanian woodlands and swamps but only very small areas of these vegetation types remain, especially of swamps so it is unrealistic to recommend new reserves in these zones.

Parks lack sufficient trained staff, equipment and other resources. Poaching, often by the military and neighbouring communities, is a major problem in reserves. There are permanent settlements in some parks and overgrazing by the stock of seasonal nomads.

RECOMMENDATIONS FOR ACTION

a: **Extending the present reserve system**

1. The present system of reserves would be adequate if there was better protection and management, especially if those faunal reserves designated as category 6 could be better protected and upgraded.

b: **Improving protection and management of existing reserves**

1. Improve levels of protection and management in all protected areas by increasing staffing levels, budgets and equipment. Special attention should be paid to anti-poaching activities.

c: **Other conservation action**

1. An essential prerequisite of successful conservation action in Chad is an appreciation by both government and general populace that wildlife is a valuable resource which should be exploited on a sustained yield basis. Conservation education programmes should be directed at all sectors of the population.

2. The problems of the Sahel are overwhelming but there is good evidence that the effects of drought are exacerbated by poor land-use with disastrous consequences for both human populations and wildlife. Chad should draw up a national conservation strategy with land-use policies to incorporate protected areas and rational use of the semi-arid zone.

3. Bushmeat is an important source of local protein. Game farms could be established to provide alternative sources of meat.

4. Chad should become a signatory of CITES.

NEED FOR INTERNATIONAL ASSISTANCE

As a poor country with severe environmental problems, Chad will require assistance to establish an adequate and well-managed system of protected areas. These should be developed in the context of an overall land-use strategy, taking into account the needs of both the human population and wildlife and the disastrous effects of overstocking on a fragile and drought-afflicted habitat.

COMOROS

Area (km^2)	:2236
Population 1980 (UN Projection)	:347,000
Population density/ sq.km.	:156
Phytochorion	:XXI

COUNTRY OVERVIEW

The Comoros are a collection of small forested islands with some unique wildlife . The Comoros support the only populations of wild lemurs outside Madagascar. *Lemur mongoz* occurs on Mohéli and Anjouan; the subspecies *Lemurfulvus mayottensis* is unique to Mayotte. Grande Comore also supports populations of lemurs in its forests (all Comorian subspecies). However on all islands the lemurs and other fauna are threatened by destruction of the rainforest habitat, especially in the densely populated lowlands (Tattersall, 1977).

RECOMMENDATIONS FOR ACTION

Urgent measures should be taken to protect remaining areas of rainforest both to protect watersheds and wildlife; forest clearing should certainly be prohibited above 800 m in the central massif (Tattersall, 1977). The only conservation area of any size in the islands is that proposed to protect the volcano of Karthala on Grande Comore; the government should be encouraged to go ahead with gazettement of this forested mountain, an important habitat for several threatened bird species. Other conservation areas include several small marine reserves.

CONGO

Area (km^2)	:342,ooo
Population 1980 (UN Projection)	:1,532,000
Population density/sq.km.	:4.5
% Permanent agriculture/pasture	:30%
% Closed forest cover	:62%
Phytochoria	:I

COUNTRY OVERVIEW

HABITAT COVERAGE FOR CONGO

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	90400	40	8627	9.5	0	0.0
1A	69300	60	2848	4.1	0	0.0
2	76800	60	2056	2.6	60	0.0
8	105500	50	0	0.0	0	0.0
Totals	342000	51	13531	3.9	60	0.0

Congo as one of the top countries in the world for remaining area of closed tropical forest (and the second after Zaire in Africa) is an area of great biological richness, reflected by its high primate diversity. Only 3.9 % of the country is protected as conservation areas but large areas of natural forest still remain undisturbed.

None of the Congo's protected areas have been assigned priority A status though several protect important ecosystems. We have little information for the protected area system of the Congo, other than that samples of all vegetation types, except swamp forest, have been included within the reserve network. There is little or no protection and management of reserves .

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Identify a suitable area for protection in the swamp forest habitat; already about 50% of this habitat type has been lost through clearance for timber and agriculture.

2. Increase the total area protected within the country's reserve system. FAO have made extensive forest surveys in the Congo. Key areas of biological richness and interest should be protected as conservation areas.

b: **Improving management and protection of current reserves**

1. Increase levels of trained staff, funds and equipment for protected areas. Present levels are totally inadequate in 1982 there were only 9 guards with one motorboat to protect the entire protected area system.

c: **Other conservation action**

1. Prepare a national conservation strategy for the rational development and utilisation of the country's forests and other natural resources.

2. Revise and implement legislation to give greater protection to protected areas and to regulate hunting.

3. Inventory utilisation of natural resources such as plants and animals which are of considerable importance in local economies.

NEED FOR INTERNATIONAL ASSISTANCE

The Congo Republic has some of the richest rainforest areas of Africa, areas that are of top priority for conservation. International assistance will be needed in the sectors of parks planning, development of a national conservation strategy, implementation of management and training.

DJIBOUTI

Area (km^2)	:21,783
Population	:119,000
Population density/sq.km.	:5.5
% Permanent agriculture/pasture	:55%
% Closed forest cover	:0
Phytochoria	:IV

COUNTRY OVERVIEW

HABITAT COVERAGE FOR DJIBOUTI

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
54B	20000	50	30	0.1	0	0.0
68B	1500	80	0	0.0	0	0.0
77	300	30	0	0.0	0	0.0
Totals	21800	51	30	0.1	0	0.0

Djibouti has already suffered appalling environmental degradation and there is very little undisturbed natural vegetation left. Only 0.1 % of the country's land area is protected but this represents Day N.P. (less than 3000 ha) which includes part of Forêt du Day. This is one of only two relict forests remaining in the country where forest is disappearing at an alarming rate due to man-induced degradation and climatic conditions.

Other natural attributes of the country such as Lakes Abbe and Assal and Ardoukuoba volcano are not at present threatened by any development schemes.

Day N.P. is a priority A area but requires immediate conservation action to ensure its continued existence.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Extend Day N.P. to include as much as possible of the remaining relict of the Goda Mountain Forest (in total 42000 ha). The Forêt du Day is a relict juniper forest in the Goda mountains, and the only known site for *Francolinus ochropectus.*

2. Protect the remaining area of coastal mangrove.

b: **Improving management and protection of the current reserves**

1. Immediate action is required to safeguard the existence of Day N.P. Measures required include prevention of forest destruction by fire and for firewood, browse for cattle and during honey collection. Overgrazing and trampling by stock are other serious problems and livestock should be excluded from the park.

2. Restrict and control visitor and military use of the Forêt du Day and control utilisation and harvesting by local people.

c: **Other conservation action**

1. Develop alternative sources of firewood and timber for the communities living in and around the Day Forest, perhaps by planting community plantations as buffer zones.
2. Develop conservation awareness with education programmes to increase public awareness of wise use of natural resources.
3. Stop military exercises in the Day Forest. In this context it would be useful if conservation organisations in France could campaign to dissuade the French army from continuing its training exercises here.
4. Encourage cooperative conservation and tourism programmes betweeen Djibouti and Ethiopia in the lakes region on their common border in the Danakil depression.

NEED FOR INTERNATIONAL ASSISTANCE

Djibouti is a poor country with serious environmental problems; it will require considerable international assistance to overcome these and embark on re-afforestation programmes. It may already be too late to achieve any great conservation successes in the country even with international support.

EQUATORIAL GUINEA

Area (km^2)	:28,051
Population 1980 (UN Projection)	:339,000
Population density/ sq.km.	:22.1
% Permanent agriculture/pasture	:10%
% Closed forest cover	:46%
Phytochoria	:I

COUNTRY OVERVIEW

HABITAT COVERAGE FOR EQUATORIAL GUINEA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
1A	100	50	0	0.0	0	0.0
3	25600	50	0	0.0	950	3.7
77	300	40	0	0.0	0	0.0
Totals	26000	49	0	0.0	950	3.6

Although an area of great biological richness and high primate diversity Equatorial Guinea has no protected areas at present. The parks of Spanish Guinea were once very good, especially Rio Ekuku G.R. (7500 ha with Sitatunga), Mt Raices park (26,000 ha which harboured chimp, gorilla, buffalo) and Mt Alen N.P. (9600 ha with lowland gorilla). Unfortunately there is now no protection of the national parks and reserves which existed prior to 1970.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Re-establish and extend the reserve system of mainland Equatorial Guinea and the islands of Bioko and Annobon as outlined in the report of Castroviejo et al. (1986) on Nature Conservation in Equatorial Guinea (see below).
2. Re-establish and extend Mt Alen N.P (80,000 ha), an area important for lowland gorillas, elephants and leopards.

3. Establish a rainforest reserve of 30,000 ha in the Mitra mountains, encompassing the peaks of Atom, Mabumu-Wom, Bekuo, Mitong, Mitono.
4. Establish a reserve of 40,000 ha in the Altos de Nsok area.
5. Establish reserves to protect the Rio Muni estuary and coastal waters (70,000 ha), only known habitat for manatees in Equatorial Guinea, and the Campo estuary (20,000 ha), habitat for birds, crocodiles and hippopotamus.
6. At present there are no reserves on Bioko (Fernando Po). Although much of the island vegetation has been destroyed to make way for coffee plantations, the remaining montane forest should be protected to conserve its unique montane flora which shows strong affinities with that of Mt Cameroon. Pennant's red colobus monkey, two bird species and several subspecies are endemic to Bioko. Specifically, Castroviejo et al. recommend:
– the establishment of a reserve of 60,000 ha in the south of the island to include offshore coastal waters and give protection to island endemics and marine fauna, including turtles and cetaceans;
– the establishment of a reserve of 15,000 ha to protect the montane forests on the peaks of Saint Isobel.
7. Declare the island of Annobon a conservation area, including the fringing coastal waters which support important colonies of seabirds, turtles and cetaceans.

b: **Improving management and protection of reserves**
The highest priority need for Equatorial Guinea is to establish some protected areas with properly planned management. It will first be necessary to establish a National Parks and Wildlife Department responsible for the management and protection of the proposed reserves and the protection of wildlife.

c: **Other conservation action**
1. Equatorial Guinea should become a signatory of CITES.
2. Conduct surveys to establish the distribution and status of key species and to determine appropriate conservation action to protect them.

NEED FOR INTERNATIONAL ASSISTANCE

International assistance should be offered to Equatorial Guinea to help establish a system of protected areas and to train parks personnel.

ETHIOPIA

Area (km^2)	:1,221,900
Population 1980 (UN Projection)	:31,522,000
Population density/sq.km.	:25.8
% Permanent agriculture/ pasture	:65%
% Closed forest cover	:3.5%
Phytochoria	:III, IV, VIII

COUNTRY OVERVIEW

HABITAT COVERAGE FOR ETHIOPIA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
17	12700	20	1000	7.8	0	0.0
19A	213400	10	3325	1.5	0	0.0
29B	127900	10	5150	4.0	1500	1.1
35B	9300	30	0	0.0	500	5.3
38	82500	20	6500	7.8	0	0.0
42	449600	40	15415	3.4	0	0.0
43	38900	30	3300	8.4	0	0.0
45	700	30	0	0.0	0	0.0
54A	3000	50	0	0.0	0	0.0
54B	128700	50	14700	11.4	0	0.0
61	2100	5	0	0.0	0	0.0
62	800	20	0	0.0	0	0.0
64	700	50	0	0.0	0	0.0
65	23200	70	2600	11.2	0	0.0
68B	2300	70	0	0.0	0	0.0
71	5200	70	0	0.0	0	0.0
Totals	1101000	30	51990	4.7	2000	0.1

Prior to 1972 extensive surveys throughout Ethiopia identified those areas important for wildlife and a system of conservation areas was proposed, consisting of nine national parks, a marine park, eleven wildlife reserves, three sanctuaries and 17 controlled hunting areas. Together these protect representative samples of several of the country's major vegetation types. 4.7% of the country's land area is already included within existing reserves.

Conservation efforts are now improving in Ethiopia but most reserves are poorly managed and protected due to a lack of trained manpower, funds and other resources. The management authority's task is also made more difficult by political unrest and a general lack of public awareness of the value of wildlife.

Priority A protected areas include Omo, Bale Mountains and Simen Mountains national parks and Mille Sardo Wild Ass Reserve.

RECOMMENDATIONS FOR ACTION

Most of the following recommendations have been identified by Hillman (1985a).

a: **Extending the protected area system**

1. Except for the Awash and Simen national parks other conservation areas are not gazetted although some, like the Bale Mountain N.P., have been developed; these reserves should be gazetted as soon as possible.

2. It is several years since a marine national park was first proposed in the Dahlak islands yet no detailed study of the area has been carried out. These islands are an important breeding site for seabirds. The

islands and surrounding seas should be assessed for development as a marine park.
3. Establish a wildlife sanctuary at Yavello near the Ethiopia/Kenya border, an area rich in wildlife.
4. The following lakes which are important habitat for flamingoes should be protected : lakes Zwai, Langano, Awasa, Abaya and Chamo. Lakes Abiatta and Shalla are already protected within the Abiatta-Shalla (Rift Valley Lakes) national park.
5. Protect those sandy beaches which are important for turtle nesting.

b: **Improving protection and management of the existing reserves**
1. Gambella N.P, an area of undisturbed tropical forests, has one of the richest wildlife concentrations in Ethiopia. The area is threatened by adjacent agricultural developments and protection and development of the park are of top priority.
2. The Bale Mountains N.P. is outstanding both for its wildlife and scenery and harbours populations of such endemic Ethiopian mammals as mountain nyala, Simien fox and Menelik's bushbuck. The mountains are an important feeding area for passage and overwintering Palaearctic migrants – especially waders, waterfowl and large raptors (Hillman, 1986). Wild *arabica* coffee is also indigenous to this mountain region. Although the park is not yet legally gazetted park headquarters have been built and the improved levels of protection have already been reflected by increases in population numbers of the region's mammal fauna; increases in numbers of mountain nyala are particularly dramatic (Hillman, 1986). A management plan has been prepared and is being implemented. The park should be gazetted as soon as possible to give it full legal protection.
3. The Omo, Mago and Nechisar national parks are some of the last untouched wilderness areas in Africa and relatively undisturbed by human interference. Protection and management of these parks should be implemented as soon as possible.
4. Viable management plans should be prepared for all conservation areas. Management plans will need to take into account the needs of surrounding communities and suggest measures to regulate their use and utilisation of the parks and their resources.
5. Local inhabitants at present living within park boundaries should be resettled elsewhere. The Awash, Simen Mountain, Bale Mountains and Nechisar national parks are the most affected by human encroachment but there is also some disturbance in the Omo and Mago national parks.

c: **Other conservation action**
1. Review and revise existing legislation for the protection of wildlife and establishment of national parks and protected areas. More rigorous implementation of laws protecting wildlife are also required.
2. Ethiopia should become a signatory to CITES and ratify the Convention.

NEED FOR INTERNATIONAL ASSISTANCE

Although development plans for wildlife conservation have been approved and integrated within the ten year development plan, the Ethiopian government will require external assistance in funding these operations. In spite of difficult conditions the Ethiopian government has begun to implement conservation measures through its wildlife department, the Ethiopian Wildlife Conservation Organisation, which deserves recognition for its conservation efforts, especially in the Bale Mountains, and Senkelle and Awash conservation areas. So far Ethiopia has received little international aid for conservation. International assistance should be sought for training, with the establishment of schemes for rational utilisation of wildlife (e.g. crocodile and ostrich farming) and for advisers to work with local counterparts in the development of national parks.

GABON

Area (km^2)	:267,000
Population 1980 (UN Projection)	:546,000
Population density/sq.km	:2
% Permanent agriculture/pasture	:15%
% Closed forest cover	:76%
Phytochoria	:I

COUNTRY OVERVIEW

The conservation situation in Gabon is relatively optimistic. Over 76% of the country is still covered in natural forest, some 46% being undisturbed. The human population is at low density and enjoys a high standard of living by African standards due to the country's wealth from oil, iron, timber and other resources. Logging is conducted in a highly selective manner removing only timber of large size and a few species, especially *Aukoumia* spp. At the current rate of logging Gabon's forest resources will last another 1690 years so that the country is losing its forests more slowly than any other African country.

Nevertheless protection of the Gabon forests is very important. This is one of the richest blocks of the whole Guineo-Congolian rainforest region. The area has enjoyed a stable moist climate since the Pleistocene and is considered one of the main refugium of African rainforest species (Hamilton, 1976). The area harbours many important species of plants and animals including chimpanzees and gorillas.

HABITAT COVERAGE FOR GABON

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	52800	50	8980	17.0	0	0.0
1A	158100	70	8550	5.4	4000	2.5
2	30800	70	0	0.0	0	0.0
3	11600	70	0	0.0	0	0.0
77	2300	50	0	0.0	0	0.0
8	11400	50	0	0.0	1000	8.7
Totals	267000	65	17530	6.5	5000	1.8

The country has an extensive network of reserves covering 6.5% of its land area and representing large blocks of forest (1 and 11 A). Further reserves are proposed in swamp forest and rainforest. However many of these gazetted reserves exist only on paper with almost no effective protection on the ground. Moreover there are no adequate provisions in the existing legislation of the country for the establishment and management of national parks. The best protected reserve is the President's private hunting reserve, reserved for the exclusive use of the President and his guests.

The only priority A protected area is Lope-Okanda national park, a rainforest reserve protecting good populations of lowland gorillas, chimpanzees, elephants and forest buffalo.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Additional areas in need of protection include:
– primary forests of the proposed Minkebe area, and,
– savanna woodlands near Franceville, home to the last lions in the country.

2. Extend Wonga-Wongue Hunting Reserve to include some swamp forest habitat.

b: **Improving management and protection of the existing reserves**

1. Increase the numbers of staff, funding, resources and equipment for all reserves. Stop hunting and poaching in all reserves.

2. Discontinue the present practice of releasing exotic species into the Gabon reserves and eliminate those exotics already released into Wonga-Wongue H.R.

c: **Other conservation action**

1. Develop a national conservation strategy to include a planned network of national reserves and a programme for the rational exploitation of the country's natural resources.

2. Revise legislation to include provisions for the establishment and management of national parks and give better protection to wildlife and protected areas.

3. Gabon should become a signatory to CITES and ratify the Convention.

NEED FOR INTERNATIONAL ASSISTANCE

Gabon is considered to have adequate financial resources to manage its natural environment and recent improvements suggest that the Gabon authorities are becoming more aware of the value of the country's rich wildlife. The government may, however, need to recruit international assistance with the development of its parks system and for training personnel.

GAMBIA

Area (km^2)	:11,295
Population 1980 (UN Population)	:563,000
Population density/sq.km.	:49.8
% Permanent agriculture/pasture	:60%
% Closed forest cover	:6.3%
Phytochoria	:III, XI

COUNTRY OVERVIEW

HABITAT COVERAGE FOR GAMBIA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	2400	5	0	0.0	100	4.1
29A	7200	10	0	0.0	0	0.0
77	1700	30	0	0.0	0	0.0
Totals	11300	11	0	0.0	100	0.8

Gambia is a very small, well-populated country where much of the original vegetation has been cleared for farmland and only a small area is protected for conservation. The proposed national park of Kiang's West is the only conservation area larger than 5000 ha in the Gambia. In general management of protected areas is good. In cooperation with its neighbour Senegal, Gambia is responsible for protecting the Delta du Saloum, a valuable area of mangrove and an important wetland for breeding waterbirds.

GHANA

Area (km^2)	:238,537
Population 1980 (UN Projection)	:11,446,000
Population density/sq.km.	:49.8
% Permanent agriculture/pasture	:60%
% Closed forest cover	:6.3%
Phytochoria	:I, III, XI

COUNTRY OVERVIEW

The government of Ghana has a specific conservation plan which aims to protect representative samples of all flora and fauna within the country. The impetus behind conservation is not based on tourism but on a desire for wise utilisation of the country's resources. The populace relies heavily on bushmeat for protein; this makes up 75% of the populace's meat consumption. The main problem affecting conservation of natural habitats is the demand for fuel wood, a problem that increases as the population rises. Destruction of vegetation for charcoal is most serious in the transition zone between forest and savanna. The prospects for conservation of flora and fauna in the country's forest reserves are not good; there is little control over felling, even though some of the forest reserves protect important water catchments.

HABITAT COVERAGE FOR GHANA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	53100	20	6250	11.7	0	0.0
12	5200	20	274	5.2	0	0.0
15	6000	20	0	0.0	0	0.0
1A	18300	10	0	0.0	0	0.0
2	60300	10	692	1.1	0	0.0
27	67000	30	4921	7.3	0	0.0
29A	10700	30	0	0.0	0	0.0
30	7300	30	0	0.0	0	0.0
77	2100	30	0	0.0	0	0.0
Totals	230000	20	12137	5.2	0	0.0

From the table it can be seen that all of the country's natural habitats have been much reduced or degraded; this is especially true for areas of lowland rainforest (vegetation types 1 and 2). Ghana has a fairly extensive system of reserves covering 5.2 % of the country's land area but most lie in already degraded habitat types such as savanna/woodland. There are no reserves in the country's coastal mangrove, an important habitat that has already been reduced to a third of its original extent.

Ghana has no priority A protected areas but several areas that represent important ecosystems and are valuable on a national scale.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Upgrade the protection, management and status of some of the forest reserves important for protecting flora, fauna and water catchments. These forest areas have not been included in the protected area total for Ghana.

b: **Improving protection and management of existing reserves**

1. The main problems facing the Wildlife and National Parks Division of the Ghana Forestry Commission

are acute shortages of trained wildlife personnel, of equipment and vehicles and of radios for communication. Funding of the Wildlife Division must be increased to pay for more staff and equipment.
2. Prepare and implement management plans for all major reserves.

c: **Other conservation action**
1. Improve conservation education and increase public awareness of the benefits accruing from parks and protected areas by increasing educational facilities and interpretation programmes. Special emphasis should be placed on the importance of wildlife to local economies and the need for wise utilisation of natural resources.
2. Revise legislation to give better protection to protected areas and wildlife. There is no definition of different categories of protected areas in the current legislation.

NEED FOR INTERNATIONAL ASSISTANCE

Ghana may need assistance with training. Parks staff should attend courses at Mweka Wildlife College, Tanzania. It may also be possible for staff to attend training courses at the recently established training school in Nigeria and at the university in Sierra Leone. Attendance at the last two may be more valuable since all the countries of West Africa face similar conservation problems and regional meetings provide useful fora for exchange of ideas.

GUINEA

Area (km^2)	:245,887
Population 1980 (UN Projection)	:5,014,000
Population density/sq.km	:20.4
% Permanent agriculture/pasture	:40%
% Closed forest cover	:8%
Phytochoria	:I, III , VIII, XI

COUNTRY OVERVIEW

HABITAT COVERAGE FOR GUINEA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	156100	30	0	0.0	2000	1.2
12	2100	30	0	0.0	0	0.0
13	4100	30	0	0.0	0	0.0
19A	1200	60	70	5.8	0	0.0
27	52500	30	0	0.0	0	0.0
29A	7600	20	0	0.0	0	0.0
3	19300	40	60	0.3	0	0.0
77	3000	40	0	0.0	0	0.0
Totals	245900	30	130	0.0	2000	0.8

Nature conservation has very low priority in Guinea and there are only two protected areas in the whole country – Mount Nimba Nature Reserve and the Biosphere Reserve of the Massif du Ziama. Both protect primarily montane vegetation and the other vegetation types of the country are not represented in any protected areas.

Both Mount Nimba and the Massif du Ziama are classed as priority A areas for conservation.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**
1. Establish the Massif du Ziama as a nature reserve, with properly defined boundaries. It has been identified as an important plant site (Droop, 1985.) Its present status is that of Biosphere Reserve.
2. Survey the country for other suitable sites for conservation areas to protect other vegetation types, particularly lowland rainforest and mangroves, and areas of wildlife richness.

b: **Improving protection and management of existing reserves**
1. Improve standards of protection and management in the existing protected areas and prepare a national parks programme.

c: **Other conservation action**
1. Increase public awareness of the importance of protected areas for protection of watersheds, gene pools and wildlife resources by education campaigns aimed at both local people and politicians.
2. Inventory the utilisation of natural resources in local economies for food, medicines, building and craft materials etc (see Sale, 1981).
3. Revise legislation to give better protection to conservation areas and wildlife.

NEED FOR INTERNATIONAL ASSISTANCE

Guinea should request international assistance for the preparation of a national conservation strategy and for the development and implementation of a parks programme. Training is another sector which requires assistance.

GUINEA BISSAU

Area (km^2)	:36,125
Population 1980 (UN Projection)	:573,000
Population density/sq.km.	:16
% Permanent agriculture/pasture	:55%
% Closed forest cover	:18%
Phytochorion	:XI

COUNTRY OVERVIEW

HABITAT COVERAGE FOR GUINEA BISSAU

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	25600	20	0	0.0	0	0.0
77	10500	30	0	0.0	0	0.0
Totals	36100	22	0	0.0	0	0.0

Guinea Bissau is a small country and includes only two major vegetation types – mangrove and a mosaic of lowland forest and secondary grassland. The forest patches are probably refuges for forest birds and may be of some conservation importance. As yet Guinea Bissau has no protected areas. Areas of natural habitat are already much reduced so it is important that areas for conservation status are identified and established quickly.

RECOMMENDATIONS FOR ACTION

Little information is available for Guinea Bissau but some recommended sites for protection include:
- an area of the remaining coastal mangrove; this vegetation is already much reduced
- forest patches which have rich bird faunas and other wildlife
- areas of the coastal wetlands, which are the most important wintering grounds in West Africa, after Banc d'Arguin, for Palaearctic waders
- the offshore islands of the Bijagos archipelago are reported to be interesting for their birdlife and mammal species.

Guinea Bissau may need some technical assistance with identifying and developing a national network of protected areas.

IVORY COAST

Area (km^2)	:322,462
Population 1980 (UN Projection)	:7,820,000
Population density/sq.km.	:24
% Permanent agriculture/pasture	:52%
% Closed forest cover	:13.8%
Phytochoria	:I, III, VIII, XI

COUNTRY OVERVIEW

Ivory Coast has an extensive system of parks and protected areas covering 5.2% of the country's land area and representing most habitat types. Although hunting was banned in 1973 poaching is now the main threat to the park network. The other major threat is encroachment from competing land uses; most natural habitats have been severely affected by timber extraction, forest clearance and uncontrolled fires. Over the past 15 years the south-west of Ivory Coast has developed faster than any other region in West Africa. As a result 90% of the classified forests of Ivory Coast have already gone and if the present rates of clearance continue there will be no forest left by 1991 (UNEP/IUCN, 1983).

HABITAT COVERAGE FOR IVORY COAST

Habitat	Orig.area	Kem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	93600	20	3520	3.7	0	0.0
19A	300	60	50	16.6	0	0.0
1A	44900	10	1300	2.8	0	0.0
2	61500	10	2040	3.3	0	0.0
27	88600	40	9500	10.7	0	0.0
3	24500	10	0	0.0	0	0.0
77	1600	40	20	1.2	0	0.0
8	3000	40	190	6.3	0	0.0
Totals	318000	21	16620	5.2	0	0.0

Although the existing protected area system is adequate in its coverage, protection and management is still generally rather poor due to shortages of trained and properly equipped staff. Azagny is fairly well protected because of the ongoing World Bank development project.

Priority A protected areas in Ivory Coast are Tai and Comoe national parks and Mount Nimba reserve, part of a transfrontier reserve and a World Heritage Site. Tai is the largest protected example of Guinea wet rainforest, with high levels of local endemism. Comoe is a very large reserve of more open

savanna habitat with some patches of relict forest and a very diverse fauna. Azagny N.P. is a smaller area of much less conservation importance although it has a wide range of habitats from mangrove to tall forest and savanna. Because of its proximity to Abidjan and its high visitor potential this reserve has been developed under a World Bank project . Efforts to restore some of its original fauna include release of chimpanzees, pygmy hippos and crocodiles.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Identify and give better protection to forest reserves important for wildlife.

b: **Improving protection and management of existing reserves**

1. The Tai and Comoe national parks are areas of great biological richness but their viability is threatened by fires, encroachment, hunting, etc. Tai is probably the most important protected area in the whole of West Africa yet it continues to be seriously abused by illegal (but semi-sanctioned) logging, gold mining and settlements. It is essential to improve protection of the Ivory Coast parks network by increasing the number of trained parks staff.

2. Implement the existing management plans for the protected areas with priority given to Tai and Comoe national parks.

3. An official mineral survey should be carried out in Tai N.P. If there are substantial gold deposits inside the reserve it is quite unrealistic to maintain the present unenforceable ban on prospecting. It would be better to lease mineral rights to one official company or agency charged with exploitation at minimum disturbance to the habitat than to continue the present uncontrollable free-for-all.

c: **Other conservation action**

1. Develop parks for wildlife tourism; Comoe is especially suitable for tourism and already has some visitor facilities.

2. Tai should be developed as a seed source for re-afforestation programmes with a centre established for seed collection and propagation.

3. Ivory Coast should become a signatory of CITES and ratify the Convention.

NEED FOR INTERNATIONAL ASSISTANCE

Ivory Coast has received considerable German aid in planning a protected areas system and has also received a World Bank loan for park development. Management plans have been prepared for all the major reserves.

International support, both financial and provision of expertise, equipment and training, should be given for the development of Tai national park which is one of the most important protected areas of the Guineo-Congolian rainforests of West Africa.

KENYA

Area (km^2)	:582,546
Population 1980 (UN Projection)	:15,688,000
Population density/sq.km.	:27.0
% Permanent agriculture/pasture	:15%
% Closed forest cover	:1.9%
Phytochoria	:IV, VIII, XII, XIII

COUNTRY OVERVIEW

HABITAT COVERAGE FOR KENYA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	11500	10	0	0.0	0	0.0
16A	28400	10	0	0.0	339	1.1
16B	4600	48	168	3.6	0	0.0
19A	28900	50	1859	6.4	113	0.3
2	2900	10	97	3.3	0	0.0
42	327300	60	22272	6.8	10409	3.1
45	69800	37	3502	5.0	339	0.4
54B	89200	60	1570	1.7	0	0.0
64	1800	50	0	0.0	0	0.0
65	1800	100	688	38.2	0	0.0
76	200	95	190	95.0	0	0.0
77	3100	30	0	0.0	500	16.1
Totals	569500	52	30346	5.3	11700	2.0

Kenya has a good system of reserves and national parks, many of them established during colonial times but maintained and extended since Independence. 5.3% of the country lies within protected areas, which conserve representative samples of most of the country's flora and fauna. Some biotic communities are not included within the reserve system, for instance coastal and marine communities. In particular the country's forest reserves have been neglected although they harbour important wildlife populations. They have already suffered heavy encroachment and over-exploitation and immediate steps should be taken to upgrade them and afford better protection.

The national parks form the mainstay of the tourist economy. Management of most of the main parks and reserves is adequate but elsewhere management is generally poor due to lack of trained staff. As the country's population increases the parks system is increasingly threatened by encroachment from surrounding communities. Poaching is a serious problem which has severely depleted the country's black rhino population.

Priority A protected areas include Lake Nakuru, Tsavo, Mount Kenya and Kakamega national parks and Arabuko Sokoke Forest Reserve.

RECOMMENDATIONS FOR ACTION

a: **Extending the existing protected area system**

Many of the following recommendations were proposed originally in Lamprey's (1974) excellent review of the protected area systems of East Africa yet are still outstanding.

1. Give better protection to relict patches of forest which constitute the last known examples of formerly more extensive types – in particular Kakamega forest, Arabuko-Sokoke forest and the coastal Kenya forests. Part of Kakamega is a national park (97 sq.km.) and the other forests are designated as forest reserves but the protection so afforded is inadequate for their biological importance. These outlier forests, relicts of the previously more extensive eastern forests, are home to several endemic species of trees and

birds, species which occur at low densities and are, therefore, particularly vulnerable to habitat destruction.

2. A relatively small proportion of the montane forests of East Africa are included in national parks; elsewhere they are being reduced by timber exploitation and encroachment for agriculture. Immediate protection of all montane floristic types should be ensured by the declaration of nature reserves of adequate area in all forest reserves e.g. Mau and Cherangani forests, Mount Elgon.

3. Establish nature reserves to protect the relict humid forests of Kakamega, South and North Nandi; at present these are forest reserves subject to timber extraction.

4. All surviving coastal forest in Kenya should be totally protected; upgrade the forest reserves of Witu and Arabuko-Sokoke to nature reserves and stop timber exploitation. Arabuko-Sokoke harbours both coastal rainforest and the only viable stand of coastal dry forest and is the only known habitat of the owl *Otus ireneae* and Clarke's weaver *Ploceus golandi.*

5. Protect the Lorian and Lotikiri swamps.

6. Desert areas are inadequately represented in the protected area systems of East Africa. Small areas of lava desert are protected in Marsabit N.P. and S. Turkana N.P., important habitats for beisa oryx and Grevy's zebra. More areas for protection should be identified in the Chalbi and Koroli deserts. Chalbi is an old lake bed and now a salt pan subject to occasional flooding. Koroli is a sand desert showing signs of recent degradation but sub-desert scrub might recover with adequate protection.

7. Immediate protection should be given to the estuaries, bays and sea grass beds of the Lamu area which are not included in any reserve. Threatened populations of dugongs occur here.

8. Establish marine parks to protect reefs, especially where they are subject to dynamiting for fishing. Also protect sandy beaches where turtles nest (see UNEP, 1984).

9. Two small areas of mangroves are included in national reserves in Kenya but other areas should be given better protection.

10. The open water of all the freshwater lakes in eastern Africa (except for very small ones) is not included in adjoining national parks and protected areas. (Note that these lakes, which contain high levels of ecological diversity, are usually treated as though they are ecologically uniform, with consequent under-representation of certain communities). This is a major omission. Lake Victoria is one of the richest lakes in the world in terms offish diversity and endemism yet has no protection. Introductions of Nile perch into L.Victoria have already had serious ecological consequences as well as reducing local fish catches. The boundaries of all protected areas abutting onto major waterbodies should extend at least 500 m offshore to protect some of the lake habitat.

11. The alkaline lakes of the eastern African rift system are virtually unrepresented in the protected area system. Lakes Turkana (Rudolf), Baringo, Bogoria and Magadi are all important habitat for flamingoes and should be given protection as such. Central Island of Lake Turkana is an important breeding area for lesser flamingoes.

b: **Improving protection and management of existing reserves**

1. Improve protection of Boni National Reserve, a particularly good example of the forest/savanna mosaic on the north coast; though protected as a game reserve it is threatened by felling for charcoal.

2. Monitor the effects of tourism on park habitats and wildlife to avoid habitat degradation and overuse of some park zones.

c: **Other conservation action**

1. Extend conservation education programmes particularly to settlements adjoining national parks and protected areas. The Wildlife Clubs of Kenya already do an excellent job in conservation education, and could serve as a model for other African countries wishing to establish NGOs concerned with conservation issues.

2. Implement development projects to stop overgrazing and bad agricultural practices in areas of critical habitat, such as the semi-arid grasslands where serious ecological degradation and soil erosion have already occurred.

NEED FOR INTERNATIONAL ASSISTANCE

Kenya already receives substantial international funding for better protection and management of its existing protected areas and research on the country's rich wildlife. This should be continued. Kenya has

developed excellent tourist facilities in its parks and reserves and good conservation education programmes; this expertise could be shared with other countries of the region through study tours and exchange programmes for parks staff.

LESOTHO

Area (km^2)	:30,355
Population 1980 (UN Projection)	:1,284,000
Population density/sq.km.	:42.3
% Permanent agriculture/pasture	:94%
% Closed forest cover	:0
Phytochoria	:VIII,

COUNTRY OVERVIEW

Much of Lesotho lies above 2000 m and agricultural development is often impracticable. The lowlands are easily accessible but here agriculture suffers from poor soils and periodic drought. Nevertheless Lesotho supports a relatively high human population. Much of the natural environment has been modified by Man and his activities, both directly by destruction of woodland and scrub and of the larger wildlife, and indirectly by veld burning, human settlement and by grazing of domestic livestock.

HABITAT COVERAGE FOR LESOTHO

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
20	19100	10	0	0.0	0	0.0
58	4700	30	0	0.0	0	0.0
66	6600	100	68	1.0	0	0.0
Totals	30400	32	68	0.2	0	0.0

Only 0.2% of the country is designated as protected area and this is all within the Sehlabathebe N.P., all altimontane habitat. The park is interesting for its specatcular scenery but is faunally rather poor.

RECOMMENDATIONS FOR ACTION

In Lesotho where lowland agricultural land is at a premium it is probably not practicable to create any reserves in lowland habitats. It may, however, be worthwhile to create another mountain park especially now that tourists are beginning to take an interest in the country's natural beauty as well as its casinos.

Extending the protected area system

1. Follow McVean's recommendations (1977) for additional small reserves and extensions to Lesotho's national park. Establish the proposed reserves of Qeme Plateau, Quthing Valley and Makhaleng Valley.
2. Implement McVean's recommendations for Sethlabethebe N.P. re status and zoning.

Other conservation action

1. Lesotho is already a signatory to CITES but should ratify the Convention.
2. The National Parks Act of 1975 should be made operational.

LIBERIA

Area (km^2)	:111,369
Population 1980 (UN Projection)	:1937,000
Population density/sq.km.	:17.4
% Permanent agriculture/pasture	:6%
% Closed forest cover	:17.9%
Phytochoria	:I, III, XI, VIII

COUNTRY OVERVIEW

HABITAT COVERAGE FOR LIBERIA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	16800	10	0	0.0	500	2.9
19A	100	80	0	0.0	70	70.0
1A	31300	20	1000	3.1	300	0.9
3	61800	10	0	0.0	1360	2.2
77	1200	30	0	0.0	50	4.1
8	200	20	250	125.0	0	0.0
Totals	111400	13	1250	1.1	2280	2.0

All natural vegetation types in Liberia have been drastically reduced with the exception of montane habitat 19a (see table). Liberia is well aware of its conservation problems. To reverse the sharp decline in wildlife populations caused by extensive, indiscriminate hunting, Liberia is developing a corps of trained wildlife officers, and planning a system of conservation areas and enforceable wildlife legislation. Only 1.1% of the country is already protected but proposed areas increase this total by another 2%.

Apart from national parks and reserves the national forests are also important refuges for wildlife; as yet there is no adequate protection of these areas. Shifting cultivation and forest clearance for agriculture, mining and limited timber extraction are the greatest threats. Protection and management is poor in all existing reserves except Sapo national park but the government is concerned to increase numbers of trained staff.

Priority A protected areas include Sapo N.P., the proposed Mt Nimba reserve and the proposed Loffa-Mano national park.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Gazette, as soon as possible, the proposed Loffa-Mano N.P. and four proposed reserves: Cape Mount Forest, Cavally Forest, Mount Nimba and Wonegezi Mountain Range. The proposed Cestos-Sankwen N.P. is of less biological interest and lower conservation priority than Loffa-Mano.

2. Loffa-Mano could be developed as a good example of integrated land-use planning with a totally protected core area surrounded by sustained-yield timber concessions with planned hunting and settlement areas. The whole unit should allow wildlife to move between Loffa-Mano and the Gola Forest reserves of neighbouring Sierra Leone.

3. Improve the protection and management of 8 national forests to better protect their plants and wildlife from forest destruction. Establish nature reserves of viable size within these national forests: Krahn Bassa (514000 ha), Grebo (251000 ha), Gola (207000 ha), Kpelle (174800 ha), North Lorma (100000 ha), Gbe (61000 ha), Gio (33000 ha) and East Nimba (29000 ha).

b: **Improving protection and management of existing reserves**

1. Improve management and protection of all reserves; at present only Sapo national park has any

effective management. Implement the management plan for Sapo and its environs, as approved by government.
2. Establish contacts with neighbouring countries to manage frontier reserves such as Loffa-Mano, Mt Nimba, Wonegezi and Cavally.

c: **Other conservation action**
1. Introduce adequate legislation to protect wildlife and forests and legislation for the establishment and management of national parks.
2. Upgrade the Wildlife and Parks section and give this department legal powers (Verschuren, 1983a).
3. At present the population of Liberia obtains 70% of its animal protein from the forest, a harvest that wild populations can no longer sustain. Attempts should be made to impose greater controls on hunting of all wildlife, with some strict no-hunting zones outside protected areas, to allow populations to recover. There should be a total ban on hunting of threatened species.
4. Almost all exploitable forest is under concession though a very low tonnage of timber is extracted. There should be no further declassification of national forests.

NEED FOR INTERNATIONAL ASSISTANCE

The government of Liberia is keen to implement a rational conservation programme. International assistance should be sought to aid the selection and establishment of protected areas, preparation and implementation of management plans, and for technical assistance and training. The government of Liberia has already requested assistance from IUCN with the preparation of a National Systems Plan and a National Conservation Strategy.

MADAGASCAR

Area (km^2)	:587,041
Population 1980 (UN Projection)	:9,329,000
Population density/sq.km	:15.9
% Permanent agriculture/pasture	:47%
% Closed forest cover	:4.5%
Phytochoria	:XIX, XX

COUNTRY OVERVIEW

Madagascar is evolutionarily and biologically unique. The island's long geological separation from the African mainland, its topography and variety of climates has led to an exceptional richness of plant and animal species, many of them endemics. 79% of the island's plants and 98% of its non-flying mammals (including the fascinating lemurs and tenrecs) are unique to Madagascar and birds, amphibians and reptiles show similarly high levels of endemism.

Florally, and faunally, the island is so different from the African mainland that it has been assigned to two separate phytochoria: the East and West Malagasy Regional Centres of Endemism. Within these broad biogeographic units are a wide range of habitats.

HABITAT COVERAGE FOR MADAGASCAR

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
F 1b	80,729	c.15	1122	1.4	400	0.4
F 7	51,875	c.15	1499	2.9	-	0
M/G 18	121,354	c.30	584	0.5	-	0
M 5	45.312	c.20	2316	5.1	-	0
M 19c	3,646	c.30	442	12.0	-	0
F/G 11	21,875	c.20	50	0.2	-	0
F/G 22	198,875	c.30	2603	1.3	-	0
B 41	38,125	c.15	432	1.1	-	0
B/G 46	31,250	c.30	129	0.4	-	0
Mn 77	2,170	c.60	-	-	-	0
Totals	595,211	c.25	9177	1.5	400	0.1

Only 1.5% of Madagascar's land surface is included within protected areas but the existing reserve network covers representative samples of most of the island's habitats. No habitat type is adequately protected, however, and some habitats such as mangrove are not protected at all within the existing system. The lack of coverage of forest habitats is particularly serious in view of the fast loss of original forest and the lack of forest regeneration because of the regular burning that is such a feature of Malagasy life.

Ever since Man first arrived on Madagascar some 1500 years ago he has been radically altering the environment. Over 80% of the natural vegetation has already been destroyed and this process accelerates as the population increases. Seriously concerned by degradation of the island environment, in 1984 the Government of Madagascar sought international assistance with the preparation of a National Conservation Strategy and in November 1985 hosted a conference in Antananarivo where aid was requested from international agencies for funding and technical assistance for environmental and conservation projects.

The Government of Madagascar intends to develop a comprehensive programme which includes the establishment of new protected areas, better management of existing reserves, environmental and reafforestation projects and public education in conservation matters. At present no protected areas have effective protection or management, other than Montagne d'Ambre where recently protection has improved. All protected areas suffer from lack of personnel and resources and are threatened by fire, poaching and agricultural encroachment.

Priority A protected areas in Madagascar include Montagne D'Ambre N.P. and the reserves of Zahamena and Andohahela. Top priority should also be given to the establishment of a reserve to include Lac Ihotry and others of the Sept Lacs with a substantial area of surrounding Didiereaceae bush.

RECOMMENDATIONS FOR ACTION

For recommendations in more detail see the relevant sections under phytochoria XIX and XX.

a: **Extending the protected area system**

1. Identify from satellite maps and ground surveys a large undisturbed tract of eastern lowland rainforest and establish one or more new reserves, each of at least 50,000 ha. Possible areas include the Mahakira plateau, the forests west of Maroantsera and Antongil Bay, and the Sihanaka Forest.

2. Re-establish a reserve on the Masoala peninsula, of at least 30,000 ha, to replace the area degazetted in 1964.

3. Extend the reserve of Perinet-Analamozaotra from its present size of 810 ha, which is too small to remain viable, to at least 10,000 ha to include more of the adjacent species-rich forests to the north.

4. There is an urgent need to establish a reserve in the region of Lac Alaotra, if the habitat is still worth protecting.

5. Surveys should be carried out to determine if there is an area of remaining lowland rainforest suitable for a reserve in the Sambirano domain.

6. Survey the mangroves of the west coast to identify an extensive area of relatively undisturbed mangrove suitable for a reserve. Possible sites include the estuaries of the Mangoky, Tsiribihana and Betsiboka rivers, Cap Saint-Andre, the Antsohiby area and the coast west of Ambodibonara.

7. Create a new reserve or national park to include Lac Ihotry and a substantial area of Didiereaceae bush.

8. Extend R.N.I.7 Ankarafantsika to include Lake Ampijoara and the hills to the north of the lake.
9. Revise the boundaries of parcelle 2 of R.N.I.11 Andohahela to excise cultivated areas from the reserve in exchange for equal amounts of undisturbed forest . Extend parcelle 2 westwards to include extensive tracts of spiny forest (O'Connor et al. 1986).
10. Extend R.N.I 9 Tsingy de Bemaraha to include a parcel in the west covering the region between Lakes Masamba and Bemamba. Tsingy de Bemaraha is an area of spectacular limestone scenery with interesting flora and fauna. The whole area has been proposed as a World Heritage Site.

b: **Improving protection and management of existing reserves**
1. Improve protection, management and staffing levels at all reserves; this will require a manifold increase in budgets. Boundaries of all reserves should be marked clearly, perhaps with firebreaks which would also afford protection against the spread of fire from adjacent agricultural lands.
2. At present all reserves suffer from lack of staff and facilities. In some reserves horses would be useful for transport.
3. Stop hunting, livestock grazing and agricultural encroachment in reserves.

c: **Other conservation action**
1. Conduct extensive surveys for the planning of an expanded and more comprehensive system of protected areas, especially in the lowland forests. A prerequisite is an up-to-date vegetation map of Madagascar showing the extent of remaining forests.
2. Survey the eastern forests to determine the distribution and status of many of Madagascar's unique plants and animals. Data from floral and faunal surveys should be recorded on standard inventory sheets and lodged with the relevant scientific and management authorities in Madagascar.
3. Surveys should be made to identify important lakes and wetlands.
4. Revise legislation to improve protection of reserves and to protect raptorial birds, *Ardea* herons and the Nile crocodile which are currently listed as vermin.
5. Extend conservation education programmes to improve public awareness of the benefits of wise conservation and of protected areas. Encourage local initiatives to discourage the national practice of burning to clear land for agriculture or to improve grazing.

NEED FOR INTERNATIONAL ASSISTANCE

Madagascar is a very poor country with enormous environmental problems. Considerable international assistance should be mobilised to strengthen the capability of the Madagascar authorities in surveys, planning and training personnel, and to provide technical assistance, funding and equipment to improve management and protection of protected areas.

MALAWI

Area (km^2)	:94,485
Population 1980 (UN Projection)	:5,577,000
Population density/sq.km.	:59
% Permanent agriculture/pasture	:36 %
% Closed forest cover	:1.6%
Phytochoria	:II, VIII,

COUNTRY OVERVIEW

HABITAT COVERAGE FOR MALAWI

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
l6B	100	50	0	0.0	0	0.0
19A	10500	60	2352	22.4	1000	9.5
25	53200	40	5710	10.7	0	0.0
26	6300	50	264	4.1	0	0.0
28	1500	70	960	64.0	0	0.0
29c	19600	40	1619	8.2	0	0.0
65	100	100	0	0.0	0	0.0
75	2800	40	0	0.0	0	0.0
Totals	94100	43	10905	11.5	1000	1.0

Malawi has an extensive protected area network covering 11.5% of the country and including representative samples of all major vegetation types. Some of the obvious gaps in the system such as the elephant marsh, salt lakes (Lake Chilwa) and freshwater lakes are so heavily utilised and populated that it would be impossible to establish protected areas there.

Malawi has one of the better-run protected area systems in the Afrotropical realm. Soil and water conservation are basic concerns in the establishment and management of parks and reserves and scientific research is a priority use for all areas. Some game and timber exploitation is allowed in game reserves on a sustained yield basis; it is the responsibility of the Parks department to monitor and regulate the offtake. Protection and management of most of Malawi's parks and protected areas are good. The main threats to reserves are poaching, wild fires and encroachment from the expanding human population. The country's extensive system of forest reserves also affords a high level of protection to biotic communities found there.

Priority A protected areas include Nyika and Lake Malawi national parks. Mount Mulanje and Thyolo/Chiradzulu forestry reserves should also have top priority for development as conservation areas.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Extend Mount Mulanje forest reserve and upgrade to a full reserve of category 4 status. Mt Mulanje is the highest mountain in the region with several endemic plant species, and interesting altimontane vegetation not protected elsewhere in the Malawi parks system. Mt Mulanje could justify World Heritage status.

2. Other isolated mountains with particularly distinct biota include the Thyolo, Sochi, Malawi, Lilonde and Nchisi mountains; at least part of these montane systems are protected within existing forest reserves but these are subject to illegal encroachment and disturbance. These important forest reserves should be extended and their management improved to give them better protection.

3. Although montane evergreen forest is already fairly well represented in the protected area system top

priority should be given to extending coverage of this biome as these forests contain large numbers of rare and endangered species and plants and animals with high levels of endemism. Priority forests identified by Dowsett-Lemaire and Dowsett (in prep.) are Chikala, Malawi, Mulanje, Mzuma, Nkhwadzi, Sochi and Thyolo.

4. Very little of the actual waterbody of Lake Malawi is protected although this is biologically the richest lake in the world with an amazing diversity of fish species (cichlids) and very high endemism. The Lake Malawi N.P. boundaries should be further extended to include more of the lake's waters within the protected area.

b: **Improving protection and management of existing reserves**

1. Protection and management of the national parks and most game reserves is good. Management should be improved for Mwabvi Game Reserve and the boundary issue resolved. Protection also needs to be strengthened for forest reserves which harbour important and unique biotic communities.

2. Increase anti-poaching activities, both by increased patrols and by enlisting the support of local communities by encouraging their appreciation of the economic benefits of conserving wildlife resources.

c: **Other conservation action**

1. Malawi is one of the more densely populated countries of Africa and to relieve pressure for land (a threat to national parks) it will be necessary to increase production on agricultural land.

2. Further investments in manpower, development and conservation operations are needed to improve the effectiveness of the Department of National Parks and Wildlife and ensure that standards do not fall.

3. Good work is already being done to promote conservation awareness among the public, particularly in Liwonde and Blantyre and at the new centre in Mzuzu, but more education and extension programmes should be directed at rural areas.

NEED FOR INTERNATIONAL ASSISTANCE

Malawi has perhaps more expertise in wildlife conservation and management than most other countries in the Afrotropical Realm but could use, and certainly deserves, further financial support in recognition of the good progress already being made in protection and management of parks and other protected areas.

MALI

Area (km^2)	:1,240,000
Population 1980 (UN Projection)	:6,470,000
Population density/sq.km	:5.2
% Permanent agriculture/pasture	:33%
% Closed forest cover	:0%
Phytochoria	:III, XVI

COUNTRY OVERVIEW

Lying in the Sahel Region, Mali has tremendous environmental problems. The Sahel Region was devastated by drought from 1969-1973 and the rains failed again in 1982 and 1984. Overgrazing of remaining poor pastures and destruction of woodland cover for firewood is leading to serious erosion and desertification.

HABITAT COVERAGE FOR MALI

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
27	78600	30	0	0.0	0	0.0
29A	265600	20	24380	9.1	0	0.0
43	145200	20	0	0.0	0	0.0
54A	222300	20	17500	7.8	0	0.0
64	42400	24	1000	2.3	0	0.0
Totals	754100	21	42880	5.6	0	0.0

Only the southern part of Mali is included within this review (the northern boundary of phytochorion XVI has been taken as the northern limit of the Afrotropical Realm). Within the Realm Mali has a fairly adequate protected area system covering 5.4% of its land area and representing most major vegetation types (but not 27). It should be extended, however, to include patches of species-rich forest near Sikasso and the forest near the Guinea border which has a good population of chimpanzees. Many of the existing protected areas have no adequate protection on the ground with many people and cattle within their boundaries.

Priority A protected areas in Mali include Boucle du Baoule N.P. and Elephant Faunal Reserve.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Establish the proposed national park at Faya. This area includes a relict large mammal fauna, chimpanzees, elephants, giant eland and duikers.

2. Establish a park or network of protected areas in the Niger floodplain in the region of Lac Debo. This is the largest floodplain in West Africa and an important habitat for manatees, warthogs and a wide range of migratory birds. Elephants migrate between these floodplains and Burkina Faso.

3. Establish reserves to protect remaining species-rich forests near Sikasso.

4. Establish a reserve to protect remaining forest on the Guinea border, an area with a good chimpanzee population.

b: **Improving protection and management of existing reserves**

1. Protection and management is poor in all protected areas in Mali. Poaching, brush fires and encroachment by human agriculturalists and livestock are threats to all reserves. Improved management will require increased numbers of trained personnel, funding, equipment, transport and other resources for all reserves.

2. Remove human settlements from within reserves or establish enclaves to exclude them from park lands. Disallow grazing of cattle and livestock within reserves, even in times of drought. This puts added pressure on wildlife populations when they too are stressed.

3. At present the Gourma Elephant Reserve does not give adequate protection to Mali's elephants. Olivier (1983) recommends that the existing Elephant Reserve be redefined as a multiple use area (IUCN category 8) covering the majority of the Gourma elephant range and that within this one or more sanctuaries (category 4) be established in critical habitats.

4. Prepare and implement management plans for all major protected areas.

c: **Other conservation action**

1. Develop land-use plans and programmes taking into account the needs of rural communities living adjacent to protected areas.

2. Study the migration routes and patterns of elephants to determine the best protection and conservation measures for the elephant population. Protect critical floodplain habitats.

NEED FOR INTERNATIONAL ASSISTANCE

Mali is a very poor country and will require considerable international assistance if it is to establish and maintain a good protected area network. International assistance should be sought for funding, technical assistance and training.

MAURITANIA

Area (km^2)	:1,030,700
Population 1980 (UN Projection)	:1,427,000
Population density/sq.km	:1.4
% Permanent agriculture/pasture	:39%
% Closed forest cover	:0%
Phytochoria	:XVI

COUNTRY OVERVIEW

HABITAT COVERAGE FOR MAURITANIA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
29A	600	10	0	0.0	0	0.0
43	175000	20	0	0.0	0	0.0
54A	213000	20	0	0.0	0	0.0
Totals	388600	19	0	0.0	0	0.0

Most of Mauritania has been excluded from the review as we have taken the northern boundary of phytochorion XVI as the boundary of the Afrotropical Realm. Within these boundaries Mauritania has no protected areas at present though measures should be taken to protect the important coastal wetlands at the mouth of the River Senegal and the country's last population of elephants which move between the Assaba Mountains and the Senegal River.

Top priority should be given to establishing the proposed Diawling Reserve adjacent to Djoudj in Senegal, a wetland site of international importance.

RECOMMENDATIONS FOR ACTION

a: **Extending the present protected area system**

1. Establish the proposed Reserve du Diawling with a minimum size of at least 5000 ha in the Senegal delta adjacent to Djoudj N.P. in Senegal to protect a greater portion of these important wetlands.

2. Make surveys to identify a reserve to protect Mauritania's last population of elephants (if it still exists). The elephants are reported to move between the Assaba mountains and the floodplains of the Senegal River.

b: **Improving protection and management of existing reserves**

1. Improve protection and management of Banc d'Arguin N.P. and increase the guard force. Fully incorporate Cap Blanc into Banc d'Arguin to protect adequately what is possibly the world's only viable population of monk seals *Monachus monachus.* (Banc d'Arguin lies outside the scope of this review but is a wetland of international importance and the most important West African wetland site for Palaearctic migrants).

c: **Other conservation action**

1. Control hunting and increase anti-poaching measures.

2. Mauritania should become a signatory to CITES and ratify the convention.

NEED FOR INTERNATIONAL ASSISTANCE

Mauritania as a poor country beset by environmental problems, droughts and past political unrest, will require considerable international assistance if it is to establish, develop and maintain an adequate protected area system. In particular it needs programmes to save its unique desert fauna, the important Senegal delta wetlands and its remaining elephants. Mauritania will need help in the form of technical assistance, funding and training of personnel.

MAURITIUS

Area (km^2)	:2040
Population 1980 (UN Projection)	:969,000
Population density/sq.km.	:475
% Permanent agriculture/pasture	:75%
% Closed forest cover	:1.3%
Phytochoria	:XXI

COUNTRY OVERVIEW

Mauritius and the outlying island of Rodrigues have very interesting flora and fauna with high levels of endemism. There are at least 10 plant species endemic to Maurtitius and another 20 endemic to the Mascarenes. Mauritius is better known, however, for the dodo, now extinct, and its other rare and endangered birds including such species as the Mauritius kestrel, pink pigeon and echo parakeet. 9 species of threatened birds are listed for Mauritius and Rodrigues by Collar and Stuart (1985). Round Island has four endemic reptiles and Mauritius itself supports giant land tortoises, interesting lizards and giant flying foxes, which are also considered endangered.

More than 75% of Mauritius is planted with sugar and other crops and very little natural forest remains. The main threat to the islands' native flora and fauna are introduced plants and animals. On Mauritius introduced long-tailed macaques *Macaca fascicularis* steal the eggs of native birds and thereby threaten island endemics. Goats and rabbits introduced on Round Island and Rodrigues have destroyed much of the native vegetation.

Mauritius has several small reserves, including Round Island, and several islands where seabirds breed but the only area larger than 2000 ha is Macchabee-Bel Ombre, which includes the Black River Gorges where Mauritius kestrels breed and the wet cloud forest of Mt Cocotte which supports several other endemic plant and bird species.

NEED FOR INTERNATIONAL ASSISTANCE

Mauritius is already receiving considerable international assistance through the Mauritius Wildlife Research and Conservation Programme, coordinated by ICBP. This includes breeding programmes for the Mauritius kestrel and pink pigeon, wildlife conservation and training and projects for reintroduction of native plant and bird species. The possibilities of game ranching will also be explored under this programme.

MOZAMBIQUE

Area (km^2)	:783,030
Population 1980 (UN Projection)	:10,375,000
Population density/sq.km.	:13.2
% Permanent agriculture/pasture	:30%
% Closed forest cover	:1.1%
Phytochoria	:III, XIII, XV

COUNTRY OVERVIEW

Although Mozambique won independence in 1975 after a long and bitter guerilla war, the country still has severe economic problems and wildlife conservation has been considered of low priority. A recent report by Tello (1986) indicates that most parks and reserves in Mozambique suffer from severe poaching, agricultural encroachment and lack of staff. All of these problems have been compounded by continuing military activity with many protected areas being fought over by Renamo guerillas and the Mozambique army. Until Mozambique's political problems are satisfactorily resolved the future for Mozambique's wildlife and protected area network seems bleak.

HABITAT COVERAGE FOR MOZAMBIQUE

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
16	6800	50	250	3.6	0	0.0
16A	229700	50	2650	1.1	0	0.0
16B	2300	50	0	0.0	0	0.0
16C	17100	50	720	4.2	0	0.0
19A	1200	80	0	0.0	0	0.0
25	92500	40	500	0.5	0	0.0
26	212100	40	16150	7.6	0	0.0
28	110600	30	11500	10.3	0	0.0
29C	68200	50	0	0.0	0	0.0
29D	14700	55	0	0.0	0	0.0
29E	10500	50	0	0.0	0	0.0
75	1900	90	0	0.0	0	0.0
76	8700	80	0	0.0	0	0.0
77	6900	40	80	1.1	0	0.0
Totals	783200	43	31850	4.0	0	0.0

At present some 4% of Mozambique's land area is designated as protected areas but there is little or no real protection and management on the ground. The Wildlife and Forestry Department suffers from extreme shortages of manpower and equipment and only a few reserves have permanent staff; in many reserves staff have been forced to abandon their posts because of guerilla activity. Other threats to reserves are increasing pressure from human populations, cattle, grazing, farming developments, industry and poaching and in several reserves most of the large wildlife has disappeared.

In recent years there appeared to have been a change in the attitudes of provincial governments and rural peoples towards conservation with the establishment of the Zambezi Wildlife Utilisation Area of 2 million hectares. This area has been designated priority A for conservation action; unfortunately the area was fought over by Renamo guerillas and government forces in 1986.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. There was, and still is, an urgent need to protect more representational habitats in Mozambique. As

soon as the political and security situation allows attempts should be made to identify more suitable areas for establishment of new reserves to extend the coverage of the reserve system, particularly to include more swamp and floodplain habitats.
2. Extend Gorongosa N.P. to include Mt. Gorongosa and land to the north of the present park boundaries.
3. Extend Niassa G.R. to include the very important Lugenda valley.

b: **Improving protection of the existing reserves**
1. Standards of protection and management are minimal in all of Mozambique's gazetted reserves and protected areas. Improvement will require substantial inputs of funds to increase levels of trained staff, budgets, equipment and other resources. Problems of settlement and cultivation within reserves and illegal grazing of cattle will have to be resolved. Again none of these problems can be tackled until the country's security problems are resolved.
2. Several Mozambique parks, including Bahine, Gorongosa and Zinave have serious and well-organised poaching. In Bahine elephants are poached for ivory but reserve protection is impossible because of continuing military problems.
3. A recent report by Tello (1986) reviews the status of protection and management in Mozambique's parks and protected areas and offers some useful recommendations.

c: **Other conservation action**
1. Prepare a National Conservation Strategy to include a system of national parks and protected areas to be developed as a viable form of alternative land use.
2. Increase general awareness of the value of protected areas and wildlife by conservation education programmes aimed at all sections of the community from rural populations living adjacent to protected areas to government officials and decision makers.

NEED FOR INTERNATIONAL ASSISTANCE

To implement an effective parks programme Mozambique will require considerable international assistance in the sectors of parks planning, management and training of personnel. It will also require substantial funding for these activities, equipment and other resources. International agencies like IUCN must seek diplomatic channels for channelling international aid and technical assistance to the Mozambique Government to re-establish its protected area system. South Africa has the necessary expertise but the current political situation precludes this possibility.

NAMIBIA

Area (km^2)	:824,292
Population 1980 (UN Projection)	:1,024,000
Population density/sq.km.	:1.2
% Permanent agriculture/pasture	:10%
% Closed forest cover	:0%
Phytochoria	:II, VI, XIV

COUNTRY OVERVIEW

Namibia has very little land of agricultural potential and what exists is suitable only for dry-land crops and free-range stock. For the forseeable future the country is likely to remain a food importer. In spite of its mineral deposits Namibia is not a rich country and in the long-term its wildlife and wildlands may prove to be its most valuable natural resources because of their potential for tourism.

HABITAT COVERAGE FOR NAMIBIA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
22A	53500	50	5300	9.9	0	0.0
28	92900	50	19000	20.4	0	0.0
35A	106900	50	0	0.0	0	0.0
35C	19600	60	0	0.0	0	0.0
36	39300	30	0	0.0	0	0.0
44	87800	40	405	0.4	0	0.0
51	177700	40	24260	13.6	0	0.0
56	92600	40	350	0.3	0	0.0
64	600	80	0	0.0	0	0.0
74	145700	100	16911	11.6	0	0.0
75	2500	90	0	0.0	0	0.0
76	4100	90	2270	55.3	0	0.0
Totals	823200	54	68496	8.3	0	0.0

Namibia has an extensive reserve network covering 8.3% of the country and including representative samples of most major vegetation types (but not swamp vegetation nor several woodland/grassland transitions). With certain notable exceptions, like the Namib/Naukluft, Skeleton Coast and Etosha national parks, the reserves, though well managed, are relatively small in size.

Namibia's reserves are well protected and management is generally good. Boundary fences to keep domestic livestock out of Etosha N.P. have resulted in serious disturbance of wildlife migration routes. Blue wildebeest in particular have suffered and the population has declined dramatically.

Priority A protected areas in Namibia include Etosha and Namib/Naukluft national parks.

RECOMMENDATIONS FOR ACTION

a: Extending the protected area system

1. Identify an area of relatively undisturbed swamp habitat suitable for reserve status.

b: **Improving protection and management of existing reserves**

1. Improve protection and management of Caprivi Game Reserve as soon as this is feasible. At present this area is classified as a military 'operational zone'. Unfortunately the relatively good conservation situation in Namibia is threatened by mounting levels of guerilla warfare.

c: **Other conservation action**

1. Namibia should become a signatory to CITES.

2. The greatest step forward for conservation in Namibia will be the resolution of the country's current political conflicts.

NEED FOR INTERNATIONAL ASSISTANCE

In spite of its mineral wealth, Namibia is not a rich country and may need some international assistance for improving protection and management of those reserves presently suffering the adverse effects of war. International assistance should also be given in the form of training for personnel and sponsorship of management-orientated research and monitoring.

NIGER

Area (km^2)	:1,267,000
Population 1980 (UN Projection)	:5,272,000
Population density/sq.km.	:14.2
% Permanent agriculture/pasture	:15%
% Closed forest cover	:0%
Phytochoria	:III, XVI

COUNTRY OVERVIEW

Niger is a vast but very poor country with increasing desertification and minimal resources. Until recently conservation has received little attention. Although hunting is officially banned it has been widely practised in the absence of law enforcement. Commercial hunting and hunting by the armed forces is widespread and almost impossible to control. It is essential that the population recognise that wildlife is a valuable resource and a valid alternative source of income and form of land use.

HABITAT COVERAGE FOR NIGER

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
29A	113900	20	2960	2.5	0	0.0
43	222100	20	0	0.0	0	0.0
54A	218100	30	760	0.3	40000	18.3
75	1900	20	0	0.0	0	0.0
Totals	556000	23	3720	0.6	40000	7.1

We have included only the southern half of Niger in the present review as we have taken the northern boundary of phytochorion XVI as the boundary of the Afrotropical Realm. Within this area only 0.6% of Niger's land area is included in protected areas. Another 7.1 % is proposed for protection as part of the Aïr and Ténéré National Nature Reserve, which will be the largest reserve in Africa and the first wildlife reserve to extend into the Sahara.

Management of reserves is very poor with virtually no protection. Major problems include poaching, illegal grazing by domestic livestock, uncontrolled bush fires and agricultural encroachment.

Priority A areas for conservation action include "W" national park and the proposed Aïr and Ténéré reserve.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. There should be immediate gazettement and development of the proposed Aïr and Ténéré National Nature Reserve, the last stronghold of Sahelo-Saharan wildlife in Niger.

2. Identify an area of relatively undisturbed swamp vegetation suitable for a reserve.

b: **Improving protection and management of existing reserves**

1. Improve protection and management of all reserves by increasing the numbers of trained staff, and increasing funding, transport and equipment. Stop agricultural encroachment, hunting and grazing by domestic livestock within reserve boundaries.

c: **Other conservation action**

1. Develop land-use programmes to encourage the wise and rational use of natural resources, including wildlife. At the same time develop a conservation education programme to increase public awareness of the values of wildlife and protected areas.

2. Introduce stricter enforcement of legislation controlling hunting.

NEED FOR INTERNATIONAL ASSISTANCE

Niger is a very poor country and will need considerable international assistance to establish and develop an adequate network of protected areas. The Government of Niger should request further international assistance in the fields of technical expertise, funding and training. The Aïr/Ténéré Integrated Rural Development project is a good example of an ecodevelopment project which helps both wildlife and rural communities in the Sahel.

NIGERIA

Area (km^2)	:923,768
Population 1980 (UN Projection)	:72,596,000
Population density/sq.km.	:78.6
% Permanent agriculture/pasture	:50%
% Closed forest cover	:6.4%
Phytochoria	:I, III, VIII, XI, XVI

COUNTRY OVERVIEW

Nigeria is a country of particular biological richness, overlapping several phytochoria, including the very rich Guineo-Congolian forests, and many habitat types. It is also one of the most densely populated countries in West Africa and as the population rises there is an increasing demand for more land for agriculture. Nevertheless the last decade has seen some good progress made in wildlife conservation in Nigeria with increased training for wildlife personnel and some states introducing new legislation to control wildlife hunting.

HABITAT COVERAGE FOR NIGERIA

Habitat	Orig.area	Rem%	Prot.area	Prot%	Prop.area	Prop%
11A	253700	20	0	0.0	0	0.0
12	23100	20	0	0.0	1900	8.2
19A	3700	50	0	0.0	0	0.0
1A	60300	10	0	0.0	4620	7.6
2	37000	10	0	0.0	1715	4.6
27	147500	30	6441	4.3	0	0.0
29A	286500	30	0	0.0	2060	0.7
30	23100	30	2240	9.6	0	0.0
32	13000	30	0	0.0	0	0.0
33	1700	30	0	0.0	0	0.0
43	24900	20	7044	28.2	0	0.0
75	2100	20	0	0.0	0	0.0
77	24400	50	0	0.0	85	0.3
8	18800	30	0	0.0	0	0.0
Totals	919800	25	15725	1.7	10380	1.1

At present only 1.7% of Nigeria's land area is included within protected areas with a further 1.1% proposed for protection. These totals do not include any areas designated as forest reserves since these areas are very poorly protected and managed primarily for timber extraction; however at least some of these forests are important for conserving rainforest species. Most of the protected areas lie within the savanna biome and little has been done to protect the southern rainforests which are the richest in animal species. The south also has oil, political unrest, most of the large population centres and many 'protected' areas are being degraded by excessive logging, farming, grazing and roadbuilding. Hunting is also a serious problem. The pygmy hippo has recently become extinct in Nigeria and the status of elephants, chimpanzees and leopards give cause for concern. It is essential that some of the forest reserves in the south which are important areas for wildlife are given full protection and reserve status.

Priority A areas for conservation include the proposed "A" and "B" game reserves, and some of the forest reserves in the south.

The forests of the Cross river area, adjacent to the Takamanda forest reserve in Cameroon, may also be an important area for conservation as they lie at the westernmost limit of the distribution of the lowland gorilla and may harbour an isolated population of a distinct subspecies of this endangered ape.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Identify lowland forest areas of particular biological richness and importance for threatened species and establish new reserves to give them greater protection.

b: **Improving protection and management of existing reserves**

1. Protection and management in Nigerian reserves is generally poor. Improvement will require increased levels of trained manpower, funds, equipment and other resources. Problems include expansion of enclaves within reserves (Gashaka-Gumti G.R.) and poaching, unauthorised fires and livestock grazing (LakeKainji N.P.).

2. Special attention should be focused on forest reserves in the remaining Guineo-Congolian lowland rainforests. These forests are currently managed for timber extraction and because of poor protection are subject to abuse such as illegal logging and boundary encroachment to clear lands for agriculture. Some of these forests may be important as a refuge for rainforest birds and other species which occur at low densities and are therefore particularly vulnerable to habitat destruction. If these areas cannot be included within the protected area system it is essential that the Forestry Department is encouraged to improve their management so as to give better protection to their resident wildlife.

c: **Other conservation action**

1. Prepare a national conservation strategy incorporating a national parks and protected area system. Encourage policy makers to realise that protected areas are an important alternative form of land use, vital to the protection of watersheds, wildlife and other natural resources.

2. Revise legislation which is currently inadequate to give better protection to protected areas and wildlife. Enforcement of existing legislation could also be improved.

3. Inventory the importance of wildlife and other natural resources in local economies. Bushmeat provides 20% of the animal protein consumed in rural areas so it is vital to protect and conserve wildlife populations to ensure a continuing supply of this valuable resource.

NEED FOR INTERNATIONAL ASSISTANCE

Nigeria is a wealthy country with sufficient resources to finance the development of a national conservation strategy and parks programme. It may, however, require some technical assistance in the fields of parks planning and management and for training personnel. The establishment of the Wildlife School at New Bussa and the development of courses in wildlife ecology and management at the University in Ibadan are encouraging signs of Nigeria's concern for conservation. It would be useful if other countries in the region could send students to attend these courses.

REUNION

Area (km^2)	:2510
Population 1980 (UN Projection)	:548,000
Population density/sq. km	:218
Phytochoria	:XXI

COUNTRY OVERVIEW

Reunion is a volcanic island with fertile soils and abundant rainfall. The island is agriculturally productive and supports a large and increasing population. Biologically the island is important as the home of several unique plants and animals. Reunion is the largest of the Mascarene islands, and is also the least disturbed, although most of the forest below 600 m has been destroyed for sugar cane cultivation. Above that level, to the highest point at 3069 m, the flora is extremely rich and varied; above 1800 m it is relatively undisturbed. About a third of all plant species are endemic. The island also has two endemic birds classified as threatened by ICBP (Collar and Stuart, 1985).

Most of the island's reserves are very small, too small to be considered in this review. There is great potential for protecting a substantial area of mountain forest which would save a large number of endemic plant species. The Reunion forests are identified as an important plant site by the Threatened Plants Unit of IUCN (Droop, 1985). Priority should be given to establishing nature reserves on Hauts de St Phillippe (3500 ha), Mazerin (2000 ha) and Bebour (1000 ha) proposed by ORSTOM (PADU/IUCN, 1986). The value of these areas would be even greater if they could be enlarged.

RWANDA

Area (km^2)	:26,338
Population 1980 (UN Projection)	:4,865,000
Population density/sq.km.	:185
% Permanent agriculture/pasture	:62%
% Closed forest cover	:4.5%
Phytochoria	:VIII, XII

COUNTRY OVERVIEW

HABITAT COVERAGE FOR RWANDA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
19A	8400	10	0	0.0	0	0.0
45	15700	10	2800	17.8	0	0.0
65	1000	100	130	13.0	0	0.0
Totals	25100	13	2930	11.6	0	0.0

Rwanda is one of the most densely populated countries in Africa yet has 11.6% of its land included within protected areas, one of the few nations of the world to have more than 10% of its area protected. Most of this land lies within the country's two national parks. Major conservation problems for the parks are competition for land for agricultural use and poaching. However tourism based on the national parks is a major earner of foreign revenue.

Park management and protection are generally poor because of lack of trained technical and administrative staff. The situation in Volcanoes National Park is better than in the other reserves but

there are still considerable poaching problems, (particularly poaching of gorillas, often killed accidentally in traps set for duikers, or slaughtered for trophies).

The only Rwanda protected area with category A status is Volcanoes National Park where there are already high levels of international involvement and assistance; these should be maintained.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Include the Nyungwe Forest Reserve of 90000 ha in the protected area system. This is a very important area for several species groups – see section 4.

b: **Improving protection and management of existing reserves**

1. Improve protection and management in Akagera N.P. and the Mutara and Nyungwe reserves. Increase anti-poaching activities in Volcanoes N.P.

2. There should be no further areas excised from the existing reserve system. The Volcanoes N.P. has already been reduced to the point where it is questionable if it is viable.

c: **Other conservation action**

1. Extend conservation education programmes to increase public awareness of the values of national parks and reserves. The education programme in Volcanoes N.P. has already achieved considerable success, making local communities and youth groups aware of the value of the park for watershed protection.

NEED FOR INTERNATIONAL ASSISTANCE

Rwanda is a densely populated and poor country with great pressure on increasing the amount of land available for agriculture, the mainstay of the national economy. The Rwandan government is to be congratulated on its conservation efforts, especially the protection and management of the Volcanoes National Park. International assistance should be continued to aid protection and management of Volcanoes N.P., one of the last strongholds of the endangered mountain gorilla.

SAO TOME and PRINCIPE

Area (km^2)	:964
Population 1980 (UN Projection)	:85,000
Population density/sq.km.	:88
Phytochorion	:XXI

COUNTRY OVERVIEW

São Tomé and Principe is a small and poor country and since Independence from Portugal in 1975 the government has had to cope with tremendous economic problems. Conservation of forests and wildlife have not been a priority concern. We have no information on parks or protected areas from São Tomé and Principe and few outside visitors have been to the islands in recent years.

The islands are home to several endemics – mammal subspecies and birds. Considerable areas of natural forests on the two islands have been cleared to make way for coffee and cocoa plantations. Nevertheless there are still extensive areas of rainforest remaining on São Tomé, including lowland forests in the south-west from where the rarest birds have been recorded. This area is a top priority for conservation. Montane forests should also be protected because of their montane biota and watershed functions. Identification of suitable forest sites for reserves is a conservation priority for São Tomé and Principe. The islands government will need technical assistance in the fields of park planning and management and for personnel training if it should decide to establish a national network of protected areas.

SENEGAL

Area (km^2)	:196,192
Population 1980 (UN Projection)	:4,989,000
Population density/sq.km.	:25.4
% Permanent agriculture/pasture	:30%
% Closed forest cover	:1.1%
Phytochoria	:III, XI, XVI

COUNTRY OVERVIEW

Senegal has an extensive system of parks and protected areas covering 10.2% of the country and affording protection to representative samples of all vegetation types. Nevertheless Senegal has considerable problems facing conservation. The country suffers from persistent drought. Other threats are mining exploration, particularly for iron in the north, the dam at Kereti and other water removal projects and poaching of marine turtles, seabirds, crocodiles, and elephants.

HABITAT COVERAGE FOR SENEGAL

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	27000	10	700	2.5	0	0.0
29A	112500	20	13837	12.2	0	0.0
43	56000	20	5496	9.8	0	0.0
77	700	60	80	11.4	0	0.0
Totals	196200	18	20113	10.2	0	0.0

More than 10% of Senegal's land area is included within the protected area network, something achieved by only a few countries in the Realm. Protection and management of Senegal's national parks are good, but the faunal reserves of Ferlo Nord and Sud lack adequate protection. Even in the parks, however, poaching is a serious problem. Senegal takes an exceedingly tough line on poaching and has very active anti-poaching units, yet 90% of its elephant population has been killed.
Priority A protected areas include Delta du Saloum N.P. and Niokolo-Koba N.P.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**
The Senegal protected area network is already adequate if it can be effectively protected and managed.

b: **Improving protection and management of existing reserves**
1. Increase staffing levels and improve protection and management of the faunal reserves of Ferlo Nord and Ferlo Sud.
2. The Niokolo-Koba N.P. is threatened by the building of a new road through the park. If possible this road should be rerouted; otherwise measures should be taken to minimise its impact on the park and no settlements allowed to develop along its route.

c: **Other conservation action**
1. Senegal will need to cooperate with Guinea to stop cross-frontier poaching of elephants in Niokolo-Koba National Park. Guinea has already agreed to form a cross-frontier reserve.
2. Senegal will need to cooperate with Mauritania for effective protection and management of the Diawling-Djoudj wetland areas and with Gambia for the Delta du Saloum reserves.
3. Inventory the plants and animals utilised by local communities and their value in local and national economies. Bushmeat is an important item of diet in Senegal and many other resources are utilised for food, fodder, building and craft materials etc. Seek, through conservation education programmes, to

make the populace aware that continued availability of these natural resources depends on wise conservation and rational utilisation.

NEED FOR INTERNATIONAL ASSISTANCE

Senegal already has a well-planned and fairly well-managed system of reserves. Further international assistance may be required in the field of training, for preparation of a national land-use plan and for specific projects concerning parks management in individual reserves.

SEYCHELLES

Area (km^2)	:119
Population 1980 (UN Projection)	:66,000
Population density/sq.km	:554
Phytochorion	:XXI

COUNTRY OVERVIEW

Florally and faunally the Seychelles have affinities with both the Afrotropical and Indo-Malayan Realms but because of its geographical location we have included the archipelago within the Afrotropical Realm. The islands support some interesting species found nowhere else in the world – the Aldabra giant tortoise, several endemic birds and the amazing coco de mer.

The only reserve of any significant size within the archipelago is Aldabra Atoll, an area of exceptional biological interest and the only place in the world where reptiles dominate the terrestrial fauna. Aldabra is unique among the atolls in the Indian Ocean for its lack of human disturbance. The atoll is carefully managed to allow an extensive scientific and monitoring programme with the minimum of human interference.

Salm and Chong Seng (UNEP, 1984) provide a useful review of coastal and marine resources of the islands and identify conservation needs for the archipelago.

SIERRA LEONE

Area (km^2)	:71,740
Population 1980 (UN Projection)	:3,392,000
Population density/sq.km.	:47.3
% Permanent agriculture/pasture	:70%
% Closed forest cover	:10%
Phytochoria	:I, VIII, XI

COUNTRY OVERVIEW

Sierra Leone lies in an area of great biological richness, but it is fairly densely populated with 80% of the population surviving by swidden agriculture and subsistence farming. The greatest threats to the native flora and fauna are uncontrolled forest clearance and inappropriate agriculture leading to environmental degradation. In the last 200 years the country has lost 90% of its primary forest. Other threats to wildlife include overfishing of rivers and hunting for food and export which has already led to the extinction of the lion and threatens the remaining populations of forest elephants, pygmy hippos, chimpanzees and crocodiles. All wildlife populations and wilderness areas are in jeopardy.

HABITAT COVERAGE FOR SIERRA LEONE

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	55600	10	0	0.0	1000	1.7
19A	800	60	0	0.0	200	25.0
3	5500	20	0	0.0	1217	22.1
77	6800	50	0	0.0	360	5.2
8	3000	10	150	5.0	50	1.6
Totals	71700	15	150	0.2	2827	3.9

At present only 0.2% of Sierra Leone has legal status as protected areas but a further 3.3% of the land area is proposed for reserves and together these protected areas will represent all vegetation types found in the country. Once proposed reserves are gazetted two important habitats – rainforests and montane habitats – will be well-represented within the system. For the establishment and management of these reserves it is essential that a qualified and efficient unit is established responsible for National Parks and Wildlife. At present shortages of manpower and finance mean that control and management are difficult to implement.

Priority A areas for conservation action in Sierra Leone are the Loma Mountains and Gola Forest, both forest reserves but proposed for greater protection.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

Phillipson (1978) recommended that Sierra Leone should establish 5% of its land area as strict nature reserves, national parks, game reserves and game sanctuaries to conserve the country's rich flora and fauna. Key areas deserving protection are identified below.

1. The Gola Forest is of top priority for conservation action. Gola Forest Reserve (4 compartments totalling 75000 ha) represents no more than 1.2% of the original forest zone of Sierra Leone and is an area of primary Guinean rainforest, the richest biome on the continent. All three of the Gola forest reserves should be given full conservation status. At least 44 mammals are expected to occur in Gola. Gola East compartments 4 and 5 are the most valuable for conservation of wildlife but already these are partly logged. Forest concessions to SILETI in Gola should be revoked and the type and intensity of logging limited in Gola North. Gola West (6200 ha) and East (22800 ha) should be designated as a national park; Gola North (45000 ha) should become a game reserve. Part of Gola East should be designated a strict nature reserve to protect unique flora and fauna and prevent siltation of the Mano River Reservoir. By protection of permanent forest corridors, Gola could be linked to Loffa Mano reserve in Liberia across the Mano river; this would allow animal movement and genetic exchange.

2. The Kangari Hills, Kuru Hills, Tingi Hills, Loma Mountains and Tama Forest reserves should all be given full conservation status to safeguard relict forest fauna including forest elephants. Loma Mountains should be declared a national park and the other areas become game reserves.

3. The Western Area F.R. should be given full conservation status and developed as a national park. This area is only of modest conservation importance but lies conveniently close to the country's capital so would make an excellent national park.

4. Establish national parks to protect important freshwater areas such as Lakes Sonfon, Mape and Mabesi and their surroundings.

5. Establish a protected area to protect the mangrove in the Sherbro River delta.

6. Establish conservation areas to protect other extensive stands of coastal mangrove. Possible sites include Yelibuya Island; Bumpe, Yawri Bay; Sewa/Waanje, Bonthe; Kpaka and Pujehun.

7. Establish Outamba Kilimi as a national park with full legal protection. Outamba-Kilimi, an area of savanna woodlands, has some fine gamelands, but the vegetation is rather degraded and mostly secondary. Chimpanzees occur in this area.

8. Give official government protection and legal status to the proposed Mamunta-Mayoso Swamp Nature Reserve (16000 ha).

9. Establish game reserves to protect the "Lophira grasslands" of Port Loko and Bo.

b: **Improving protection and management of existing reserves**

1. At present few reserves have any conservation status other than forest reserves with no-hunting zones. All the reserves proposed above deserve conservation status but immediate protection should be given to:
a: part of the Gola Forest reserves
b: Sherbro delta and other mangrove areas.
c: Outamba-Kilimi
d: Western Area
e: Mamunta Swamp.
These proposed areas are arranged in order of their conservation importance.

2. The creation of a qualified and efficient administrative unit for National parks and Wildlife is considered essential to improve conservation in Sierra Leone (Roth and Merz, 1983).

c: **Other conservation action**

1. Review forest concessions in Gola Forest Reserves and other important forests. Revoke concessions in Gola East and establish part of this forest as nature reserve to protect unique forest flora and fauna and protect the watershed of the Mano River reservoir.

2. Extend the conservation programmes established by the Sierra Leone Nature Conservation Association and generally increase public and government awareness of the important role of protected areas in protecting watersheds and valuable wildlife resources.

3. At present Sierra Leone has only four non-hunting zones. Amend the Wildlife Conservation Act to allow the establishment of more protected areas and to protect threatened species of plants and animals. Make regulations for the establishment and running of the Wildlife Conservation Estate i.e. protected areas, and enforce existing legislation protecting wildlife.

4. Develop areas for wildlife tourism. At present Sierra Leone's wildlife is so depleted that it is unlikely to attract large numbers of tourists but several of the areas proposed as national parks have future potential for tourism developments.

5. Sierra Leone should apply for immediate membership of IUCN.

6. Sierra Leone should ratify the African Convention on Conservation of Nature and Natural Resources, 1968.

7. Sierra Leone should become signatory to, and ratify, the Convention on International Trade in Endangered Species of Wild Flora and Fauna, 1975 (CITES).

NEED FOR INTERNATIONAL ASSISTANCE

The government of Sierra Leone should seek further international aid in the form of technical assistance for the establishment and protection of a network of protected areas, and preparation and implementation of management plans. Other aid required includes funding for management, transport and equipment and assistance with training of personnel.

SOMALIA

Area (km^2)	:637,657
Population 1980 (UN Projection)	:3,652,ooo
Population density/sq.km.	:5.7
% Permanent agriculture/pasture	:15%
% Closed forest cover	:2.4%
Phytochoria	:IV, VIII, XIII

COUNTRY OVERVIEW

Somalia is a very poor country which since Independence has suffered droughts, environmental degradation and a costly and unsuccessful war to claim the Ogaden from Ethiopia. Conservation of wildlife has been given low priority during this period. Eleven wildlife areas have been declared since 1970 but only two are functional. Because of general aridity and the need to control landuse Somalia now has 136 grazing areas and 16 range cooperatives (totalling more than 7 million hectares) but the prime purpose of these areas is to protect grazing lands rather than conservation of wildlife. The status of wildlife in Somalia is reported as sparse and scattered due to a combination of livestock grazing rangelands and illegal hunting. Environmental problems such as desertification due to destruction of forest and pastures, soil erosion and the formation of sand dunes are increasingly exacerbated by the drought and the increased pressure from human and livestock populations.

HABITAT COVERAGE FOR SOMALIA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
16A	18200	30	2000	10.9	1400	7.6
19A	1200	80	0	0.0	280	23.3
38	8600	40	0	0.0	1100	12.7
42	427100	60	1000	0.2	24450	5.7
54B	173400	60	0	0.0	15800	9.1
67	6000	100	0	0.0	0	0.0
68B	1400	80	0	0.0	0	0.0
77	1800	30	340	18.8	30	1.6
Totals	637700	59	3340	0.5	43060	6.7

Somalia's wildlife is unique. The country has several rare plants such as the frankincense tree, endangered Carin palm and the creeping palm as well as a semidesert fauna. The Somali mammals and birds are essentially species of the plains and plateaux but because of their long history of isolation from the rest of Africa many new species have evolved and Somalia is a centre of local endemism. At present 0.5% of the country is included within protected areas; this is all due to one area the Lag Badana N.P. Another 6.7% is proposed for protection (Simonetta and Simonetta, 1983).

Priority A areas for conservation action in Somalia are the Lag Badana N.P., and the proposed national parks of the Daalo Forest and Las Anod-Taleh-El-Chebet.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

Somalia needs to establish a network of protected areas conserving representative samples of the country's major vegetation types. The following recommendations are taken mainly from Simonetta and Simonetta (1983).

1. Create a network of reserves to protect Somalia's unique wildlife. Choose reserves and national parks in arid lands with little agricultural potential. Protect habitats used during wildlife seasonal migrations.

2. Create several small parks in the trans-Juba region before all land is given over to agriculture.
3. Establish the mountain area of the Daalo Forest as a national park. The area has good *Juniperus* forest, leopards in the mountains and is home to the rare Warsangli linnet. Extend the boundaries of this forest reserve to the east to protect a population of wild ass and beira gazelle.
4. Establish a national park in Las Anod to protect wild ass, oryx and gazelle which at present suffer from competition from grazing domestic wildlife. The Taleh area should be established as a wildlife reserve. El Chebet should also be protected; this is a permanent grazing area but is rich in prehistoric sites and the rare creeping palm also occurs here.
5. Protect Far Wamo as a wildlife reserve. This area is important for elephants, giraffes and rhinos and provides a dry season water supply.
6. Establish the proposed Gaan Libaax national park but choose better boundaries and declare the adjacent Waggar Mtns a forest reserve.
7. A partial reserve was established at Zeila in colonial times. This should be re-established to include the Libaax Xeeleh mountains (at present a forest reserve) rich in montane fauna and flora, and the area of Zeila and offshore islands.
8. Establish Lack Dere as a national park and wildlife reserve. This area includes Hunter's and Grant's gazelles. It has potential for tourism development.
9. Establish Jowhar Warshek as a national park. This includes the area designated as Mogadishu Game Reserve. Make realistic boundaries to the park limiting it to a strip of swamp, a tract of riverine formation and dunes and coastal plain. The swamp is rich in birds, hippos and crocodiles. The coastal plains support Soemmerring's and Speke's gazelle, kudu and gerenuk.
10. Establish Hobyo Game Reserve to protect dibatag, oryx, Soemmerring's and Speke's gazelles.
11. Establish Harqan-Dalandoole as a national park or wildlife reserve.
12. Establish a wildlife reserve at Haradere-Awale Rugno, a key area for dibatag and Soemmerring's gazelle.
13. Establish a wildlife reserve or national park to protect Gezira lagoon, important for its bird fauna and rare plants.
14. Establish a wildlife reserve in the Boja swamps, which have elephant and buffalo populations.

b: **Improving protection and management of existing reserves**
1. Management and protection of all reserves in Somalia is poor to non-existent. Protection needs to be improved in all proposed and existing conservation areas by increasing levels of staffing, budgets and equipment.
2. Establish enclaves to excise villages from national parks and reserves e.g at Lag Badana.
3. Zone parks and reserves into wilderness zone and zones of more intensive use. Control fishermen on the coast and nomadic pastoralists grazing their herds within reserves and competing with wildlife for grazing.

c: **Other conservation action**
1. Traditional methods have had only limited success in protecting Somalia's large number of rare and endemic plant and animal species. The National Range Agency has, therefore, adopted a new conservation strategy to establish breeding populations of rare and/or endemic wild animals both in Somalia and overseas to guarantee populations which can be used to re-populate parks and reserves in the future when the nation's economic and touristic development has developed sufficiently so that such parks and reserves can be properly protected and exploited.
2. Prepare a national conservation strategy and systems plan for park planning to identify areas appropriate for conservation or other land use. Conservation programmes should aim to aid environmental restoration.
3. Continue traditional protection through enforcement and legislation. Ratify the proposed laws prepared to control possession of ivory, hunting of rare species and licences for subsistence hunters.
4. Somalia should become a signatory of CITES and ratify the convention.

NEED FOR INTERNATIONAL ASSISTANCE

Somalia will require considerable international assistance in the fields of parks planning and management, also aid with funding the establishment of reserves and training of staff. The immediate priority for conservation is to identify which areas should be protected as the most valuable for conservation of wildlife.

SOCOTRA ISLAND (SOUTH YEMEN)

Socotra lies on the African continental shelf 225 km east of Cape Guardafui. Floristically it is part of the Somalia-Masai Regional Centre of Endemism and it has been treated in unit IV. Although impoverished in total numbers of plant and animal species, like most offshore islands Socotra shows high levels of species endemism. Socotra is an important local centre of plant endemism; it also has two threatened endemic birds – the Socotra sisticola and Socotra cormorant.

As yet there are no protected areas on the island which is part of the Republic of South Yemen. The north of the island is a priority area for conservation. Steps should be taken to identify and establish reserves to protect some of the unique plant communities of the Hamadar Hills and Haggier massif, and the succulent shrubland of the limestone cliffs and rugged valley slopes of north Socotra. The island also has some good areas of mangrove.

SOUTH AFRICA

Area (km^2)	:1,221,037
Population 1980 (UN Projection)	:28,533,000
Population density/sq.km	:23.4
% Permanent agriculture/pasture	:60%
% Closed forest cover	:0%
Phytochoria	:II, V, VI, VIII, XIV, XV

COUNTRY OVERVIEW

South Africa is a large and prosperous country spanning 6 phytochoria, one of which, phytochorion V, is confined to South Africa. The country has great biological richness. In spite of a past history when wildlife was overhunted and some species became extinct, today in South Africa conservation awareness is as high as anywhere in Africa. South Africa even produces its own Red Data Books for Mammals, Birds, Reptiles, Fishes and Plants, listing the status of resident species within national boundaries. South Africa has a long history of conservation and an excellent system of national parks including representative samples of most major vegetation types. However two very important biomes are under-represented – lowland fynbos with its unparallelled richness and distinctiveness of plant species, and succulent Karoo. This very rich and distinctive biotic community is almost totally unprotected.

At present 4.3% of South Africa's land area is included within national parks and protected areas. The country has a long list of protected areas which are generally managed to very high standards but are mostly rather small in size (with certain notable exceptions, e.g. Kruger N.P. and Gemsbok Kalahari) and show a considerable imbalance in coverage.

Priority A protected areas for conservation include Kruger N.P., Hottentots Holland State Forest, Hester Malan R., Karoo N.P., protected areas of the Drakensberg range, and Kalahari Gemsbok N.P.

HABITAT COVERAGE FOR SOUTH AFRICA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
16C	51600	50	1804	3.4	0	0.0
19A	77400	50	3246	4.1	0	0.0
20	21100	40	0	0.0	0	0.0
24	27400	60	129	0.4	0	0.0
28	25000	70	8558	34.2	0	0.0
29D	127900	60	8097	6.3	0	0.0
29E	18300	40	5900	32.2	0	0.0
34	20600	50	133	0.6	0	0.0
35A	5300	40	0	0.0	0	0.0
39	28000	50	247	0.8	0	0.0
44	137800	39	257	0.1	0	0.0
48	7400	20	0	0.0	0	0.0
50	76600	40	12364	16.1	0	0.0
51	105500	50	2727	2.5	0	0.0
52	48600	60	0	0.0	0	0.0
53	138800	30	0	0.0	0	0.0
56	58300	40	9591	16.4	0	0.0
57A	12900	40	162	1.2	0	0.0
57B	99800	30	891	0.8	0	0.0
58	135800	30	251	0.1	0	0.0
66	2700	40	347	12.8	0	0.0
74	8800	100	0	0.0	0	0.0
77	900	50	0	0.0	0	0.0
Totals	1236500	43	54704	4.4	0	0.0

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Extend the protected area system to include adequate areas of two very distinct, rich habitats virtually unique to South Africa. Identify areas of lowland fynbos and succulent Karoo suitable for gazettement as protected areas.

b: **Improving protection and management of existing reserves**

In general protection and management of protected areas in South Africa is as good as anywhere in the African continent and better than in many other countries of the world.

c: **Other conservation action**

All provinces have already passed strict legislation to protect and conserve South African species that are threatened.

NEED FOR INTERNATIONAL ASSISTANCE

South Africa has no need of international assistance to manage its protected area systems but with the high level of expertise of its Parks Boards is in an ideal position to offer technical assistance and training to other African nations. Unfortunately poor international relations currently preclude this possiblity.

SUDAN

Area (km^2)	:2,505,813
Population 1980 (UN Projection)	:21,420,000
Population density/sq.km.	:8.5
% Permanent agriculture/pasture	:13%
% Closed forest cover	:0.26%
Phytochoria	:III, IV, VIII, XI, XVI

COUNTRY OVERVIEW

Although Sudan was one of the first countries in Africa to achieve independence (in 1956) its history since then has been characterised by political instability and unrest. This and the ongoing civil war in the south have made protection of wildlife and reserves difficult. The country's large size and remoteness of some protected areas works both for and against wildlife protection; some areas are protected by their remoteness but this inaccessibility also makes policing and control difficult.

HABITAT COVERAGE FOR SUDAN

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	22800	9	170	0.7	1360	5.9
19A	4200	40	0	0.0	1000	23.8
19B	1700	80	0	0.0	1500	88.2
27	267700	30	12920	4.8	38560	14.4
29A	195400	20	0	0.0	1050	0.5
29B	17200	30	1400	8.1	5000	29.0
35B	80100	30	7500	9.3	20700	25.8
38	700	50	0	0.0	0	0.0
42	26400	50	0	0.0	4600	17.4
43	214400	20	0	0.0	0	0.0
54A	461500	40	0	0.0	0	0.0
54B	700	50	0	0.0	0	0.0
61	147700	30	0	0.0	16500	11.1
62	190900	20	0	0.0	7300	3.8
63	15500	20	0	0.0	0	0.0
64	56100	59	0	0.0	13660	24.3
Totals	1703000	30	21990	1.2	111230	6.5

1.2% of Sudan's land surface is presently included within protected areas and another 3.7% is proposed as national parks and reserves. Together existing and proposed protected areas will protect representative samples of most major habitat types. As yet there are no reserves to protect desert and semi-arid habitats, montane forest and marine habitats. Savanna grasslands, rainforest and wooded savanna all have less than 10% of their area protected (Hillman, 1985b). Protection and management of the current protected area system is poor with poaching at an extremely high level.

Priority A areas for conservation action include the Imatong Mountains (proposed reserve), Shambe Game Reserve and the Dinder and Southern national parks.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Sudan is in desperate need of any forest and all areas should be carefully conserved and utilised (Hillman, 1985b). The Imatong Mountains in the south-east is the only area of montane forest but is currently the site of tea and forest plantation development. Top priority should be given to establishing a conservation area in these mountains to protect the unique flora and fauna.

2. As yet there are no conservation areas in the desert zone of Sudan which makes up 35% of the country, an area important for at least eight species of threatened ungulates. Similarly there are no reserves in the arid zone, also important gazelle habitat and home to dry-area carnivores such as fennec and sand foxes. Priority should be given to establishing a reserve in the Red Sea Hills, an important area for Nubian ibex, gazelles and other mammals which have no protection at present. The value of this conservation area would be further enhanced if it could be linked with a Marine Conservation Area.
3. Priority should be given to establishing a reserve to protect Jebel Marra, an isolated mountain block with a unique flora and fauna.

b: **Improving protection and management of existing reserves**
1. Some of the existing and proposed conservation areas have been developed to some extent with game scout outposts, boundary outlines and some tracks. Yet others exist only on paper. All proposed conservation areas should be gazetted as soon as possible. These include Boma and Lantoto national parks and the game reserves of Boro, Meshra and Badingilo.
2. The Sudd Swamps are an ancient swamp area of major importance. Their conservation and wise management are a conservation priority. The Sudd is already protected by the Zeraf and Fanyikang Game Reserves, but management and protection of these reserves needs to be improved. The effect of major developments in the area (oil exploration and the Jonglei Canal) will have considerable impact in the near future and need to be monitored.
3. Sudan has only a tiny edge of the great central African rainforest, represented in Bangangai reserve. Although this habitat is well-represented in other countries of the region, Bangangai and other small sites such as Bire Kpatuos are of national importance and measures should be taken to improve protection and management of these rainforest habitats.

c: **Other conservation action**
1. Develop a National Conservation Policy and determine areas of priority for conservation. The success of any conservation programme will depend on public support so active education programmes should be established to change public attitudes to wildlife and the environment.
2. Stop poaching and indiscriminate hunting of wildlife for food and sport. The army and police are some of the worst offenders so this will require internal departmental disciplinary measures. Parks personnel assigned to anti-poaching activities will require arms and should be trained in their upkeep and use. Bands of well-armed Sudanese poachers are decimating elephant populations and other game in neighbouring Zaire and Central African Republic. This will have to be stopped from within Sudan.
3. Increase research in conservation areas and elsewhere. In particular implement research on seasonal movements of certain species e.g kob and elephant. Investigate the possibilities of wildlife utilisation and game ranching *outside* conservation areas.

NEED FOR INTERNATIONAL ASSISTANCE

Although Sudan merits international assistance with the protection and management of its conservation estate it is difficult to implement such aid while the southern part of the country is torn by civil strife. Sudan requires technical assistance with planning and implementation of management, also with funding, equipment and training for parks personnel.

SWAZILAND

Area (km^2)	:17,363
Population 1980 (UN Projection)	:543,000
Population density/sq.km.	:31.3
% Permanent agriculture/pasture	:75%
% Closed forest cover	:0%
Phytochoria	:VIII, XIV, XV

COUNTRY OVERVIEW

HABITAT COVERAGE FOR SWAZILAND

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
19A	2200	60	180	8.1	0	0.0
24	1600	60	0	0.0	0	0.0
29E	13600	40	175	1.2	0	0.0
Totals	17400	44	355	2.0	0	0.0

Swaziland has a network of generally small but well-managed nature reserves, wildlife sanctuaries and game reserves. Together these protected areas cover 2% of the country's land area and represent two of the three habitat types found in Swaziland – bushland and montane habitat. Although there are no reserves in vegetation type 24 this is a transitional scrub habitat of little biological interest.

Swaziland's reserves are already well-managed and there are no areas for priority conservation action. The Government of Swaziland is anxious to protect its natural heritage. In 1972 the Swaziland National Trust was founded to oversee nature conservation and the preservation of Swazi heritage; this Commission is advised by FAO (PADU/IUCN, 1986).

TANZANIA

Area (km^2)	:945,087
Population 1980 (UN Projection)	:18,052,000
Population density/sq.km.	:19.1
% Permanent agriculture/pasture	:55%
% Closed forest cover	:1.5%
Phytochoria	:II, IV, VIII, XII, XIII

COUNTRY OVERVIEW

Nature conservation is a major land use in Tanzania with over 25% of the country within gazetted reserves (including forest reserves). In addition there are 49 Game Controlled Areas where unlicensed hunting is prohibited but control is virtually non-existent in these areas. National parks and protected areas include representative samples of most major habitats and cover 12.4% of the country with a further 2.4% of the land area proposed as new reserves. Habitats which are under-represented or not protected by the reserve system include montane forests, Itigi thicket, coastal forest, mangrove and marine systems.

HABITAT COVERAGE FOR TANZANIA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	12700	20	1107	8.7	0	0.0
16A	97700	24	16700	17.0	150	0.1
16B	600	50	0	0.0	0	0.0
17	7600	90	250	3.2	0	0.0
19A	50300	80	507	1.0	7300	14.5
25	116900	38	3885	3.3	5213	4.4
26	297500	79	48530	16.3	2400	0.8
29C	6300	50	0	0.0	0	0.0
35A	10100	40	1800	17.8	0	0.0
40	6800	50	0	0.0	600	8.8
42	213000	49	31513	14.7	700	0.3
45	18700	36	0	0.0	1000	5.3
54B	1000	80	0	0.0	0	0.0
59	17700	60	3820	21.5	0	0.0
64	9800	80	0	0.0	200	2.0
65	1200	100	400	33.3	0	0.0
76	12200	80	2000	16.3	0	0.0
77	5300	40	0	0.0	150	2.8
8	800	20	0	0.0	0	0.0
Totals	886200	57	110512	12.4	17713	1.9

The protected area estate of Tanzania is of enormous importance to the whole of Africa and currently is estimated to contain more than one third of all remaining black rhinos in the Realm, as well as a large proportion of Africa's elephants. Protection and management of existing reserves varies from fairly good in the major parks to poor but there is a general need for more trained staff and greater resources. Major threats to wildlife are poaching and depletion of forest by over-exploitation and agricultural encroachment.

Priority A areas of conservation importance include Ruaha N.P, Selous G.R., Serengeti N.P., Kilimanjaro N.P., the Uluguru and Usambara mountains (at present inadequately protected as forest reserves) and the proposed Uzungwa Forest N.P.

RECOMMENDATIONS FOR ACTION

Many of the following recommendations are derived from the review by Lamprey (1974); it is disappointing that so few of Lamprey's recommendations have been implemented over the past decade.

a: **Extending the protected area system**

1. Only a relatively small proportion of the montane forest area in eastern Africa is included in national parks and protected areas. Much of this habitat type is included within forest reserves but these are subject to timber felling, or felling for agriculture and softwood plantations. Several of the isolated mountains have highly distinct biota with a high level of species endemism. Top priority should be given to establishing conservation areas in the Usambara, Uluguru, Uzungwa and Mahale mountains. At present these areas are all forest reserves ; the Mahale Mountains is a proposed national park.

2. Few extensive swamps in eastern Africa are included in parks and reserves. In Tanzania the following swamp areas still require protection : Wembere, Malagarasi, Kilombero, Bahi and Kagera swamps.

3. The flood plains of Buhoro, Kilombero, Wembere, Malagarasi and Lake Rukwa are unprotected with the result that their wild mammal populations are subject to uncontrolled hunting.

4. Itigi thicket is a restricted biome in central Tanzania, though extensive and well-protected in other parts of unit II, and an important habitat for rhino. At present it has no conservation status and is felled for agriculture. This area should be wholly or partly protected by the declaration of a game or forest reserve.

5. Although several alkaline lakes are fully or partly protected, Lake Natron is unprotected even though it is the only breeding place for lesser flamingoes and many of the greater flamingoes in eastern Africa. In Tanzania the following lakes should be protected as important flamingo habitat : Lakes Natron, Eyasi, Balangida, Balangida Lelu.
6. The open water of most freshwater lakes in eastern Africa (except for very small ones) is excluded from national parks and protected areas although adjacent land areas may have park status. Lakes Tanganyika and Victoria are two of the richest lakes in the world in terms of fish diversity yet none of their open water is protected. Extend the park boundaries of Gombe Stream Reserve to at least 500 m offshore to protect part of Lake Tanganyika.
7. No areas of mangrove are protected in Tanzania. Immediate action should be taken to establish a reserve in the Rufiji Delta, the most extensive area of mangrove on the Tanzanian coast. This area could be proposed as a national park or part of a marine park.
8. Although there are extensive coastal reefs along the entire eastern coast of Africa from Egypt to Mozambique few are protected in national parks or reserves. There is an urgent need to establish a marine park to protect the coral reefs off the Tanzanian coast. There is good coral on Mafia Island which together with the Rufiji Delta could form an important marine park. (see also UNEP, 1984).
9. Establish conservation areas to protect areas of saltbush thicket *(Suaeda)* on the margins of Lake Manka and the Ruvu valley, and fringing the coastal salt pans.
10. Establish a reserve to protect riverine forest at the mouth of the Kagera River between Uganda and Tanzania, important habitat for blue duiker and black mangabey.
11. Coastal forest is inadequately protected in Tanzania. Prime sites are the Pugu Hills near Dar es Salaam and the Rondo Plateau in the south-east.
12. The island of Fungu Kizimkazi off the Tanzanian coast is important for seabirds and nesting turtles and should be gazetted as a game reserve.

b: **Improving protection and management of existing reserves**
1. Develop a national land-use strategy. To encourage public support for protected areas it is important to have a reasonable balance between protection and utilisation. Tanzania's huge reserves are probably only justifiable if there is more utilisation. Any harvesting of wildlife must be carefully monitored and controlled by the parks authorities.
2. Many Tanzanian parks suffer from similar problems : poaching (especially of elephant and black rhino), agricultural encroachment , timber felling and illegal grazing of cattle. As the pressure on land increases these problems will become worse. Although staffing levels are adequate in some parks there is a general lack of funding and equipment, especially for the maintenance of facilities.
3. In particular improve protection of Selous G.R. which has suffered a drastic reduction in numbers of elephants and rhinos due to heavy poaching.
4. Establish firewood plantations adjacent to rural settlements to supply the needs of local people for fuelwood and timber and reduce illegal felling in protected areas and forest reserves.
5. Monitor the effects of tourism on wildlife populations and habitats. Control visitor use to prevent environmental degradation.

c: **Other conservation action**
1. International funding should be continued to Mweka Wildlife College, Tanzania. Refresher courses for graduates would be a useful extension of the college's programme.
2. Continue support for the Malihai Clubs to extend their conservation education programmes.
3. Develop interpretation programmes in each national park, aimed both at park visitors and villagers living in the park environs.

NEED FOR INTERNATIONAL ASSISTANCE

Tanzania is a poor country with serious economic problems. The government should seek continued international aid for technical assistance, funding of research programmes and training. In particular international funding should be continued to Mweka Wildlife College which has played an important role in training wildlife managers throughout English-speaking Africa.

TOGO

Area (km^2)	:56,000
Population 1980 (UN Projection)	:2,596,000
Population density/sq.km.	:46.4
% Permanent agriculture/pasture	:52%
% Closed forest cover	:5.3%
Phytochoria	:III, XI

COUNTRY OVERVIEW

HABITAT COVERAGE FOR TOGO

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	12800	20	350	2.7	0	0.0
2	5200	10	0	0.0	0	0.0
27	32900	40	3716	11.2	0	0.0
29A	5100	60	90	1.7	0	0.0
Totals	56000	34	4156	7.4	0	0.0

Togo has only two national parks and two nature reserves which have no legal basis but are protected more strictly than the country's integrated hunting reserves. All classified forests have also been designated Animal Preserves where all exploitation is prohibited except for the collection of dead wood and water. Together these protected areas cover 7.4% of the country and represent most major habitat types except lowland rainforest which is already very depleted. The proposed Mandouri Animal Preserve (180,000 ha) will increase the area under protection.

The main threats to reserves and wildlife are poaching, forest fires and illegal clearing of land. Fines and long prison sentences are imposed for burning or for killing of wildlife in protected areas. Protection and management could be improved in most reserves; as yet none have management plans.

There are no areas of priority A conservation importance in Togo.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Gazette the proposed Mandouri Animal Preserve (180,000 ha).

2. Extend Keran N.P. and Hunting Reserve north to form a corridor with the Pendjari N.P. in Benin.

b: **Improving protection and management of existing reserves**

1. Increase anti-poaching activities especially in Fazao-Malfakassa near the border with Ghana. Although attention in Togo has focused on Keran for tourism development, Fazao-Malfakassa has greater tourist potential and also greater concentrations of wildlife. Active management here will require increasing levels of trained staff, budgets and resources.

c: **Other conservation action**

1. Prepare a national land use strategy for the development of an adequate national parks sytem not in conflict with the needs of adjoining communities.

2. Implement legislation for the establishment of national parks and nature reserves.

3. Develop a conservation programme to increase public awareness of the value of protected areas and conserving wildlife. Bushmeat is an important addition to local diets and makes a substantial contribution to the local and national economy.

NEED FOR INTERNATIONAL ASSISTANCE

International assistance is needed in the fields of planning and training, and for the development of a national conservation strategy.

UGANDA

Area (km^2)	:241,139
Population 1980 (UN Projection)	:13,222,000
Population density/sq.km.	:54.8
% Permanent agriculture/pasture	:45%
% Closed forest cover	:3.2%
Phytochoria	:I, III, IV, VIII, XI, XII

COUNTRY OVERVIEW

HABITAT COVERAGE FOR UGANDA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	88400	10	3279	3.7	0	0.0
19A	6600	50	474	7.1	410	6.2
2	7300	58	1852	25.3	625	8.5
27	2300	30	289	12.5	0	0.0
29A	52100	30	2873	5.5	421	0.8
42	16200	40	2056	12.6	3600	22.2
45	19700	20	2571	13.0	508	2.5
65	1000	100	0	0.0	0	0.0
8	100	20	0	0.0	0	0.0
Totals	193700	22	13394	6.9	5564	2.8

Uganda spans several biogeographical regions and is a country of great biological richness and spectacular scenery. The country has a good system of national parks and reserves first established in colonial times. Protected areas cover 6.9% of Uganda's land surface and represent most major habitat types. Approximately 8% of Uganda's lowland forests are within forest reserves with little remaining forest outside these protected areas (Struhsaker, 1981). Since the Forest Department started systematic exploitation of forest reserves representative parts of the forest have been established as nature reserves but these are relatively small.

Protection and management of protected areas has suffered considerably during the turmoils associated with periods of civil war and political unrest in Uganda. Legally no settlement or any other form of land use is permitted in national parks and game reserves but prevention of illegal cultivation has been difficult with the parks department's lack of transport and resources. Although the government has been encouraging projects to reinforce national parks and establish new areas the major difficulty is lack of funds for managing reserves. Other problems include illegal timber felling, illegal hunting and poaching and agricultural and livestock incursions.

Priority A areas for conservation in Uganda include Murchison Falls N.P., the Rwenzori Mountains (at present partly protected by a forest reserve) and Queen Elizabeth N.P.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Top priority should be given to establishing a national park in the Rwenzori Mountains, which are *not* included within the Queen Elizabeth (Rwenzori) N.P. 8o% of the Rwenzori mountains lie within Uganda; the adjacent area in Zaire is already protected within the Virunga N.P. The Rwenzoris include beautiful and spectacular ice-clad mountains reaching more than 5000 m (the famous Mountains of the Moon), extensive snow-fields and glaciers, unusual flora and some endemic wildlife. The remarkable moss and bog complexes function as a massive sponge, absorbing and regulating the year-round rainfall, providing the headwaters of the Nile. At present part of the mountain range is partially protected as forest

reserve, but deforestation and hunting threaten the area's wildlife. The Rwenzori mountain range should be gazetted immediately as a national park and nominated as a World Heritage Site (Yeoman, 1985).
2. Several other areas of remaining forest with high species diversity and endemism are presently inadequately protected as forest reserves but should be gazetted as full reserves:
Bwindi (Impenetrable) Forest is one of the largest forests in eastern Africa and the richest forest in Uganda in terms of numbers of plant and bird species. Bwindi has one of the richest montane avifauna in Africa. Bwindi harbours about a third of the world's remaining mountain gorillas, six other species of diurnal primates, including chimps, and several endemic birds. The area is also an important water catchment.
Kibale Forest (50000 ha) harbours 11 species of primates including the only viable population of Uganda red colobus. It has a rich bird fauna and many large mammals including elephants and buffalo. Like most forests in Uganda, Kibale is managed primarily for timber production and has only a small strict nature reserve of 6000 ha, only 11 % of the total forest area. This strict nature reserve should be extended to protect more of the area's wildlife.
3. A strict nature reserve should be established in part of the Mount Elgon forest reserve. Large areas of the natural montane forest are being replaced by conifers and increasing agricultural settlement.
4. The Lake Opeta flood plain should be protected to conserve its abundant bird life.
5. The open water of the freshwater lakes of Uganda are excluded from national parks and reserves, even though adjacent land has park status. This includes Lake Victoria, one of the most biologically rich lakes in the world. Major freshwater lakes include Victoria, Kyoga, Mobutu, Edward and George. This is a major omission with potentially serious consequences for aquatic flora and fauna.
Extend Kabalega N.P. boundaries to 500 m offshore to include part of Lake Mobutu.
Extend the boundaries of Queen Elizabeth N.P. to 500 m offshore to include part of the open water of Lakes Edward and George.
6. *Butyrospermum* moist savanna is extensive in northern Uganda and southern Sudan but is not included in any park or reserve. Surveys should be made of remaining areas of this habitat to identify a new reserve.

b: **Improving protection and management of existing reserves**
1. The major problem facing park managers is lack of funding. Better management is dependent on increased budgets, more trained staff, and provision of more transport and other resources for parks and reserves. After so much civil unrest in the country national parks cannot be expected to raise their own revenue from tourism.

c: Other conservation action
1. Prepare a national conservation systems plan concerned with the conservation of wildlife and development of forest reserves.
2. Uganda should become a signatory to CITES and ratify the convention.

NEED FOR INTERNATIONAL ASSISTANCE

Uganda is already receiving considerable aid from UNDP and EEC to rehabilitate the three major national parks but will require further assistance for development of national parks and protected areas. Uganda will also need further technical assistance and aid for training and for preparation and implementation of a national systems plan and management plans for individual reserves. This could be part of the ongoing IUCN project to produce a National Conservation Strategy.

ZAIRE

Area (km^2)	:2,344,885
Population 1980 (UN Projection)	:27,952,000
Population density/sq.km.	:11.9
% Permanent agriculture/pasture	:14%
% Closed forest cover	:45%
Phytochoria	:I, II, III, VIII, X, XI, XII

COUNTRY OVERVIEW

Zaire is a large country spanning several biogeographical regions and still retaining 45% of its original forest cover. The country lies in a zone of great biological richness, a fact reflected by its high primate diversity. In particular the eastern Zaire forests are of special importance as a Pleistocene refugium harbouring many endemic species. Protection of these forests helps species such as okapi, and all but four of Africa's threatened primates.

HABITAT COVERAGE FOR ZAIRE

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
11A	395400	31	13420	3.3	0	0.0
14	4700	40	0	0.0	0	0.0
15	2100	20	0	0.0	0	0.0
19A	54100	80	5000	9.2	3500	6.4
1A	617200	50	33560	5.4	0	0.0
2	339300	46	2730	0.8	0	0.0
21	32000	30	0	0.0	0	0.0
25	365000	48	14500	3.9	0	0.0
29A	2700	10	0	0.0	0	0.0
31	70200	28	550	0.7	0	0.0
37	12900	30	550	4.2	0	0.0
4	22200	40	4330	19.5	0	0.0
40	400	20	0	0.0	0	0.0
45	7100	60	3800	53.5	0	0.0
60	57300	80	3670	6.4	0	0.0
65	600	100	0	0.0	0	0.0
75	4300	50	0	0.0	0	0.0
77	2500	50	0	0.0	0	0.0
8	148800	30	4500	3.0	0	0.0
9	197100	50	6000	3.0	4000	2.0
Totals	2335900	45	92610	3.9	7500	0.3

The present network of protected areas covers 3.9 % of the country and represents several major habitat types. Major omissions are mangrove and transitional grassland/woodland mosaics, and altimontane and swamp habitats. Threatened species not as yet adequately protected include the rare and endangered pygmy chimpanzee, whose presence in Salonga N.P. is still in doubt. There should also be more reserves in phytochorion X even though this is one of the least biologically rich units of the Realm and, therefore, not a top priority for conservation. At present this transitional unit has only two reserves larger than 5000 ha, one in Zaire and the other in Angola.

Protection and management of a few national parks is fairly good but elsewhere management needs to be improved. The main threat to wildlife is poaching, especially in the lakes and floodplains areas.

Priority A areas for conservation action in Zaire include Kahuzi-Biega N.P., the proposed Lomako Reserve, Maiko N.P., Salonga N.P., Kundelungu N.P., the proposed Marungu Mountains Reserve, Virunga N.P., and Garamba N.P.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Establish a reserve in the Lomako Forest to protect populations of the endangered pygmy chimpanzee, which is endemic to Zaire and probably not protected by the current reserve system.
2. Establish the proposed reserves in the Marungu and Uvira mountains to protect the montane forests and their unique wildlife.
3. Establish new reserves to protect important wetlands including swamps and coastal mangroves. For wetland areas of conservation priority see section 4.2.
4. Take action to give some protection to the important Zaire lakes, particularly Lake Tumba with its endemic fish fauna.
5. Establish a protected area in the Itombwe mountains, an area of critical importance for montane birds. East Zaire has the richest montane avifauna in Africa with the mountains of the Albertine Rift supporting the greatest number of endemic species.

b: **Improving protection and management of existing reserves**

1. Although many of Zaire's reserves are protected by their isolation from human settlements, there is a general need to increase levels of trained staff, funds, equipment and transport, and to improve and maintain existing facilities, e.g. repair patrol roads.
2. Prepare and implement management plans for all major reserves.
3. Increase anti-poaching activities and the numbers and frequency of patrols. Guards should be well-trained and well-equipped with firearms, transport and radios for communication and coordinating activities.

c: **Other conservation action**

1. Increase efforts to stop trade in poached elephant ivory and animal skins across the border to Sudan and Central African Republic. Increase measures to stop poachers from Sudan crossing into Zaire parks.
2. Encourage tourism by developing and maintaining tourist facilities in major national parks.

NEED FOR INTERNATIONAL ASSISTANCE

Zaire is a wealthy country with sufficient resources to develop its system of national parks and protected areas but it will require technical assistance for preparation of systems and management plans, and for training.

ZAMBIA

Area (km^2)	:752,614
Population 1980 (UN Projection)	15,875,000
Population density/sq.km.	:7.8
% Permanent agriculture/pasture	:46%
% Closed forest cover	:4%
Phytochoria	:II, VIII

COUNTRY OVERVIEW

Zambia has a good wildlife estate with national parks covering 8.2% of the country and including representative samples of most major habitat types. Game management areas and forest reserves extend over another 21% of Zambia (here included with proposed areas as these utilisation areas contribute less to the effective conservation score than if they were more rigorously protected). Several grassland and woodland habitats are very well covered by the protected area system, as are floodplains, important

grazing areas for game. Areas of the floodplains of the Kafue, Zambezi and Bangweulu are all afforded some protection in national parks or game management areas. Although most vegetation types are well-represented in the park network, there are a few biotic communities that are threatened or still inadequately protected. The *Cryptocephallum* forests in the north need careful management. The hilly areas of Nyika, Msuka and Mfika are of high conservation importance; Nyika is a national park (but poorly managed) and the other two are forest reserves with little or no protection.

HABITAT COVERAGE FOR ZAMBIA

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
16B	300	50	0	0.0	0	0.0
19A	300	80	0	0.0	0	0.0
21	20100	20	540	2.6	1700	8.4
22A	16100	50	3600	22.3	10175	63.1
25	372700	80	28150	7.5	37805	10.1
26	134700	50	11014	8.1	30230	22.4
28	37600	100	9142	24.3	28320	75.3
29C	24300	70	300	1.2	2000	8.2
40	5000	60	500	10.0	1800	36.0
6	33700	40	1404	4.1	9350	27.7
60	28300	90	2600	9.1	12000	42.4
64	64100	80	4260	6.6	20514	32.0
75	12900	90	0	0.0	4100	31.7
76	2500	80	400	16.0	400	16.0
Totals	752600	71	61910	8.2	158394	21.0

With the exception of a few well-managed national parks protection and management are generally poor. In 1981 most parks were not managed at all which led to some uncontrolled bushfires. Poaching is the main threat to the integrity of the parks system. It is estimated that Zambia lost 1100 black rhinos to poachers between 1980-1984, almost one fifth of the numbers lost throughout the whole Afrotropical Realm. Major deficiencies recognised by the Parks and Wildlife Service are lack of national land use plans, trained staff and transport.

Priority A areas for conservation action include Bangweulu Game Management Area, Kafue N.P., Liuwa Plain N.P., Luangwa N.P and West Zambesi Game management Area.

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Very few extensive swamps in eastern Africa are included in parks or reserves. Establish parts of the floodplains of the Zambezi River and the Bangweulu Swamp as reserves. At present these areas are included within Game Management Areas which may not give adequate protection.

2. The boundaries of the Nsumbu N.P. should be extended into Lake Tanganyika to protect some of the open water of this important freshwater lake.

3. Establish reserves to protect the montane habitats of the Msuku and Mfika Hills.

b: **Improving protection and management of existing reserves**

1. Improve protection of Mosi-Oa-Tunya N.P. which is suffering from heavy poaching. Title deeds allowing villagers to farm within the park also threaten the park's integrity.

2. There is a general need in Zambia to prepare and implement system and management plans and improve protection and management in all protected areas. This will require increased numbers of trained staff, equipment and transport, particularly water transport for wardens as there is considerable poaching of animals in lake and floodplain areas.

3. Other measures to improve reserve management include excluding illegal settlements from parks and game management areas; stopping agricultural encroachments and illegal grazing of domestic livestock; and taking adequate measures to control and stop the spread of bushfires.

4. Monitor the effects of tourism (in Zambia based exclusively on the national parks system) on wildlife and habitats.

c: **Other conservation action**

1. Implement the national conservation strategy for rational land use, attempting to minimise the conflicts that can arise between national parks and neighbouring communities.

2. Improve control and management of Game Management Areas where uncontrolled human settlements continue to be a problem.

NEED FOR INTERNATIONAL ASSISTANCE

Zambia will require international assistance and technical assistance for training and the development of national land use plans, system plans and the preparation and implementation of management plans for individual protected areas. Assistance is needed to upgrade the rather run-down system of protected areas and restore it to its former excellence.

ZIMBABWE

Area (km^2)	:390,245
Population 1980 (UN Projection)	:7,495,000
Population density/sq.km.	:19.2
% Permanent agriculture/pasture	:40%
% Closed forest cover	:0%
Phytochoria	:II, VIII

COUNTRY OVERVIEW

HABITAT COVERAGE FOR ZIMBABWE

Habitat	Orig.area	Rem.%	Prot.area	Prot.%	Prop.area	Prop.%
16	1200	50	0	0.0	0	0.0
19A	6500	80	485	7.4	0	0.0
22A	34500	60	13003	37.6	0	0.0
26	170600	40	7735	4.5	0	0.0
28	110600	45	21272	19.2	0	0.0
29C	66800	45	3292	4.9	0	0.0
Totals	390200	44	45787	11.7	0	0.0

Zimbabwe has an extensive and well-managed system of protected areas, covering 11.7% of the country and representing all major habitat types (except 16). Under-represented communities include the *Parinari* forests and the serpentine soil vegetation on the Great Dyke, but measures have already been agreed to give further protection to these habitats.

Zimbabwe's parks and protected areas are some of the best managed in the world with a highly trained and efficient National Parks and Wildlife Department. Considerable emphasis is placed on the role of protected areas in raising rural living standards and generating material revenue through domestic and foreign tourism and utilisation of wildlife (Child, 1984). The greatest threats to wildlife and the parks system are poaching and wildfires.

Priority A areas of high conservation value in Zimbabwe include Gonarezhou, Chimanimani and Mana Pools national parks. Zimbabwe also has several other parks of regional importance including the Ngezi Recreation Park (one of the few areas protecting the serpentine flora of the Great Dyke).

RECOMMENDATIONS FOR ACTION

a: **Extending the protected area system**

1. Establish a reserve to protect the *Parinari* forests; this is already agreed.

2. Increase the protected area of endemic serpentine soil vegetation found along the Great Dyke by extending the Sebakwe Recreational Park.

3. Extend the Chimanimani N.P. to include a wider area of quartz grassland and forest known to contain some endemic wildlife; abandoned proposals to establish an adjoining conservation area in Mozambique should be reconsidered.

b: **Improving protection and management of existing reserves**

1. Improve protection and management of Chegutu (Hartley A) Safari Area and Chipinga A Safari Area which have no management at present. Zimbabwe's Botanical Reserves are completely neglected.

2. Improve protection of Gonarezhou N.P. which is under considerable pressure from poachers, from surrounding subsistence farmers who move their livestock into the park in times of drought and from refugees from Mozambique, who poach and graze their livestock in the park.

c: **Other conservation action**

1. A project has been proposed to institute a programme for the long-term conservation of natural resources in communal areas by placing custody and responsibility with resident communities. This is particularly directed at growing problems of land use and resource management in the remote marginal lands in the north.

2. Within Zimbabwe great areas of land are already managed as biosphere reserves and would be appropriate for this international status.

NEED FOR INTERNATIONAL ASSISTANCE

Zimbabwe has a fine network of national parks and protected areas and a well-trained corps of managers and guards but maintaining these high standards will require increased levels of expenditure on parks management and some international aid with funding and training. Zimbabwe could assist other countries of southern Africa by helping to train their parks staff within Zimbabwe.

BIBLIOGRAPHY

Acocks, J. P. H. 1979. The flora that matched the fauna. *Bothalia* 12: 673-709.

Ash, J. S. and Miskell, J. E. 1983. Birds of Somalia: their habitat, status and distribution. *Scopus* Special Supplement Number 1. Ornithological Sub-Committee of the East African Natural History Society, Nairobi.

Assi, A. and Pfeffer, P. 1975. *Parc National de Tai: Inventaire de la Flore et de la Faune.* Societe d'Etat—Bureau Pour le Developpement de la Production Agricole.

Aubreville, A. 1971. The destruction of forests and soils in the tropics. *Adansonia,* ser. 2, 11, p. 5-39.

Aveling, C. and Aveling, R. J. 1980. *Report on A Visit to Masisi District of Zaire.* Ruhengeri, Rwanda.

Badrian, A. and Badrian, N. 1977. Pygmy Chimpanzees. *Oryx.* XIII/5: 463-468.

Barber, K. B., Buchanan, S. A., and Galbreath, P. F. 1980. *An Ecological Survey of the St. Floris National Park, Central African Republic.* International Park Affairs Division, National Park Service, Washington.

Benson, C. W. and Benson, F. M. 1977. *The Birds of Malawi.* Montfort Press, Limbe, Malawi.

Bjornstad, A. 1976. *The Vegetation of Ruaha National Park, Tanzania: Annotated Check-List of the Plant Species.* Serengeti Research Institute Publication No. 215, Oslo.

Borner, M. 1981/2. *Wildlife Survey, Burigi Game Reserve, West Lake Region, Tanzania.* Frankfurt Zoological Society.

Boudet, G. 1972. Desertification de l'Afrique tropicale seche. *Adansonia,* ser. 2, 12: 505-24.

Brenan, J. P. M. 1978. Some aspects of the phytogeography of tropical Africa. *Ann. Mo. Bot. Gdn.,* 65: 437-78.

Brooke, R. K. 1984. *South African Red Data Book – Birds.* South African National Scientific Programmes Report No. 97. Foundation for Research Development, Council for Scientific and Industrial Research, Pretoria.

Butler, L. M. 1982. *Relationships of Selected Socio-Economic and Physical Variables to the Establishment of National Parks and Reserves in Sub-Saharan Africa.* Unpublished Master's thesis at Clemson University.

Carcasson, R. H. 1964. A preliminary survey of the zoogeography of African butterflies. *E. Afr. Wildl. J.* 2: 122-157.

Castroviejo Bolivar, J., Balleste, J. J. and Alvarez, R. C. 1986. *Lnvestigacion y Conservaçion de la Naturaleza en Guinea Ecuatonal.*

Chapin, J. P. 1923. Ecological aspects of bird distribution in tropical Africa. *Am. Nat.* 57: 106-125.

Child, G., Smith, P. and von Richter, W. 1970. Tsetse control hunting as a measure of large mammal population trends in the Okavango Delta, Botswana. *Mammalia,* 34: 34-75.

Child, G. F. T. 1984. Managing Wildlife for People in Zimbabwe. In: *National Parks, Conservation and Development: The Role of Protected Areas in Sustaining Society.* (Eds J. A. McNeely and K. R. Miller). IUCN/Smithsonian Institution.

Clarke, J. E. and Bell, R. H. V. 1986. Representation of Biotic Communities in Protected Areas: A Malawian Case Study. *Biol. Cons.* 35: 293-311.

Coe, M. J. 1967. *The ecology of the alpine zone of Mount Kenya.* The Hague, Junk.

Coetzee, J. A. 1967. Pollen analytical studies in East and Southern Africa. *Palaeoecol. Afr.* 3: 1-146.

Collar N. J. and Stuart S. N. 1985. *Threatened Birds of Africa and Related Islands, The ICBP/IUCN Red Data Book.* ICBP and IUCN, Cambridge.

Collar, N. J., Dee, T. J. and Goriup, P. D. (in press). Nature Conservation in Madagascar: the ICBP perspective. WWF-US.

Collar, N. J. and Stuart, S. N. (in prep). *Forests important for threatened bird species conservation in the Afrotropical and Malagasy regions.* ICBP/IUCN.

Collins N. M. and Morris M. G. 1985. *Threatened Swallowtail Butterflies of the World, The IUCN Red Data Book.* I.U.C.N., Gland.

Cott, H. B. and Pooley, A. C. 1972. *The status of crocodiles in Africa.* IUCN Publications New Series Supplementary Paper No. 33. I.U.C.N., Morges.

Crowe, T. M. and Crowe, A. A. 1982. Patterns of distribution, diversity and endemism in Afrotropical birds. *J. Zool., Lond.* 198: 417-442.

Cumming, D. H. M. and Jackson, P. 1984. *The Status and Conservation of Africa's Elephants and Rhinos.* Proceedings of the Joint Meeting of IUCN/SSC African Elephant and African Rhino Specialist Groups at Hwange, Zimbabwe, 1981.

Dasmann R. F., 1973. A system for defining and classifying natural regions for purposes of conservation. *IUCN Occasional Paper* 7: 1-47.

Davidson, J. 1985. *Economic Use of Tropical Moist Forests.* Commission on Ecology Papers Number 9. I.U.C.N., Gland.

Davies, G. 1984. *A Review of Forest and Wildlife Management in the Gola Forests, Sierra Leone.* Njala University College.

De Vos, A. 1975. *Africa, the devastated continent?* Junk, The Hague.

D'Huart, J. P. 1983. *Conservation et Aménagement des Forêts Naturelles de la Crete Zaire-Nil au Rwanda.* Union International Pour la Conservation de la Nature et de ses Ressources, rapport de mission.

Diamond, J. M. 1975. The island dilemma: lessons of modern biogeographic studies for the design of natural reserves. *Biol. Conserv.* 7: 129-146.

Diamond, A. W. and Hamilton, A. C. 1980. The distribution of forest passerine birds and Quaternary climatic change in tropical Africa. *J. Zool. Lond.* 191: 379-402.

Dorst, J. and Dandelot, P. 1972. *A Field Guide to the Larger Mammals of Africa.* Collins, London.

Douglas-Hamilton, I. 1979. *The African Elephant Action Plan.* Report for the IUCN/WWF/NYZS Elephant Survey and Conservation Programme.

Douglas-Hamilton, I. 1984. Trends in Key African Elephant Populations. *Pachyderm* 4: 7-9.

Douglas-Hamilton, I., Froment, J. M., and Doungoube, G. 1980. *Aerial Census of Wildlife in the North of the Central African Republic.* Report to CNPAF/WWF/IUCN/PNUD/FAO.

Downing, B. H. and Russell, G. E. G. 1981. Phytogeographic and biotic relationships of a savanna in Southern Africa: analysis of Angiosperm checklist from *Acacia* woodland in Zululand. *J. S. Afr. Bot.* 47: 721-742.

Dowsett-Lemaire, F. and Dowsett, R. J. (In prep.) The evergreen forests of Malawi- their natural history, biogeography and conservation.

Droop, S. J. M. The work of the IUCN Conservation Monitoring Centre at Kew and the forthcoming Plants Sites Red Data Book. Lecture at the Missouri Botanical Garden, 14 June, 1985.

East, R. 1981. Area requirements and conservation status of large African mammals. *Nyala* 7: 3-20.
Ebin, C. 1983. *An Appraisal of the Biotic and Material Resources of some Game Reserves and Wildlife Management in Nigeria.* Nigerian Conservation Foundation, Lagos.
Elton, C. S. 1975. Conservation and the low population density of invertebrates inside neotropical rainforests. *Biol. Conserv.* 7: 3-15.
Estes, R. D. 1982. *A Palanca Negra Gigante e A Conservaçao da Fauna em Angola.* Antelope Specialist Group, I.U.C.N. .
F.A.O. 1977. *Assistance aux Parcs Nationaux de la Zone de Savane du Cameroun: Conclusions et Recommandations du Projet.* Rome.
F.A.O. 1977. *Assistance aux Parcs Nationaux de la Zone de Savane du Cameroun: L'Ecologie et l'Amenagemenl du Parc National de Waza.* Rome.
F.A.O. 1977. *Strengthening of Forestry and Wildlife Management, Somalia: Project Findings and Recommendations.* Rome.
F.A.O. 1977. *Wildlife Conservation and Management in the Southern Sudan: Project Findings and Recommendations.* Rome.
F.A.O. 1977. *Wildlife Management and Utilization, Botswana: Project Findings and Recommendations.* Rome.
F.A.O. 1978. *Wildlife Management, Kenya: Plans for Rural Income from Wildlife in Kajiado District.* Rome.
F.A.O. 1978. *Eludes Preliminaires d Aménagement de la Faune en Zone Nord, Empire Centrafricaine: Conclusions et Recommandations du Projet.* Rome.
F.A.O. 1978. *Développement des Ressources Forestieres, de la Faune Sauvage et de la Peche, Haute-Volta: Un Schema Directeur d'Amenagement Pour le Parc National d'Arli.* Rome.
F.A.O. 1979. *Développement des Pares Nationaux, Benin: Plan Directeur Parc National de la Pendjari.* Rome.
F.A.O. 1979. *Aménagement de la Faune et Des Pares Nationaux Phase 1, Benin: Rapport Interimaire.* Rome.
F.A.O. 1980. *Wildlife Management, Kenya: Project Findings and Recommendations.* Rome.
F.A.O. 1982. *Développement des Ressources Forestieres et Renforcement du Service Forestier, Haute Volta: La Consommalion de Bois de Feu.* Rome.
F.A.O. 1982. *Aménagement de la Faune, Republique Centrafricaine: Rapport Interimaire.* Rome.
F.A.O. 1982. *Etude de Reboisement, Aire: Rapport Technique: Reboisement de Kinzono Sur le Plateau Bateke.* Rome.
F.A.O. 1982. *Développement des Pares Nationaux, Benin: Conclusions et Recommandations du Projet.* Rome.
F.A.O. 1983. *Inventaire des Ressources en Faune Sauvage et Etude Economique sur son Utilisation en Zone Rurale.* Rome.
F.A.O. 1983. *Développement des Ressources Forestieres et Renforcement du Service Forestier, Haute Volta: Inventaire Forestier National.* Rome.
F.A.O. 1984. *Regional Assistance to Training in Wildlife and Protected Area Management in Africa: Project Findings and Recommendations.* Rome.
F.A.O. /U.N.E.P. 1981. *Tropical Forest Resources Assessment Project. Forest Resources of Tropical Africa.* F.A.O., Rome.
Ford, J. 1971. *The Role of the Trypanosomiases in African Ecology.* Clarendon Press, Oxford.
Frankel, O. H. and M. E. Soulé. 1981. *Conservation and Evolution.* Cambridge University Press. New York.
George, W. 1962. *Animal Geography.* Heinemann, London.
Government of Mauritius, 1983. *Wildlife Research and Conservation Programme, Phase I: 1984 to 1985, Initiation and Integration.* International Council for Bird Preservation, Cambridge.
Grettenberger, J. F. and Newby, J. E., 1984. *La Reserve Naturelle Nalionale de l'Aïr et du Ténéré, Etudes Ecologiques: Proposition pour un plan-directeur d'aménagement pour la conservation et l'utilisation des ressources naturelles de la reserve.* Republic du Niger and International Union for the Conservation of Nature/ World Wildlife Fund, Niamey.
Groombridge, B. 1982. *The IUCN Amphibia – Reptilia Red Data Book.* I.U.C.N., Gland.
Grove, A. T. and Warren, A. 1968. Quaternary landforms and climates on the south side of the Sahara. *The Geographic Journal* 134: 199-208.
Guillaumet, J. L. 1967. Recherchcs sur la végétation et la flore de la region du Bas-Cavally (Cote D'lvoire). *Mem. ORSTOM* 20: 1-247, with vegetation map 1:1000000.
Gwynne, M. D., Torres C. B. and Croze, H. J. 1983. Tropical Forest Extent and Changes. *Advances in Space Research* 2,8:81-89.
Hall, A. V. (Ed.) 1984. *Conservation of Threatened Natural Habitats.* South African National Scientific Programmes Report No. 92. Foundation for Research Development, Council for Scientific and Industrial Research, Pretoria.
Hall, A. V., de Winter, M., de Winter, B. and van Oosterhoot, S. A. M. 1980. *Threatened plants of Southern Africa.* South African National Scientific Programmes Report No. 45. Cooperative Scientific Programmes Council for Scientific and Industrial Research, Pretoria.
Hall, A. V. and H. A. Veldhuis. 1985. *South African Red Data Book: Plants – Fynbos and Karoo Biomes.* South African National Scientific Programmes Report Number 117, Foundation for Research Development, Pretoria.
Hall, B. P. and Moreau, R. E. 1970. *An atlas of speciation in African passerine birds.* British Museum (Natural History), London.
Haltenorth, T. and Diller, H. 1977. *A Field Guide to the Mammals of Africa including Madagascar.* Collins, London.
Halwagy, R. 1962. The impact of man on semi-desert vegetation in the Sudan. *J. Ecol.*, 50, p. 263-73.
Hamilton, A. C. 1972. The interpretation of Pollen diagrams from highland Uganda. *Paleoecol. Afr.* 7: 45-149.
Hamilton, A. C. 1976. The Significance of Patterns of Distribution Shown by Forest Plants and Animals in Tropical Africa for the Reconstruction of Upper Pleistocene Palaeoenvironments: A Review. *Palaeoecol. Afr.* 9: 63-97.
Hamilton, L. S. and Snedaker, S. C. (Eds) 1984. *Handbook for Mangrove Area Management.* U.N.E.P. and East-West Center.
Hcdberg I. and Hedberg O. (Eds.) 1968. Conservation of Vegetation in Africa South of the Sahara. *Acta Phytogeographica Suecica 54.* Uppsala.
Hillman, K. 1981. *The Status of Rhino in Africa and an Action Programme.* IUCN/WWF/NYZS Africa Rhino Group Report.
Hillman, A. K. K., Snyder, P. M., Tear, T. and Sommerlatte, M. 1981. *An Aerial Reconnaissance of the Shambe Area, Southern Sudan, 22-26th April, 1981.* Report to IUCN/WWF and the Ministry of Wildlife Conservation and Tourism, Southern Region, Sudan.
Hillman, J. C. 1985a. *Wildlife Conservation in Ethiopia and Development Priorities.* Wildlife Conservation Organisation, Addis Ababa.
Hillman, J. C. 1985b. *Wildlife Research in relation to Conservation and Management.* Seminar on Wildlife Conservation and Management in the Sudan. Khartoum.
Hillman, J. C. 1985c. *Bale Mountains National Park Management Plans.* Wildlife Conservation International for the Ethiopian Wildlife Conservation Organisation.
Hillman, J. C. 1986. Conservation in Bale Mountains National Park, Ethiopia. *Oryx* XX: 89-94
Hooker, J. D. 1864. On the plants of the temperate regions of the Camerouns Mountains and islands in the Bight of Benin. *J. Linn. Soc. Bot.* 7:171-240.

Horsten, F. 1982. *Os Parques Naçonais E As Outras Zonas De Proteccao Da Naturazzn De Angola.* Direccao Nacional Conservaçao Da Naturazza. Ministerio da Agricultura. Republica Popular de Angola.

Hugot, H. J., Quezel, P. and Martinez. O. 1962. Documents scientifiques. Mission Berliet Tenere-Tchad, Paris.

Humbert, H. 1965. *Notice de la carte Madagascar.* Carte internationale du tapis vegetal à 1:1000000. Trav. Sect. Sci. Tech. Inst. Franc. Pondicherry: 1-164.

Huntley, B.J. 1973. *Distribution and status of the large mammals of Angola with special reference to threatened species.* Unpubl. mimeo. 37pp.

Huntley, B. J. 1978. Ecosystem Conservation in Southern Africa. *Biogeography and Ecology of Southern Africa.* 1978/41: 1333-1384.

Huntley, B. J. and Ellis, S. 1984. Conservation Status of Terrestrial Ecosystems in Southern Africa. *Proc. 22nd Working Session, Commission on National Parks and Protected Areas.* Victoria Falls, Zimbabwe, 1983.

Hutagalung, T. and Sawe, J. A. 1983. *Progress Report on the Implementation of Recommendations on Regional Programmes in the Conservation and Management of African Wildlife.* Joint Inspection Unit, United Nations, Geneva.

I.U.C.N., 1976. *Proceedings of a Regional Meeting on the Creation of a Coordinated System of National Parks and Reserves in Eastern Africa.* I.U.C.N., Morges.

I.U.C.N. 1980. *World Conservation Strategy: Living Resource Conservation for Sustainable Development.* IUCN/UNEP/WWF, Gland, Switzerland.

IUCN Task Force, 1986. *The IUCN Sahel Report—A Long-Term Strategy for Environmental Rehabilitation.* Conservation for Development Centre, IUCN.

Jarman, M. L. 1986. *Conservation priorities in lowland regions of the fynbos biome.* South African National Scientific Programmes Report 87: 1-53.

Jenkins, M. D. (Ed.) 1986. *An Environmental Profile of Madagascar.* I.U.C.N. Conservation Monitoring Centre, Cambridge.

Jolly, A., Oberlé, P., and Albignac, R. (Eds.) 1984. *Key Environments: Madagascar.* Pergamon Press, Oxford.

Kendall, R. L. 1969. An ecological history of the Lake Victoria Basin. *Ecol. Monogr.* 39: 121-176.

Koechlin, J., Guillaumet, J. L. and Morat, P. 1974. *Flore etvégétation de Madagascar.* Vaduz, Cramer.

Lamprey, H. 1974. The distribution of protected areas in relation to the needs of biotic community conservation in eastern Africa. *Proc. of a Regional Meeting on the Creation of a Coordinated System of National Parks and Reserves in Eastern Africa.* IUCN Publications New Series, Supplementary Paper No. 45.

Leakey, M. 1984. *Disclosing the Past.* Weidenfeld and Nicholson, London.

Letouzey, R. 1968. *Elude phylogéographique du Cameroun.* Lechevalier, Paris.

Livingstone, D. A. 1967. Postglacial vegetation of the Ruwenzori Mountains in Equatorial Africa. *Ecol. Monogr.,* 37: 25-52.

Livingstone, D. A. 1975. Late Quaternary climatic change in Africa. *Ann. Rev. Ecol. Syst.* 6: 249-280.

Lovejoy, T. E. and Oren, D. 1981. The Minimum Critical Size of Ecosystems. In: *Forest Island Dynamics in Man-Dominated Landscapes,* Eds. R. L. Burgess and D. M. Sharpe, pp 7-13, Springer, New York.

Luxmoore, R. 1985 Game farming in South Africa as a force in conservation *Oryx.* XIX/4: 225-231.

Luxmoore, R. A., Barzdo, J. G., Broad, S. R. and Jones, D. A. 1985. *A Directory of Crococodihan Farming Operations.* I.U.C.N.

MacArthur, R. H. and E. O. Wilson, 1967. *The Theory of Island Biogeography.* Princeton University Press, Princeton, New Jersey.

MacKinnon, J. 1976. Mountain Gorillas and Bonobos. *Oryx.* XIII/4: 372-382.

MacKinnon, J. 1978. *The Ape Within Us.* Collins, London.

MacKinnon, J. 1985. Forming an Island Fauna Data Base. *World Birdwatch* 7(2).

McNeely, J. A. and Miller, K. R. 1983. IUCN, National Parks, and Protected Areas: Priorities for Action. *Environmental Conservation.* 10/1:13-21.

McNeely, J. A. and Miller, K. R. (Eds.) 1984. *National Parks, Conservation and Development. The Role of Protected Areas in Sustaining Society.* IUCN and Smithsonian Inst.

McVean, D. N., 1977. *Nature Conservation in Lesotho, Report on Current Progress and Forward Planning.* International Union for Conservation of Nature and Natural Resources, Morges.

Malpas, R. C. and Infield, M. M., 1982. *The Mgaghinga Forest and Gorilla Game Reserves, Uganda.* World Wildlife Fund/ I.U.C.N.

Marsh, C. 1976. *A Management Plan for the Tana River Game Reserve, Kenya.* New York Zoological Society/ University of Bristol.

Martin, E. B. 1983. *Rhino Exploitation.* World Wildlife Fund, Hong Kong.

Martin, E. B. 1985. Rhinos and daggers: a major conservation problem. *Oryx* XIX: 198-201.

Martin, P. S. 1966. Africa and Pleistocene overkill. *Nature.* 212: 339-342.

Matthiessen, P. & Douthwaite B. 1985. The impact of tsetse fly control campaigns on African wildlife. *Oryx* XIX: 202-209.

Meester, J. A. J. 1976. *South African Red Data Book-Small Mammals.* South African National Scientific Programmes Report No. 11.

Meggers, B. J., Ayensu, E. S., Duckworth, W. D. (Eds). 1973. *Tropical forest ecosystems in Africa and South America: A Comparative Review.* Smithsonian Inst.

Ministere de l'Agriculture et des Eaux et Foreêts, Republique de Cote d'lvoire, 1985. *Les Parcs Nationaux de Cote d'lvoire.* Abidjan.

Monod, T. 1963. Aprés Yangambi (1956). Notes de phytogeographie africaine. *Bull IFAN,* ser. A, 25p. 594-619.

Moreau, R. E., 1966. *The Bird Faunas of Africa and its Islands.* Academic Press, New York.

Myers, N. 1975. *The Cheetah Acinonyx jubatus in Africa.* IUCN Monograph No. 4. I.U.C.N., Morges.

Myers, N. 1976. *The Leopard Panthera pardus in Africa.* IUCN Monograph No. 5. I.U.C.N., Morges.

Myers, N. 1980. *Forest Refugia and Conservation in Africa—With Some Appraisal of Survival Prospects for Tropical Moist Forests Throughout the Biome.* Symposium. ms, Nairobi.

Newby, J. E., 1982. *Avant-Projet de Classement d'Une Aire Protégée dans l'Aïr et le Ténéré: La Reserve Naturelle Nationale de l'Aïr et du Ténéré.* I.U.C.N. / World Wildlife Fund.

Newby, J. E., 1974. *The Ecological Resources of the Ouadi Rime-Ouadi Achim Faunal Reserve.* UNDP/ FAO.

Oates, J. F., 1983. *Conservation of Rain-Forest Wildlife in Sierra Leone.* Application to the New York Zoological Society, New York.

Oates, J. F., 1986. *Action Plan for African Primate Conservation:* 1986-90. IUCN/SSC Primate Specialist Group.

O'Connor, S., Pidgeon, M. and Randria Z., 1986. Conservation Programme for the Andohahela Reserve, Madagascar. *Primate Conservation* 7:48-52.

Odera J. A. 1984. *Forestry Research for Development of Natural Forests and Indigenous Species in Kenya.* Forestry Research Department, Kenya Agricultural Research Institute.

Okula, J., 1979. *1979 Elephant Report, Waza National Park – Kalamaloue National Park.* Cameroun Bureau de Tourisme, Garoua.
Oliver, R. & Crowder, M. 1981. *The Cambridge Encyclopedia of Africa.* Cambridge University Press, Cambridge.
Olivier, R. 1983. Mali Elephants Suffer in Drought. *African Elephant and Rhino Group Newsletter* 2: 14-15.
Osmaston, H. A. 1965. *The past and present climate and vegetation of Ruwenzori and its neighbourhood.* D. Phil. thesis, Oxford Univ.
PADU/IUCN 1986. *IUCN Directory of Afrotropical Protected Areas.* Conservation Monitoring Centre, IUCN.
PeaceCorps/CentralAfricanRepublic,1980.*ProjectProposalforManagementandResearchinManovo-Gounda-St.FlorisNationalPark.*
Phillipson, J. 1978. *Wildlife Conservation and Management in Sierra Leone.* The British Council.
Pielou, E. C. 1979. *Biogeography.* Wiley-Interscience, New York.
Pinhey, E. 1982. *Preliminary List of Little Known or Vanishing Afrotropical Odonata.* Reports of the Odonata Specialist Group, IUCN, 2.
Plotkin, M., Randrianasolo, V., Sussman, L., and Marshall, N. 1985. *Ethnobotany in Madagascar.* A Report on Conservation Priorities to I.U.C.N. /W.W.F.
Poorter, E. and Zwarts, L. 1983. *Resultats d'une première mission ornitho-écologique de l'UICN/WWF en Guinée-Bissau.* I.U.C.N. / World Wildlife Fund.
Pratt, D. J., Greenway, P. J. & Gwynne, M. D. 1966. A classification of East African rangeland, with an appendix on terminology. *J. appl. Ecol.,* 3, p. 369-82. with 3 maps 1:3000000.
Purseglove, J. W. 1974. *Tropical Crops: Dicotyledons.* Longman.
Purseglove, J. W. 1975. *Tropical Crops: Monocotyledons.* Longman Group, Ltd., London.
Rabesandratana, R. 1984 Flora of the Malagasy SouthWest. In: *Madagascar,* Eds. A. Jolly, P. Oberlé and R. Albignac. Pergamon Press.
Richards, P. W. 1952. *The Tropical Rain Forest.* Cambridge University Press.
Richards, P. W. 1973. Africa, the "Odd Man Out". In: *Tropical forest ecosystems in Africa and South America* , Eds. B. J. Meggers, E. S. Ayensu and W. D. Duckworth, Smithsonian Inst.
Richardson, S. D. 1970. Gene pools in forestry. In: *Genetic resources in plants.* Eds O. H. Frankel and E. Bennett, London.
Richter, W. von. 1977. *The National Parks and Game Reserve System of Botswana.* FAO Project BOT 72/020. Field Document 3. F. A. O., Rome.
Rijksen, H. D. 1977. Origins of Hunting in Hominids. In *Proc. 6th Int. Congr. Primal.* Academic Press, London.
Robertson, I. J. M. 1970. *Awash National Park Working Plan 1970-1975.*
Rodgers, W. A. and Homewood, K. M., 1982. Species richness and endemism in the Usambara mountain forests, Tanzania. *Biological Proc. of the Linnean Society.* 18: 197-242.
Rodgers, W. A., Hall, J. B., Mwasumbi, L. B., Griffiths, C. J. and Vollesen, K., 1983. *The Conservation Values and Status of Kimboza Forest Reserve, Tanzania.* Forest Conservation Working Group, University of Dar es Salaam, Dar es Salaam.
Rodgers, W. A., 1983. *Tanzania Forest Conservation.* Final Report, WWF/IUCN Project No. 3203.
Rosevear, D. R. 1947. Mangrove swamps. *Farm and Forest* 8: 23-30.
Roth, H. H. and Merz, G., 1983. *Conservation of Elephants in Sierra Leone with Special Reference to the Management of the Gola Forest Complex.* Final Report on IUCN/WWF Project No. 3039, Kronberg/Heidelberg.
Saboureau, P. 1959. Propos sur les cyclones et inondations à Madagascar en février et mars 1959. *Bois Forêts Trop.* 67: 3-12.
Saenger, P., Hegerl, E. J. and J. D. S. Davie. 1983. *Global Status of Mangrove Ecosystems.* Commission on Ecology Papers No. 3. IUCN.
Sale, J. B. 1981. *The Importance and Values of Wild Plants and Animals in Africa.* IUCN/UNEP.
Scharff, N., Stoltze, M. and Jensen, F. P., 1981. *The Uluguru Mountains, Tanzania: Report of a Study-Tour.*
Simmonds, M. 1985. The fynbos and the frogs. *Oryx. XIX: 104-108.*
Shantz, H. L. & Turner B. L. 1958. *Photographic documentation of vegetational changes in Africa over a third of a century.* Univ. of Arizona, Coll. of Agriculture.
Simberloff, D. S. 1974. Equilibrium Theory of Island Biogeography and Ecology. *Annual Review of Ecology and Systematics.* 5: 161-182.
Simonetta A. M. and Simonetta, J., 1983. An Outline of the Status of the Somali Fauna and of its Conservation and Management Problems. *Rivista di Agricoltura Subtropicale e Tropicale.* LXXVII/4: 458-483.
Simpson, G. G. 1977. Too many lines: the limits of the Oriental and Australian Zoogeographic regions. *Proc. Am. Philosophical Soc.* 121:102-20.
Sinclair, A. R. E. and Fryxell, J. M. 1985. The Sahel of Africa: ecology of a disaster. *Can. J. Zool.* 63: 987-994.
Skinner, J. D., Fairall, N. and J. du P. Bothma. 1977. *South African Red Data Book – Large Mammals.* South African National Scientific Programmes Report No. 18.
Snow, D. W. 1978. *An atlas of speciation in African non-passerine birds.* British Museum (Natural History), London.
Soulé, M. E. 1983. Applications of Genetics and Population Biology: The What, Where and How of Nature Reserves. In: *Conservation, Science and Society.:* 252-264, UNESCO-UNEP.
Soulé, M. E. and Simberloff, D. 1986. What Do Genetics Tell Us About the Design of Nature Reserves? *Biol. Cons.* 35: 19-40.
Soulé, M. E., B. A. Wilcox and C. Holtby. 1979. Benign neglect: a model of faunal collapse in the game reserves of East Africa. *Biol. Cons.* 15: 259-272.
Spinage, C. A. and Souleymane, T. 1984. *Resume des Aires de Faune Protegee et Propositions.* Working Document 3, Project FO:DP/ UPV/82/008. FAO.
Spinage, C. A. 1986. *Plan Quinquennal Secteur Chasses et Faune 1986-1990, République Centrafricaine.* FAO.
Stewart, C. W. R. 1975. *A Vegetational Survey of the Ouadi Rime-Ouadi Achim Faunal Reserve.* Report to the Direction of National Parks and Faunal Reserves of Chad.
Stuart, S. N. (Ed.) 1986. *Conservation of Cameroon montane forests.* International Council for Bird Preservation, Cambridge.
Stuart, S. N. (in press). Biogeographic Theory and Conservation Practice in Eastern Africa. Proc. I. O. C.
Struhsaker, T. T. 1981. Forest and primate conservation in East Africa. *J. Afr. Ecol.* 19: 99-114.
Susman, R. L. and Badrian, N. 1983. *Conservation of Wild Pygmy Chimpanzees (Pan paniscus) in the Lomako Forest of Central Zaire.* Project proposal.
Tattersall, I. 1977. Lemurs of the Comoros. *Oryx* XIII, 5: 445-448.

Teleki, G. and Baldwin, L. 1980. *Provisional List of Fauna for Sierra Leone: 1980 Wildlife Survey Project.*
Teleki, G. and Baldwin, L. 1981. Sierra Leone's Wildlife Legacy: Options for Survival, *Zoonooz.* Oct 81: 21-31.
Tello, J. 1986. *Survey of Protected Areas and Wildlife Species in Mozambique with recommendations for strengthening their conservation.* Report to WWF, Gland, Switzerland.
Terborgh, J. 1974. Preservation of natural diversity: the problem of extinction prone species. *BioScience* 24: 715-722.
Terborgh, J. 1975. Faunal equilibria and the design of wildlife preserves. In : *Trends in Tropical Ecology,* Academic Press, New York: 369-380.
Thomas, D. B. & Pratt, D. J. 1967. Bush-control studies in the drier areas of Kenya. IV. Effects of controlled burning on secondary thicket in upland *Acacia* woodland. *J. appl. Ecol.,* 4, p. 325-35.
Thompson, K. 1976. Swamp development in the head waters of the White Nile. In: *The Nile: Biology of an ancient river.* Ed. J. Rzoska, Junk, The Hague.
Thornback, J. 1984. *The Mammals of Africa, A Preliminary List.* IUCN Conservation Monitoring Centre.
Tinley, K. L. 1985. *Coastal Dunes of South Africa.* South African National Scientific Programmes Report No. 109.
Tucker, C. J., Townshend, J. R. G., and Goff, T. E. 1985. African land-cover classification using satellite data. *Science.* 227/4685: 369-228.
Tutin, C. and Fernandez, M. 1983. *Recensement des Gorilles et des Chimpanzes du Gabon.* Centre International de Recherches Medicales de Franceville, Franceville.
Tutin, C. E. G. and Fernandez, M. 1984. Nationwide Census of Gorilla (Gorilla g. gorilla) and Chimpanzee (Pan t. troglodytes) Populations in Gabon. *American Journal of Primatology.* 6:313-336.
Tyson, P. D. 1978. Rainfall changes over South Africa during the period of meteorological record. In: *Biogeography and ecology of Southern Africa,* Ed. M. J. A. Werger, 53-69.
Udvardy, M. D. F. 1975. A classification of the biogeographical provinces of the world. *IUCN Occ. Pap.,* 18, p. 1-48.
Udvardy, M. D. F. 1984. A Biogeographical Classification System for Terrestrial Environments. In: *National Parks, Conservation and Development,* Eds. J. A. McNeely and K. R. Miller, Smithsonian Institution.
U.N.E.P. /F. A. O. 1982. *The Global Assessment of Tropical Forest Resources.* GEMS PAC Information Series No. 3, Nairobi.
U.N.E.P. /I.U.C.N. 1983. *La Repartition des Aires Protegees en Fonction des Besoins de la Conservation des Communautés Biotiques de L'Afrique Centrale et de l'Ouest.* I.U.C.N.
U.N.E.P. 1984. *Marine and coastal conservation in the East African region.* UNEP Regional Seas Reports and Studies No. 39.
VanOrsdol, K.G. 1982. *The Status of Kibale Forest Reserve of Western Uganda and Recommendations for its Conservation and Management.* Kibale Forest Project, Fort Portal.
Verschuren, J. 1976. *Conservation de la Nature et Parcs Nationaux au Burundi.* Institut Royal des Sciences Naturelles de Belgique, Bruxelles.
Verschuren, J. 1983a. *Conservation of Tropical Rain Forest in Liberia: Recommendations for Wildlife Conservation and National Parks.* I.U.C.N. / World Wildlife Fund, Gland.
Verschuren, J. 1983b. *République Islamique de Mauritanie Parc National du Banc d'Arguin: Plan Directeur Préliminaire.* World Wildlife Fund / I.U.C.N., Gland.
Walter, H. 1936. Die ökologischen Verhaltnisse in der Namib-Nebelwuste (Sudwestagrica) unter Auswertung der Aufzeichnungen des Dr. G. Boss (Swakopmund). *Jb. wiss. Bot.,* 84: 58-222.
Walter, H. 1954. Die Verbuschung, eine Erscheinung der subtropischen Savannengebiete, und ihre ökologischen Ursachen. *Vegetatio,* 5-6, p. 6-10.
Weber, A. W. and Vedder, A. 1983. Population Dynamics of the Virunga Gorillas: 1959-1978. *Biol. Conserv..* 26: 341-366.
Western, D. 1984. Amboseli National Park: Human values and the Conservation of the Savanna Ecosystem. In: *National Parks, Conservation and Development.* Eds J. A. McNeely and K. R. Miller, IUCN and Smithsonian Inst.
Western, D. and Vigne, L. 1984. The status of rhinos in Africa. *Pachyderm.* African Elephant and Rhino Group Newsletter 4.
Western, D. & Vigne, L. 1985. The deteriorating status of African rhinos. *Oryx* XIX: 215-220
White, F. 1978. The Afromontane Region. In: *Biogeography and ecology of Southern Africa,* Ed. M. J. A. Werger, 463-513. Junk, The Hague.
White F. 1981. The history of the Afromontane archipelago and the scientific need for its conservation. *Afr. J. Ecol.,* 1:33-54. Oxford.
White, F. 1983. *The Vegetation of Africa: A descriptive memoir to accompany the Unesco/AETFAT/UNSO vegetation map of Africa.* Unesco, Paris.
White, F. 1983b. Long-Distance Dispersal and the Origins of the Afromontane Flora. *Sonderbd. naturwiss. Ver. Hamburg.* 7: 87-116.
Whitlow, R. 1984. The study of vegetation in Africa: a historical review of problems and progress. *Singapore Journal of Tropical Geography.* 5/1: 88-101.
Wilcox, B. A. 1984. In Situ Conservation of Genetic Resources: Determinants of Minimum Area Requirements. In: *National Parks, Conservation and Development.* Eds J. A. McNeely and K. R. Miller. IUCN and Smithsonian Inst. Press.
Williams, J. G. 1981. *A Field Guide to the National Parks of East Africa.* Collins, London.
Williams, J. G. and Arlott N. 1980. *A Field Guide to the Birds of East Africa.* Collins, London.
Wilson, E. O. and Willis E. O. 1975. Applied biogeography. In: *Ecology and evolution of communities,* Eds M. J. Cody and J. M. Diamond: 522-34
Wolfheim, J. H. 1983. *Primates of the World: Distribution, Abundance and Conservation.* Harwood Academic, Switzerland.
World Wildlife Fund, 1985. *W. W. F. Africa Programme 1986-90.* Discussion Documents for Africa Programme Meeting, 18 June 1985, Gland.
Yeoman, G. 1985. Can the Rwenzori be saved? *Swara.* 8(3): 8-12. East African Wildlife Society.
Young, T. P. 1983. *Kenya's Indigenous Forests, Status, Threats, and Prospects for Conservation Action.* A report to the WWF/IUCN Eastern Africa Regional Office.
Zinderen Bakker, E. M. Van, 1964. A pollen diagram from equatorial Africa, Cherangani, Kenya. *Geol. Mijnbouw* 43: 123-128.

Prepared by IUCN in collaboration with the
United Nations Environment Programme.
A contribution to GEMS - the Global Environment
Monitoring System.

This book is part of
THE IUCN CONSERVATION LIBRARY

For a free copy of the complete catalogue please write to:
IUCN Publications Services,
219c Huntingdon Road, Cambridge CB30DL, UK
or Avenue du Mont-Blanc, CH-1196 Gland, Switzerland