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CONSERVATION AND MANAGEMENT  
OF  
TROPICAL FORESTS AND BIOLOGICAL DIVERSITY IN ZAIRE

USAID/Kinshasa

1988

Prepared By:

Jeff Goodson

Regional Science & Technology Advisor  
REDSO/WCA

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## EXECUTIVE SUMMARY

This analysis was prepared pursuant to Sects. 118 and 119 of the U.S. Foreign Assistance Act, requiring USAID missions to prepare assessments of the actions necessary to achieve conservation and management of tropical forests and biological diversity and to evaluate the extent to which actions proposed by the Agency meet those needs (Sct. 10).

Zaire is of extreme global importance from both the tropical forest and biological diversity perspectives. It contains about half of all true tropical forests found in Africa and about 10% of all those remaining in the world. Worst-case calculations suggest that at least 87.6% of all original forest in Zaire remains, and that the prevailing deforestation rate is a low to extremely low 0.15-0.50%/yr. While solid quantitative substantiation of these figures is unavailable, the deforestation situation in Zaire is clearly one of the 'least bad' found anywhere in the world (Sct. 9.4).

As in most of the rest of Africa, deforestation is primarily attributable in Zaire to smallholder agriculture. Worst-case calculations suggest that deforestation attributable to smallholder agriculture as of about 1985, however, was roughly equivalent to the amount of deforestation probably occurring in Zaire due to natural treefall (Sct. 9.4). A very low overall national population size in relation to Zaire's natural resources exists, moreover, and extremely low rural population densities prevail throughout most of the country. Net rural growth rates are only about 1.3%/yr nationwide, and the two megatrends of rural-urban migration and movement from the agricultural to other employment sectors can be expected to indirectly slow the loss of biological resources by slowing growth in the number of smallholder farmers primarily responsible for deforestation (Sct. 4.0).

Zaire is also one of six countries which may collectively contain over half the world's biota. This is attributable to its large size, the diversity of terrestrial vegetation and aquatic habitats, long periods of relative stability, prolonged periods of isolation, and the presence of centers of particularly high endemism. Somewhat poorer in species richness than other tropical areas outside of Africa, Zaire nonetheless contains an extreme diversity of vegetation types and very high numbers of species and endemic taxa (Sct. 8.0). While the flora and fauna remain very poorly known, particularly the lower plants and invertebrates, there are 82 currently-listed threatened or endangered species in Zaire. Most are mammals and birds (no plants are listed), but there are probably thousands of other undocumented species just as rare (Sct. 6.0).

Eight existing national parks cover 3.6% and 2 proposed parks 1.0% of the country, including the largest tropical forest park in the world. The park system includes examples of most biotic communities and vegetation types found in Zaire and probably contains nearly all of the listed endangered species. The extent to which this system includes representative areas of sufficient size to protect those resources under a best case management scenario, however, cannot be conclusively evaluated at the present time due to data limitations. The most important park-related problems are insufficient trained human and inadequate economic resources to control pressures on these parks' resources. Other reserves include 3 UNESCO Biosphere Reserves, 117 forest reserves, 57 hunting reserves and 5 nature reserves. These in total cover about 0.5% of the country, but most have no legislative protection and many have been abandoned or are essentially unprotected (Sct. 5.0).

Ex-situ conservation activities in Zaire are extremely limited with the possible exception of agriculturally-related species, and are not expected to play a major role in biological resource conservation in the near future (Sct. 7.0).

The GOZ has clearly demonstrated its concern for conservation of forests and biological diversity. It is a signatory to all or most major international treaties and agreements germane to biological resource conservation, and basic legislative and institutional structures exist to effect such conservation. Legislative weaknesses include lack of post-independence legislation protecting hunting, forest and Biosphere Reserves, and, in spite of a genuine commitment to legislatively-mandated responsibilities, institutional weaknesses include limited numbers of trained professionals and especially a lack of economic resources to carry out those responsibilities (Sct. 2.0).

At least 39 NGO's work directly or indirectly with conservation-related activities throughout Zaire, but there are considerable gaps in information available on their activities. The bilateral and multilateral donor communities are also actively involved directly and indirectly with biological conservation. The EEC, UN, IUCN, WWF, Canada, West Germany and Belgium appear to play the greatest direct roles, while the World Bank and USAID play largely indirect roles. A significant increase in assistance from these organizations and in the role of the private sector will probably be required to effectively conserve Zaire's biological resources in the long term (Scts. 2.0, 8.0).

Development activities affect biological resources throughout Zaire. Timber resources are vast, ranking second in the world, but total production is only a few percent of its potential because of general resource inaccessibility, poor transportation infrastructure and very high transportation costs. Mining is concentrated in four areas in southern and eastern Zaire, hydroelectric operations near the capital and in southern and eastern Zaire, petroleum production just offshore, and ancillary manufacturing in the southeast, near the capital and to some extent in the southcentral and eastern portions of Zaire. Major activities funded by 22 donors include 35 agricultural, 4 mining and 2 hydroelectric projects distributed throughout the country. The impact of these on biological resources is extremely variable, having both positive and adverse effects, but with a few notable exceptions they are considered by

the preparer to be neither major contributors to nor major factors inhibiting biological resource conservation (Sct. 8.0).

There is no systematic, institutionalized project environmental review system or related legislation in Zaire, but existing legal instruments establish institutional responsibilities for taking into account the environmental impacts of projects and establishing such a system would probably not accomplish a great deal in real terms at the current time. Most multilateral and bilateral donors conduct some level of project environmental review at some stage of the project cycle, although there are notable exceptions. The best systems are those of the World Bank, insofar as it's wildland policy is concerned, and USAID which has a longstanding institutionalized system (Sct. 8.3).

Major outstanding issues related to biological conservation in Zaire include 1) the geographical and ecological adequacy of the protected area system in terms of its representative coverage of biotic communities; 2) protected area management; 3) fuelwood consumption and the urban halo effect; and 4) prevailing deforestation extents and rates (Sct. 9.0).

Immediately pressing constraints to effective conservation and management of tropical forests and biological diversity in Zaire are considered by the preparer to include: 1) lack of economic resources to protect those conservation areas already established within the national reserve system; 2) insufficient well-trained technical and managerial personnel in principal GOZ institutions; and 3) lack of sufficient basic technical information on which to objectively and scientifically base establishment of conservation priorities. In the short to mid-term, and while limited funds and human resources should focus on the national park system and management of specific associated hunting reserves, specific additional recommendations for the GOZ, donor and NGO organizations in the near future are prioritized here as follows (Sct. 10.0):

1) Establishment of a donor coordination committee to evaluate conservation intervention alternatives, identify and mobilize resources for conservation activities, and advise on ways to effectively focus limited human and economic resources in the conservation sector;

2) Basic national vegetational mapping from satellite imagery, and establishment of quantitatively confirmable statistics on biotic communities;

3) Establishment of an institutionalized system for identifying gaps in the representation of significant biotic community types in the national protected area system;

4) A study of the practicality of increasing the role of the private commercial sector in management of select national parks and hunting reserves;

5) Basic vegetational and biotic system inventory work and research on the composition of biotic communities;

6) Development of more precise information on the conservation activities of NGO's and PVO's;

7) Generation of specific legislation related to the formal protection of hunting reserves, and legislative guidelines permitting management and use of such reserves by the private sector; and

8) Expanded public conservation education.

While the effect of USAID programs on tropical forest and biological diversity conservation and management are primarily indirect, the Agency also undertakes limited activities which directly contribute to such conservation both at the

mission and bureau levels. There exist nonetheless potential low cost/low management-intensive activities which could further meet the needs identified and which could be conducted within the existing sectoral and geographical foci of the USAID/Zaire program and within USAID/Zaire's existing project portfolio (Sct. 10.2).

## Table of Contents

Title Page  
Disclaimer  
Executive Summary  
Table of Contents  
List of Tables  
List of Figures  
List of Acronyms  
List of Contract Assessments

<u>Section</u>	<u>Page</u>
1.0 <u>INTRODUCTION</u>	1-1
2.0 <u>LEGISLATIVE STRUCTURES AND INSTITUTIONAL RESOURCES AFFECTING CONSERVATION IN ZAIRE</u>	2-1
2.1 LEGISLATIVE STRUCTURES	2-1
2.1.1 <u>International Treaties and Agreements</u>	2-1
2.1.2 <u>Host Country Legislation</u>	2-3
2.2 INSTITUTIONAL RESOURCES	2-5
2.2.1 <u>Government of Zaire</u>	2-5
2.2.2 <u>Non-governmental Organizations</u>	2-9
2.2.3 <u>International Organizations</u>	2-11
3.0 <u>BIOGEOPHYSICAL AND ECOLOGICAL OVERVIEWS</u>	3-1
3.1 BIOGEOPHYSICAL OVERVIEW	3-1
3.2 ECOLOGICAL OVERVIEW	3-3
3.2.1 <u>Vegetation</u>	3-6
3.2.2 <u>Fauna</u>	3-9
4.0 <u>HUMAN GEOGRAPHY</u>	4-1
4.1 BASIC RELEVANT NATIONAL STATISTICS	4-1
4.2 AGRICULTURE AND ANCILLARY ACTIVITIES IN ZAIRE	4-4
4.2.1 <u>Agriculture</u>	4-4
4.2.2 <u>Hunting and Fishing</u>	4-6
4.2.3 <u>Livestock</u>	4-7
4.3 INDUSTRY IN ZAIRE	4-7

<u>Section</u>	<u>Page</u>
<b>5.0 <u>STATUS AND MANAGEMENT OF PROTECTED AREAS</u></b>	<b>5-1</b>
5.1 NATIONAL PARKS	5-2
5.2 BIOSPHERE RESERVES	5-5
5.3 NATURE RESERVES	5-6
5.4 FOREST RESERVES	5-6
5.5 HUNTING RESERVES	5-7
5.6 SAFEGUARDED AREAS	5-8
5.7 AREAS PROPOSED FOR PROTECTION	5-8
<b>6.0 <u>STATUS OF ENDANGERED AND PROTECTED SPECIES</u></b>	<b>6-1</b>
6.1 ANIMAL SPECIES	6-1
6.2 PLANT SPECIES AND BIOTIC COMMUNITIES	6-3
6.3 CONSERVATION PRIORITIES	6-4
<b>7.0 <u>EX-SITU CONSERVATION</u></b>	<b>7-1</b>
7.1 BOTANICAL ACTIVITIES	7-2
7.2 ZOOLOGICAL ACTIVITIES	7-4
<b>8.0 <u>DISTRIBUTION OF DEVELOPMENT PROJECTS IN THEIR REGIONAL CONTEXT</u></b>	<b>8-1</b>
8.1 PROJECT AND REGIONAL RESOURCE DISTRIBUTION	8-2
8.1.1 <u>Bas-Zaire</u>	8-2
8.1.2 <u>Bandundu</u>	8-3
8.1.3 <u>Equateur</u>	8-4
8.1.4 <u>Haut-Zaire</u>	8-4
8.1.5 <u>Kivu</u>	8-5
8.1.6 <u>Kasai-Orientale</u>	8-6
8.1.7 <u>Kasai-Occidentale</u>	8-7
8.1.8 <u>Shaba</u>	8-7
8.2 HOST COUNTRY AND DONOR ENVIRONMENTAL REGULATIONS	8-8
8.2.1 <u>Government of Zaire</u>	8-8
8.2.2 <u>Multilateral Donors</u>	8-9
8.2.3 <u>Bilateral Donors</u>	8-12

<b>9.0</b>	<b><u>MAJOR ISSUES IN BIOLOGICAL DIVERSITY AND FOREST CONSERVATION</u></b>	<b>9-1</b>
9.1	PROTECTED AREA REPRESENTATION	9-1
9.2	PROTECTED AREA MANAGEMENT	9-2
9.3	FUELWOOD CONSUMPTION AND THE URBAN HALO EFFECT	9-5
9.4	DEFORESTATION EXTENT AND RATE	9-8
<b>10.0</b>	<b><u>RECOMMENDATIONS AND PROPOSED ACTIONS</u></b>	<b>10-1</b>
10.1	ACTIONS NECESSARY TO ACHIEVE CONSERVATION AND SUSTAIN- ABLE MANAGEMENT OF TROPICAL FORESTS AND BIOLOGICAL DIVERSITY IN ZAIRE	10-1
10.2	EXTENT TO WHICH ACTIONS PROPOSED FOR SUPPORT BY THE AGENCY MEET THE NEEDS IDENTIFIED TO ACHIEVE CONSERVA- TION OF BIOLOGICAL RESOURCES	10-3
References Cited		R-1
Biodata of the Préparer		B-1

List of Tables

<u>Table</u>		<u>Page</u>
2-1	SUMMARY OF NGO CONSERVATION-RELATED ACTIVITIES IN ZAIRE	2-14
2-2	SUMMARY OF PRINCIPAL CONSERVATION-RELATED PROJECTS OF INTERNATIONAL AND OTHER DONOR ORGANIZATIONS IN ZAIRE	2-16
3-1	TAXONOMIC COMPARISON, AFRICA, THE NEOTROPICS AND INDO-MALAYSIA	3-14
3-2	NEWLY DISCOVERED TAXA FROM ZAIRE, CA. 1974-1987	3-17
3-3	VEGETATION OF ZAIRE	3-18
3-4	PERCENT BREAKDOWN OF VEGETATIONAL STRUCTURE IN ZAIRE BY VEGETATION TYPE	3-23
3-5	PERCENT BREAKDOWN OF NATURAL VEGETATIONAL STRUCTURE IN ZAIRE BY ADMINISTRATIVE REGION	3-24
4-1	BASIC NATIONAL STATISTICS RELEVANT TO THE CONSERVATION AND MANAGEMENT OF TROPICAL FORESTS AND BIOLOGICAL DIVERSITY IN ZAIRE	4-12
4-2	BASIC REGIONAL AREA AND URBAN POPULATION STATISTICS FOR ZAIRE	4-16
4-3	URBAN AND NON-URBAN POPULATION DATA (km <sup>2</sup> )	4-17
4-4	BASIC TRADITIONAL FARM DATA FOR ZAIRE	4-18
4-5	AGRICULTURAL PRODUCTION, SELECTED COMMODITIES, 1972	4-19
5-1	BASIC DATA, PROTECTED AREAS OF ZAIRE	5-12
6-1	RARE, THREATENED, ENDANGERED AND PROTECTED SPECIES OF ZAIRE	6-6
6-2	PRINCIPAL HABITAT PREFERENCES OF RARE, THREATENED AND ENDANGERED ANIMAL SPECIES IN ZAIRE	6-14
8-1	REGIONAL DISTRIBUTION OF MAJOR DONOR-SUPPORTED PROJECT COMPONENTS HAVING AN IMPACT ON THE ENVIRONMENT IN ZAIRE	8-15
8-2	SURVEY OF VEGETATION TYPES AND MAJOR PROJECTS BY REGION	8-16
9-1	SUMMARY OF AVAILABLE DATA ON THE URBAN DEFORESTATION HALO EFFECT IN ZAIRE	9-13

List of Figures

<u>Figure</u>		<u>Page</u>
3-1	THE VEGETATION OF ZAIRE, RWANDA AND BURUNDI	3-13
4-1	GEOGRAPHICAL DISTRIBUTION OF POPULATION DENSITY IN ZAIRE	4-11
5-1	GEOGRAPHICAL DISTRIBUTION OF MAJOR PROTECTED AREAS IN ZAIRE	5-11

### List of Acronyms

ACCZ.	Association des Conducteurs de Chariots au Zaïre.
ACFZa.	Association des Cultivateurs et Fermiers du Zaïre.
AFDB.	African Development Bank.
AGF.	Appui aux Gestions Forestières.
ANEZA.	Association Nationale des Entrepreneurs du Zaïre.
APRODEC.	Association Pour la Promotion du Développement Endogène des Communautés.
BEAU.	Bureau d'Etudes d'Aménagement et d'Urbanisme
BOZ.	Bank of Zaïre.
C.	Centigrade
CAPADER.	Centre d'Animation et d'Encadrement Pilote pour L'Action du Développement Rural.
CAR.	Central African Republic.
CATEB.	Centre d'Adaptation des Techniques en Energie du Bois.
CDD.	Commission Diocésaine Pour le Développement.
CDDAK.	Commission Diocésaine de Développement et de l'Archdiocèse de Kananga.
CEDECO.	Centre de Développement Communautaire de Kimpese.
CEP.	Centre d'Encadrement des Paysans.
CEPC.	Centre d'Exécution des Programmes Communautaires.
cfs.	Cubic feet per second.
CITES.	Convention on International Trade in Endangered Species.
CMB.	Commission de la Mercuriale du Bois.
COI.	Commission on Investments.
COOFAB.	Coopérative des Fabricants de Braïse.
COOPRODIT.	Cooperative de Production et de Distribution Tropicale.
CPB.	Le Centre de Promotion du Bois.
DAFECN.	Département des Affaires Foncières, Environnement et Conservation de la Nature.
DGRNR.	La Direction des Ressources Naturelles Renouvelables.
DOP.	Department of Plan.
DPFRI.	La Direction de la Programmation, Formation et Relations Internationales.
DPP.	Développement Progrès Populaire.
DSDEK.	Département Social et Développement de l'Eglise de Kimbanguiste.
EC.	Executive Council of the GOZ.
EEC.	European Economic Community.
ERTS.	Etude des Ressources Terrestres par Satellite.
FED.	Fonds Européen de Développement.
FIS.	Fondation Internationale pour la Science (Stockholm).
FRCP.	Fonds de Reconstitution du Capital Forestier.
FUCID.	Belgian NGO represented at the Department of Biology at the University of Kinshasa.
FZS.	Frankfurt Zoological Society.
GEAFA.	Groupe d'Etudes et d'Assistance en Gestion des Affaires.

**GECAMINES.** Générale des Carrières et des Mines.  
**GENAGRO.** Gestion Environnement Agronomique.  
**GTER/EDC.** Groupe Technique d'Encadrement Régional/Eglise de Christ.  
**GOZ.** Government of Zaire.  
**HRDA.** Human Resources Development for Africa - AID/Project.  
**IBPGR.** International Board of Plant Genetic Resources.  
**IBRD.** International Bank for Reconstruction and Development  
 (The World Bank).  
**IJZBZ.** Institut des Jardins Zoologiques et Botaniques du Zaire.  
**INERA** Institut National de Recherche Agronomique  
**IUCN.** International Union for the Conservation of Nature and  
 Natural Resources.  
**IZCN.** Institut Zairois pour la Conservation de la Nature.  
**km.** Kilometer(s).  
**km2.** Square kilometers.  
**m.** Meter(s).  
**m3.** Cubic meters.  
**mm.** Millimeters.  
**MAB/Zaire.** Man and the Biosphere Program/Zaire (UNESCO).  
**MPR.** Mouvement Populaire de la Revolution.  
**NP.** National Park.  
**NYZS.** New York Zoological Society.  
**OAU.** Organization of African Unity.  
**OZAC.** Office Zairois de Contrôle.  
**PAA.** Projet Agricole-Apicole, Armée du Salut.  
**PARC.** Projet d'Appui au Reboisement Communautaire.  
**P.I.P.** Priority Investment Program of the GOZ.  
**PRD/MM.** Projet Rural Diocésain/Mbuji-Mayi.  
**PRI.** Promotion Rurale d'Isangila.  
**PRODAF.** Projet de Développement Agricole et Forestier de Kibunzi.  
**PROFER.** Service de la Promotion Féminine Rurale.  
**PSS.** Presidential Studies Service  
**RAMSAR.** Convention relative to coastal zones of international  
 importance, especially as habitat to wild animals; name  
 derives from the Iranian town where the convention was  
 adopted.  
**REDSO/WCA.** USAID Regional Economic Development Services Office for  
 Central and West Africa.  
**SNR.** Service National de Reboisement.  
**SODIMIZ.** Société de Développement Industriel et Minier du Zaire.  
**SPIAF.** Service Permanent d'Inventaire et d'Aménagement Forestier.  
**TTD.** Teledetection Technical Division.  
**UN.** United Nations.  
**UNDP.** United Nations Development Program.  
**UNESCO.** United Nations Environmental, Social and Cultural  
 Organization.  
**UNFAO.** United Nations Food and Agriculture Organization.  
**UNICEF.** United Nations Children's Education Fund  
**UNIDO.** United Nation Industrial Development Organization

UNIPAZA. Union Paysane du Zaire.  
UPEBAZ. Union des Planteurs et Eleveurs du Bas-Zaire.  
UPPFL. Union des Pisciculteurs, Planteurs, et Fermiers de  
Lukonga-Luozi.  
USAID. United States Agency for International Development.  
USDOI. United States Department of Interior.  
VJAPROD. Volontaires Unis dans l'Action pour le Progrès et le  
Développement.  
WWF. World Wildlife Fund.  
yr. Year.

## List of Contract Assessments

The following background assessments, funded by USAID/Zaire, were prepared as background material to assist with preparation of this analysis and are available in the files of the USAID Mission in Kinshasa, Zaire.

"Legislation en Vigeur au Zaire en Matiere de Conservation de la Nature." (IZCN).

"Cadre Institutionnelle de la Conservation de la Nature au Zaire." (IZCN).

"Non-governmental Organizations and Conservation in Zaire." (K. Owen).

"Report on the Activities of International Organizations and National Government Missions in the Area of Conservation and Management of Tropical Forests and Biological Diversity in Zaire." (S. Quick).

"Status of Endangered Species in Zaire." (K. Owen).

"Etude et Evaluation Générale de l'Impact des Projets de Développement de l'Environnement au Zaire." (GEAF).

"Règlementation de l'Impact des Projets sur l'Environnement." (GEAF).

"Agricultural Systems in Zaire." (J. Price).

"Seed Collection Activities and Seed Banks." (I. Picquot).

"Ex-situ Conservation in Zaire." (I. Picquot).

"Les Parcs Nationaux et Reserves Apparentées du Zaire." (IZCN).

## 1.0 INTRODUCTION

"The need for a carefully planned international program of biotic diversity analysis and monitoring in Africa is an urgent priority."

—Brian J. Huntley

This analysis of conservation and management of tropical forests and biological diversity ("biodiversity") in Zaire was prepared to fulfill the requirements of Scts. 118 and 119 of the U.S. Special Foreign Assistance Act (SFAA) of 1986, PL 99-529 (25 October 1986). Those sections require U.S. Agency for International Development (USAID) missions to prepare an analysis of the "the actions necessary to achieve conservation and sustainable management of tropical forests" and "conserve biological diversity," and an analysis of the "the extent to which the actions proposed for support by the Agency meet the needs thus identified."

Tropical forests are defined here on purely ecological grounds to include only closed canopy vegetation types (86)\* with an absence or near absence of grass in the understory which occur between 23.5 degrees north and south latitude. Deforestation is defined here as reduction of canopy cover such that light penetration to the understory is sufficient to permit establishment of a grass stratum, and is taken to include both natural and anthropogenic canopy cover reduction of either a temporary or permanent nature.

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\* Numbers in parentheses throughout this report refer to a list of cited references beginning on p R-1.

Probably the most biologically productive and diverse ecosystems on earth outside of certain coastal and marine systems (77), the association of tropical forests with biodiversity is predicated on the assumption that while such forests cover only about 7% of the earth's surface they contain over half of all species in the entire world biota (98). The rationale for their conservation on economic, medical and certain other grounds in addition to purely biological considerations is strong. Active work in chemical screening of Zairean plants, for example, has recently been conducted for alkaloids, triterpenoids, saponins, flavonoids, tannins, steroids, hemoanthocyanes and quinones as well as natural insecticides and a range of medicinal applications including for the treatment of leprosy, respiratory illness, malaria, febrifugal illness, staphylococcus, venereal disease and general medical applications.

Zaire's specific importance from both the tropical forest and biodiversity perspectives has gradually come to assume greater worldwide importance in recent years for three main reasons. The first is the continued existence of large and relatively unimpacted forest blocks in the country. Tropical forests are believed to have formerly covered about 53% of Zaire, comprising about 47% of all such forest found on the African continent (87,99; Sct. 9.4) and about 10% of the estimated 11,020,000 km<sup>2</sup> of such forests remaining worldwide (49). Indeed, Zaire ranks third worldwide in terms of forest areal extent (36). The second reason is the relatively low deforestation rates prevailing in Zaire in comparison to most other rain forest areas in the world (76). Zaire's current deforestation rate is estimated at only about 0.15-0.50%/yr (Sct. 9.4), vs. a worldwide rate of circa (ca.) 0.63%/yr (49) and published rates in Africa of over 7.0%/yr (Sct. 9.4); clearly, the deforestation situation in Zaire is one of the 'least bad' found anywhere in the world. The third reason is the relatively high level of biological endemism and large number of species occurring within this single country. Zaire is considered one of the six most important countries worldwide with respect to the number of species present (59), containing for example more

genera of primates than any country in the world and ranking second in the number of primate species.

Tropical forest and biodiversity issues, however, are extraordinarily complex and the source of considerable divisiveness among professional ecologists and biogeographers. As an example, the total number of species on Earth is not currently known even to the nearest order of magnitude (98). This analysis must therefore be considered a review of the available literature and an assessment and interpretation of available data as filtered through the field and experiential perspectives of the preparer.

This analysis begins with an assessment of the legislative and institutional structures affecting biological resources (Sct. 2.0), followed by biogeophysical and ecological overviews of baseline conditions in Zaire (Sct. 3.0) and a review of basic relevant human geographical phenomena (Sct. 4.0). This is in turn followed by an assessment of protected areas and endangered species (Scts. 5.0 and 6.0), a review of ex-situ conservation activities (Sct. 7.0), and a general evaluation of development projects as they affect biological resources (Sct. 8.0). A summary of major issues related to tropical forests and biodiversity is found in Sct. 9.0, and recommendations and proposed actions addressing specific concerns of Scts. 118 and 119 of the SFAA are found in Sct. 10.0.

## **2.0 LEGISLATIVE STRUCTURES AND INSTITUTIONAL RESOURCES AFFECTING CONSERVATION IN ZAIRE**

**"With very few exceptions, knowledge of biotic conservation needs and priorities far exceeds the ability of African governments to implement conservation action plans."**

**--Brian J. Huntley**

The Government of Zaire (GOZ) has demonstrated by both word and action that it is one of the most aware and concerned countries in Africa with respect to tropical forest and biological resource conservation, and GOZ legislative and institutional structures for the most part exist to effect such conservation. While these facts are in and of themselves extremely important, there are nonetheless specific weaknesses in certain of the legislative and institutional arenas whose improvement could significantly facilitate the attainment of long term conservation objectives.

### **2.1 LEGISLATIVE STRUCTURES**

#### **2.1.1 International Treaties and Agreements**

Zaire is a signatory to or is in the process of becoming a signatory to virtually all major multi- and bilateral international treaties and agreements of direct and germane relevance to conservation and management

of tropical forests and biological diversity in the country. It signed the Convention on International Trade in Endangered Species (CITES) in 1976, limiting commercial exploitation and international trade in endangered plants and animals, and it is in the process of becoming a party to the RAMSAR Convention which constitutes an international cooperative effort to conserve humid and coastal zone biotypes. It is also a party to the "Convention Concernant la Protection du Patrimoine Mondial Culturel et Naturel," designed to protect certain cultural and natural sites of extreme international importance, and has inscribed four national sites into this program (the Virunga, Garamba, Salonga and Upemba national parks (NP)). Zaire is also a signatory to the African Convention for the Conservation of Nature and Natural Resources, an effort by African states to take measures necessary to ensure the conservation, use and development of soil, water, flora and faunal resources on scientific principles taking into consideration the major interests of their populations, and a signatory to the Lagos Plan of Action for the Economic Development of Africa, 1980-2000, which obliges members of the Organization of African Unity (OAU) to identify priorities in their countries concerning the environment and to incorporate policies, strategies, institutions and programs into a national action plan for protection of the environment (39).

In addition, Zaire is also a signatory to two bilateral agreements of notable importance. The Gbado-Lite declaration, endorsed by Zaire, Uganda and Sudan and signed in June 1981, established three subcommissions to address anti-poaching operations and illicit trade in animal and plant products. The second agreement, the Accord Relative to the Exploitation and Protection of Animals, Plants and Their Products, was signed between Zaire and the Central African Republic (CAR) in August 1983 as an attempt to coordinate the respective legislation of the two countries with respect to conservation education and the exploitation, management and protection of nature (39).

### 2.1.2 Host Country Legislation

There are six principal national laws comprising the basic GOZ legislative framework relative to conservation and management of tropical forests and biodiversity. The first and perhaps most important of these, the Ordinance-Law of 22 August 1969 (No. 69-041) 'Relative to the Conservation of Nature,' defines the conditions wherein portions of the national territory may be established as "integrated national reserves" and determines the jurisdictional regime applicable to such reserves and to a certain extent the authority charged with their management (39).

The Law of 22 July 1975 (No. 75-024) 'Relative to the Creation of Safeguarded Sectors' fixes the method of creation, the jurisdictional framework and the management organization responsible for safeguarded sectors. The principle behind creation of these sectors is that 'all parts of the national territory not covered by urbanism can be established, by ordinance of the President of the Republic, as safeguarded sectors when they present a special interest by their nature to justify their conservation, restoration or development.' Such sectors can be subjected to particular restrictions, including restriction from hunting or fishing, development of private or public works, extraction of natural resources, use of water, public access, and/or any action to inhibit the development of the fauna and flora or to alter the character of the sector. Management of individual sectors are designated by the Ordinance which creates them. No such sectors have been created, however, since 1975 (39).

The Law of 28 May 1982 (No. 82-002) 'Regulating Hunting in Zaire' establishes the conditions under which hunting is permitted, the documents required of hunters, animals for which hunting is permitted, and animals for which hunting or trapping is prohibited. Strongly influenced by the CITES Convention, this law includes two annexes listing species totally or partially protected (See Table 6-1) and also defines the opening and closing

of hunting seasons for each region of the country. The passage of ordinances and effective implementation of the provisions of this law, however, are said to have yet to be undertaken (36, 72).

The Law of 22 July 1975 (No. 75-023) 'Establishing the Institut Zairois Pour la Conservation de la Nature (IZCN)' defines the rationale for IZCN and establishes the objectives that the legislature assigns to this state enterprise. Those objectives include management of 'integrated and quasi-integrated natural reserves,' particularly the national parks and related reserves. A related ordinance (No.75-321, 22 July 1975) 'Creating the Department of the Environment, Conservation of Nature and Tourism,' also created and assigned responsibilities to this department in urban and rural areas (39).

The Ordinance of 30 August 1985 (No. 85-211) creating the "Fonds de Reconstitution du Capital Forestier" is important legislation in that it creates the available funds announced by the President in a speech on investment on 5 December 1984. This law in essence taxes exported timber by volume, and logging by area deforested, and establishes use of these taxes for reforestation purposes (39).

There also exist a number of minor laws and ordinances in Zaire which create management organizations, establish hunting reserves and particular national parks, and regulate forest exploitation (39).

In general, the basic legislative structures exist in Zaire for the conservation and management of biological resources. As discussed in Sect. 5.0, however, a number of areas protected prior to independence such as forest reserves are no longer technically protected except through a series of official letters and circulars, and a second weakness is the lack of legislation related to the United Nations Environmental, Scientific and Cultural Organization's (UNESCO) Man and the Biosphere (MAB) reserves.

## 2.2 INSTITUTIONAL RESOURCES

### 2.2.1 Government of Zaire

While the basic institutional structures exist within the GOZ to effectively conserve biological resources, and while in most institutions there is said to exist a genuine concern for and commitment to those responsibilities, major prevailing institutional weaknesses in Zaire include lack of sufficient trained human resources and economic resources to carry out institutional responsibilities.

Most national institutions with direct responsibility for activities related to the conservation and management of tropical forests and biodiversity in Zaire exist within the Department of Lands, Environment and Conservation of Nature (DAFECN). The departments of Agriculture and Rural Development have responsibilities more indirectly affecting conservation and management of resources, however, as do certain other national institutions. Major responsibilities can be briefly described as follows (37).

#### A. DEPARTMENT OF LANDS, ENVIRONMENT AND CONSERVATION OF NATURE (DAFECN).

This Department can be broken down institutionally into three subgroups, i.e., the Environment and Conservation of Nature Branch, the IZCN, and the Institut des Jardins Zoologiques et Botaniques du Zaire (IJZBZ) (37).

A.1. ENVIRONMENT AND CONSERVATION OF NATURE BRANCH. This branch comprises eight principal institutions concerned with natural resource conservation and management. Run by a General Secretariat, it includes approximately 3500 employees of which 23 are professional foresters, 44 are high level technicians, and 150 have received various forms of technical training (37).

A.1.a. Direction Générale des Ressources Naturelles Renouvelées (DGRNR). The DGRNR is principally responsible for forest administration, including rational allocation of natural resources found in association with the nation's forests. It includes three divisions: Forests, Hunting and Fishing. The Forest Division employs 17 agents and has responsibility for development of the forestry sector, forest exploitation, forest stocks and stocking, and statistics. The Hunting Division employs 10 agents and is charged with all aspects of animal exploitation including issuance of export permits and permits for holding wild animals or their products. It was also formerly responsible for management of hunting reserves, but this responsibility was transferred to IZCN in 1978. The Fishing Division employs 19 agents and currently functions as a nearly separate entity dealing principally with fisheries productivity (37):

A.1.b. Direction de la Programmation, Formation et Relations Internationales (DPFRI). The DPFRI is responsible for studies and sectoral analyses, especially those related to the forestry sector. The MAB/Zaire Project, which to date has no legislative or jurisdictional status in Zaire, functions for all practical purposes under the DPFRI and is probably one of the most important conservation activities undertaken by this institution (37).

A.1.c. Service Permanent d'Inventaire et d'Aménagement Forestier (SPIAF). Employing about 80 agents, this service has responsibility for inventory of national forest species, development of management plans for the rational use of forest resources, and training of Zairois cadres capable of assuring rational forest management. To date SPIAF has inventoried over 150,000 km<sup>2</sup> of forest in Zaire, about 60% of which was national forest and about 40% of which was forest for private exploitation (37).

A.1.d. Corps des Inspecteurs. Essentially serving as the inspection arm for national laws relating to forests, reserves, hunting and fishing, this institution issues guarantees of stocks, cutting permits, felling certificates, trimestral cutting declarations and similar types of certifications (37).

A.1.e. Service National de Reboisement (SNR). The SNR is responsible for development of a national reforestation policy and its implementation, with a central focus on fuel wood as it relates especially to provisions for urban centers (37).

A.1.f. Centre d'Adaptation des Techniques Energie-Bois (CATEB). CATEB was created through a Canadian-Zairois cooperative effort in 1983 to promote and extend techniques for the production and consumption of fuel wood and for increasing the production of charcoal for serving larger domestic energy centers (37).

A.1.g. Bureau des Etudes. This institution was recently created as a forest coordination unit to develop and coordinate various studies on questions of administrative structures, laws and regulations, and international conventions and accords (37).

A.1.h. Fonds de Reconstitution du Capital Forestier (FRCF). Created by ordinance to administer revenues generated from forest exploitation and wood exportation, the FRCF supports reforestation projects, forest inventories, forest management, and ecological and economic projects related to development of the forestry sector and the promotion of tropical woods (37).

#### **A.2. INSTITUT ZAIROIS POUR LA CONSERVATION DE LA NATURE (IZCN).**

Probably the most important GOZ conservation institution, the IZCN is a parastatal technical and scientific institution that has a mandate to 1) assure the protection of fauna and flora in the natural reserves of the country; 2) accentuate in these areas scientific research and tourism with respect to the fundamental principles related to the conservation of nature; and 3) to manage "capture" stations inside and outside the reserves. IZCN is also relatively unusual in the Zairean institutional context because it is headed by a "Président Délégué Général" and has a mandate to generate revenues. IZCN has its own law enforcement personnel and independent financial standing, including approximately 2295 employees of which 1782 are guards and/or conservators in the national parks with paramilitary standing and a mandate to assure protection of the parks and natural reserves (37). It also manages seven of the eight existing national parks, comprising a total area of about 85,000 km<sup>2</sup> or about 3.5% of the country (51), as well as 57 hunting reserves comprising an area of at least 110,000 km<sup>2</sup> or about 4.7% of the country (Table 5-1).

#### **A.3. INSTITUT DES JARDINS ZOOLOGIQUES ET BOTANIQUE DU ZAIRE (IJZBZ).**

National zoological and botanical gardens were largely established during the colonial era. Since 1978 they have been managed by IJZBZ (except for the Presidential Reserve at N'Sele managed by the National Labor Union) with a mandate to study and promote, through scientific, didactic and touristic means, the fauna and flora of Zaire and other countries and to manage and create zoological and botanical gardens in the public interest. Composed of scientific, financial and administrative substructures, IJZBZ operates on subsidies provided by the GOZ Executive Council (EC) and various donations from individuals, embassies and international organizations (37).

## B. OTHER RELEVANT INSTITUTIONS

There are also four miscellaneous GOZ institutions with direct or major indirect responsibilities for biological resource conservation in Zaire. The Office Zairois de Controle (OZAC), under the Department of Foreign Trade, is charged with the control of forest production and the surveillance, allotment, consumption and export of wood and raw ivory. The Commission de la Mercuriale du Bois (CMB), also under the Department of Foreign Trade, is charged with gathering statistics relative to the Marketing and pricing of Zairean wood overseas and with recommending pricing controls to the appropriate authorities. The Bank of Zaire (BOZ) intervenes in the retrocession of foreign bills for forest and related products, and the Association Nationale des Entreprises du Zaire (ANEZA), the Zairean National Chamber of Commerce, was created to defend the business interests of private companies (37).

### 2.2.2 Non-governmental Organizations

There are currently over 300 identified non-governmental organizations (NGOs) working in Zaire. A recent attempt by DAFECN and CATEB to identify specific information about the forestry or forestry-related activities of over 100 of these provides some insight into the scopr of conservation-related activities of NGOs in the country (63). While less than 40 questionnaires were returned, it is clear that the geographical distribution of conservation-related projects by these organizations is extensive, covering portions of every region in the country, and that the number of organizations involved is considerable. A 1988 census of NGOs estimated that at least 94 organizations work in the forestry sector alone, mostly in the Kinshasa, Bas-Zaire, Shaba and Kivu regions (Manyong a Manyong, cited in (36)).

NGO activities in conservation can generally be divided into 11 categories (Table 2-1). While some activities exist with conservation as their primary goal or objective, and fund projects which protect wild animals and their habitats by helping to maintain and/or expand the system of national parks in the country (63), most projects are typically involved in conservation not as a raison d'etre but rather as a means of successfully implementing other activities. Many, for example, exploit wood for fuel but also provide for reforestation of affected lands, and most agricultural projects are concerned with soil conservation activities (63).

A basic breakdown of NGO conservation-related activities by region and general category, based on primary or secondary contact with organizations in Zaire (63), is found in Table 2-1. Of the organizations listed, 28 were involved in reforestation, 15 in environmental education, 14 in soil fertility, 11 in erosion control, 8 in wildlife management, 4 in park management, 3 in forest conservation, 3 in soil use, 2 in forest protection, and 1 each in planning and wood conservation.

Perhaps the most important NGOs from the conservation perspective in Zaire are the International Union for the Conservation of Nature and Natural Resources (IUCN) and the World Wildlife Fund (WWF). IUCN activities include the principal study for and development of the Salonga NP project (with European Community Funding), coordination of the Garamba NP project with UNESCO and WWF, and a study of German-Zairean cooperation with respect to nature conservation. WWF is involved in three principal conservation projects in Zaire, the okapi project in the Ituri Forest, the gorilla conservation project in eastern Zaire and rehabilitation of the Garamba NP (73). WWF is also said to be active in conservation education in the Virunga NP.

Salonga  
Garamba  
Ituri  
Virunga

Significant gaps in available information on conservation-related activities of NGOs in Zaire exist, however, and filling these gaps would be of significant benefit to future programming of conservation actions.

### 2.2.3 International Organizations

A 1988 review of international and other donor organizational activities related to conservation and management of tropical forests and biodiversity in Zaire provided substantial information on the seven international and four bilateral donors with the most significant conservation-related portfolios (Table 2-2). Most projects directly related to conservation are undertaken in conjunction with DAPECN, specifically with IZCN, SNR or DGRNR, while projects more indirectly related to tropical forest and biodiversity conservation are for the most part undertaken in conjunction with the departments of Agriculture or Rural Development (73).

The European Economic Community (EEC) is currently the most active donor involved directly with conservation in Zaire, with five existing projects totalling about US\$ 23.28 million. These include current work in the Virunga NP, the Salonga NP, a reforestation project and associated research on the Bateke Plateau, and community reforestation projects in Kivu and Kasai. A limited project to study the fish reserves of Lake Edward (Idi Amin) is also planned and other possible future projects include a study of the fish fauna of Lake Tanganyika, elephant censuses, and establishment of a CITES organization for control of ivory and rhino horn exportation (73).

Among United Nations (UN) organizations, UNESCO operates three conservation-related activities in Zaire. These include rehabilitation of the Garamba NP (US\$ 441,550), the MAB/Zaire activity consisting of three subprojects in the Yangambi, Lufira and Luki biosphere reserves, and very limited support to the Salonga NP project. UNESCO has also provided three conservation education grants totalling eight person-years. The UN Development Program (UNDP) has been involved in two projects, one an integrated rural development activity with renewable energy, soil conservation and village level natural resource management components (US\$ 395,400), and the other implemented through the UN Food and Agriculture Organization (UNFAO) for assistance to the IZCN (US\$ 545,464) (73). *for what?*

The World Bank (IBRD) financed a forestry policy review for Zaire in 1987-8 at a cost of US\$ 400,000, and is providing in-kind support for a multidonor study of the tropical forests of 34 countries of which Zaire is one. IBRD has no ongoing conservation-related projects in Zaire, but does have US\$ 20 million earmarked for an as yet unidentified forestry project in 1991. It is currently involved in several projects which indirectly affect tropical forest and biodiversity conservation, however, including a smallholder maize project, a cotton rehabilitation project, and two agricultural development projects in the Lulua and south Shaba regions (73). possibly?

Among bilateral donors, Canada has the most extensive forestry-related portfolio at nearly US\$ 50 million with four long-term projects having offices and staffs in Kinshasa, a fifth in the process of opening, and twelve full time expatriate specialists. These include support to SPIAF, CATEB and the IJZBZ. Canada has also sent five Zairean engineers per year to Quebec University for a four year B.Sc. program since 1977, and is coordinating the Zairean portion of the worldwide Tropical Forest Action Plan (TFAP)(73).

The Federal Republic of Germany has one conservation project in Zaire at US\$ 2.43 million, involving support to the Kahuzi-Biega NP, but it has also carried out studies related to conservation and has an ongoing training program for foresters and conservationists which has been operational for more than ten years (73).

Belgian support in the sector includes 1) activities to obtain copies from Belgium of the extensive technical archives related to the national parks of Zaire; 2) revival of scientific research in the national parks; 3) publication of an action plan for the Virunga NP; 4) a reforestation project in planning on the Bateke Plateau expected to affect about 2000 ha; and 5) an ongoing training program supporting conservation education in Belgium for Zaireans (73). Belgium has also, since before the colonial period, carried out by far more basic scientific research on the natural resources of Zaire

than any other bilateral or multilateral donor, and Belgium is also said to be providing substantial assistance to the GOZ in remote sensing, a critical if not the most critical technical need related to resource conservation in Zaire at the present time.

USAID does not directly fund any bilateral conservation or tropical forestry/biodiversity management activities per se in Zaire. The USAID/Zaire mission has, however, substantial agricultural and rural development portfolios and most of these projects indirectly benefit conservation of forests and biodiversity by encouraging sound land use practices. The mission also 1) supports a number of Peace Corps activities which indirectly affect forest management and directly affect fisheries management; 2) supported preparation of 11 background assessments from which much of the information for this analysis was derived; 3) has supported preparation of a Country Environmental Profile (28) for Zaire; and 4) has provided considerable project funds for training of 35-40 Zairean technical ~~specialists~~ <sup>what field</sup>, the curricula for which include up to one third class time on issues directly related to forest and/or biodiversity conservation. It also funds limited and directly related activities as a mitigative measure if and when potentially significant adverse environmental impact is anticipated as a result of bilateral project activities (e.g., non-lethal anti-poaching support in the Upemba NP). In addition, USAID regional funds continue to provide support to Mweka Wildlife College in Tanzania, and this and consultative services funded under a natural resource management support project are both expected to continue to contribute to biological resource conservation in Zaire.

V. Little

TABLE 2-1

SUMMARY OF NGO CONSERVATION-RELATED ACTIVITIES IN ZAIRE

NGO	REGION	PRINCIPAL ACTIVITIES
ACCZ	Shaba	R, EE
Bureau Pour le Développement de l'Eglise Catholique	Kinshasa	EC, SF, R
Communauté Armée du Salut	Kinshasa	EC, R
COOPRODIT	Kinshasa	R, FP
DSDEK	Kivu	SF, SU, R, EC, EE
Frankfurt Zoological Society	Kivu, Haut-Zaire	W, PM
GENAGRO	Haut-Zaire	R
GTER/EDC	Bas-Zaire, Kivu, Kassai-Occidental	
	Kassai-Oriental, Haut-Zaire; Kivu	R, EE, EC
INADES-Formation Zaire	Kinshasa	SF, R
IUCN	Haut-Zaire; Equateur, Bandundu, Kasais	W, PM; P, FC
NYZS	Haut-Zaire	W
Taba Zaire	Haut-Zaire	PM, W
Technoserve	Kinshasa	EC, R
UNIPAZA	Kinshasa	R, SU, WC, W, EE
VUAPROD	Kinshasa	FC
WWF	Haut-Zaire; Kivu	PM; W, R, EE
COOFAB	Bandundu	R
DPP	Bandundu	SF, R, EE
CDD	Bandundu	R, EE
ACFza	Bas-Zaire	EC, SF, EE
APRODEC	Bas-Zaire	EE, SF
CAPADER	Bas-Zaire	EE, W
CEP	Bas-Zaire	R
CEDECO	Bas-Zaire	SF, R
PAA	Bas-Zaire	R, SF, EE
PRODAF	Bas-Zaire	R, SU
PRI	Bas-Zaire	SF, EE
UPPFL	Bas-Zaire	EC, SF, R

NGO	REGION	PRINCIPAL ACTIVITIES
UPEBAZ	Bas-Zaïre	SP, FP, W, EE
CDDAK	Kasai-Occidental	R
Promotion de Paysan	Kasai-Occidental	R, SP
PROFER	Kasai-Occidental	FC, EE
PRD/MM	Kasai-Oriental	EC, SF, R
Comite Anti-Bwaki	Kivu	R, EC
PARC	Kivu	R
Solidarité Paysanne	Kivu	R, EC
Solidarité Paysanne Frère des Hommes	Kivu	Sf, R, EE
CEPC	Shaba	EC, R
Eglise Méthodiste Unie	Shaba	R

Notes: R = reforestation; EE = environmental education; EC = erosion control; SP = soil fertility; FP = forest protection; SU = soil use; W = wildlife conservation; PM = park management; P = planning; WC = wood conservation; FC = forest conservation;

Source: (63)

TABLE 2-2

## SUMMARY OF PRINCIPAL CONSERVATION-RELATED PROJECTS OF INTERNATIONAL AND OTHER DONOR ORGANIZATIONS IN ZAIRE

Project	Donors/GOZ Institutions	Funding	Life of Project
Programme Virunga/Projet CEE/Kivu	EEC/IZCN	ECU 8,000,000	1988 - *
Reforestation Project: Plateau de Bateke	EEC/DAFEEN	ECU 10,000,000	1987-92
Essai d'Accompagnement, Bateke	EEC/DAFEEN	ECU 1,000,000	1987-92
Projet CEE/Salonga	EEC/IUCN/UNESCO/IZCN	US\$ 2,000,000	1988-91
Projet Pilote pour Appui aux Reboisements Communautaires	Canada/EEC/DAFEEN	*	*
Fisheries Project /Kivu	EEC/DRNR	*	4 months
Rehabilitation du Parc National de la Saramba	UNESCO/MWF/IUCN/FZS/IZCN	US\$ 441,550	1983-88
MAB/Zaire	UNESCO/GOZ (various)	*	1978-present
Programme Pilote d'Ecodéveloppement des Communautés de Base	UNDP/DAFEEN	US\$ 395,400	1988
Renforcement de l'IZCN	UNDP/FAO/IZCN	US\$ 545,464	1982-84
Forestry Policy Review	IBRD	US\$ 400,000	1987-88
Tropical Forest Study (34 Countries)	Canada/IBRD/Belgium/FAO/DAFEEN	*	1988-89
Conservation des Okapis dans la Forêt de l'Ituri	MWF/NYZC/Tabazaire/AIM/IZCN	US\$ 1,300,000	1985-90
Protection et Conservation des Gorilles de l'Est du Zaire	MWF/FZS/IZCN	US\$ 500,000	1985-88
Appui à la Gestion Forestière (AGEF)	Canada/DRNR	C\$ 6,500,000	1986-91
Service Permanent d'Inventaire et d'Aménagement Forestiers	Canada/DAFEEN	C\$ 12,000,000+	1977-91
Centre d'Adaptation des Techniques d'Energie de bois	Canada/DAFEEN	C\$ 2,000,000	*
Société Forestière et Commerciale	Canada/GOZ	C\$ 35,000,000	1980-89
Assistance to IJZBZ	Canada/IJZBZ	C\$ 4,000,000	1984
Project Pilote pour Appui aux Reboisements Communautaires	Canada/DAFEEN	C\$ 2,000,000	1988-91
Parc National de Kahuzi-Biega	GTZ/IZCN	DM 4,500,000	1985-91
Recovery of National Park Archives from Belgium	Belgium/IZCN	*	*
Revival of Scientific Research in National Parks	Belgium/IZCN	*	*
Action Plan for Virunga National Park	Belgium/IZCN	*	*
Reforestation Project, Plateau de Bateke	Belgium/DAFEEN	*	1988-92

Notes: \* = No data

Total known resource commitments: Circa US\$ 79.107 billion at September 1988 exchange rates of ECU x 1 = US\$ 1.12;

C\$ = 1 = US\$ 0.61; DM = 1 = US\$ 0.54.

Source: (73)

### 3.0 BIOGEOPHYSICAL AND ECOLOGICAL OVERVIEWS

"Rarity in an ecosystem is in fact the common condition."

—Thomas E. Lovejoy

#### 3.1 BIOGEOPHYSICAL OVERVIEW

Zaire is the third largest country in Africa after Sudan and Algeria and one of the most biologically and physiologically diverse. Stretching from about 5 degrees north to about 13 degrees south latitude, and from the east African rift valley to the Atlantic Ocean, it lies almost entirely within the Congo Basin and varies in altitude from sea level to 5119m (36). The climate of Zaire is entirely tropical. The lowest precipitation (840 mm) occurs at the coast, but virtually all of the country receives over 1200 mm/yr and most of the "Cuvette Centrale" or Central Basin receives over 2000 mm/yr. Maximum temperatures are mostly in the 24-25C range, dropping to 18-20C at higher altitudes, and relative humidity is usually about 70-85% (43).

Zaire can be broken down geographically into several more or less discrete regions. The Cuvette Centrale is an area of about 750,000 km<sup>2</sup> dominating the westcentral portions of the country. Underlain mostly by upper Tertiary, Cretaceous and Quaternary alluvial deposits, it occurs at altitudes mostly under 700 m and roughly coincides with the major portion of the Congolese lowland rainforest block. The vast Kwango-Kwilu and Kasai plateaus surround the Cuvette Centrale to the south and east. Underlain mostly by Precambrian, Cretaceous and Tertiary deposits, these plateaus are highly incised and are characterized by vegetational gradation along a rain forest-savanna continuum. The high plateaus of Shaba dominate most of the southeastern

portions of the country. Occurring at altitudes generally over 1000 m, they are underlain primarily by Precambrian rocks and support woodland, savanna and grassland vegetation dissected by gallery forests and extensive papyrus swamps.

The Bas-Zaire hills region occurs between Kinshasa and the coast. Sometimes referred to as the Mayombe Hills, it is underlain by Precambrian and Tertiary rocks and Quaternary alluvium and formerly supported rain forest vegetation and limited coastal formations. The East African mountain region occurs in association with the rift valley system, is generally underlain by recent volcanic deposits (43), and exceeds 5000 m in altitude in the Ruwenzori Range (36).

The vegetation of Zaire consists very generally of rain forest grading into woodland and savanna to the north and south, with major inclusions of grassland and steppe vegetation on the high plateaus and at higher altitudes in the mountains (43).

Most wetlands in Zaire are associated with the Zaire River, the eighth longest river (4700 km), second largest river in terms of discharge (1,400,000 cfs) and second largest watershed in the world (81). The Zaire watershed is roughly the shape of a shallow saucer, with rims at about 1500 m to the south, 1000 m to the north and west and about 3000 m to the east (55). It includes numerous natural lakes of variable morphology including Mai-Ndombe (2325 km<sup>2</sup>) and Tumba (765 km<sup>2</sup>) in the northwest of the country; portions of Mweru (5000 km<sup>2</sup>) and Bangweulu (4150 km<sup>2</sup>) in the upper reaches of the Zaire River watershed; and the rift valley lakes Mobutu (5000 km<sup>2</sup>), Edward (2150 km<sup>2</sup>), Kivu (2370 km<sup>2</sup>) and Tanganyika (34,000 km<sup>2</sup>), the latter of which is the second deepest lake in the world (43,55). There also exists a major 'inland delta' system comparable to the Sudd region of southern Sudan and the inland delta of the Niger River in Mali. Known as the Kamalondo Depression and found in the upper Lualaba watershed, this depression includes an area of about 10,000 km<sup>2</sup>

in which are found several large areas of free water (e.g., Lake Upemba) connected by channels to the upper Lualaba River. The Kamalondo Depression is best described as a labyrinth of true swamps including dense stands of papyrus, periodically flooded grasslands, thickets of Ambatch trees, and floating water plants such as Nile lettuce and water chestnut (55). Other significant wetlands include the manmade lakes Mwadingusha (400 km<sup>2</sup>), Nzilo (200 km<sup>2</sup>) and Koni (4.5 km<sup>2</sup>) in Shaba (55), and coastal wetlands associated with a shoreline of only 37 km including limited mangroves, coastal waters in the deep trench cut by the Zaire River, and open continental shelf (28).

### 3.2 ECOLOGICAL OVERVIEW

"Productivity is what interests most of humanity. Is diversity an issue here?"

—G. Carleton Ray

Humans have exerted a tremendous pressure on African environments in the last million years, resulting in an extraordinary 'environmental dynamic' of which extinction, speciation and change are integral parts; African ecosystems are not, moreover, as "fragile and vulnerable as popularly believed" (31). Because of this and the fact that so little taxonomic work has been done in Zaire in relation to the diversity of communities and species present, any ecological discussion of forest and biodiversity conservation must necessarily be both broad and provisional. Indeed, a national vegetation map at a scale of 1:5,000,000 was only recently published (11), little work

ever  
w/o  
human  
influence

How can all Afr  
ecosystems  
be impacted?

has been done on the species-rich lakes, rivers and wetlands of the country, and virtually no work has been done on Zaire's inselbergs, escarpments and many other specialized habitats (31).

"Core forest areas", "centers of endemism" and "Pleistocene refugia" in Central and West Africa are typically characterized by both an unusually large number of species and in some cases an unusually large number of endemic taxa in contrast to the relative impoverishment of adjacent areas. It has been hypothesized that these areas persisted under forest cover during periods of relative aridity during the course of the Pleistocene, permitting the survival of forest species which later expanded their ranges outside of the "refugia" during times of increasing humidity (26), and thereby caused the currently observed pattern of core areas of high species richness surrounded by areas of lower species richness. Geological evidence for this hypothesis is mainly paleopalynological and biogeographical evidence is largely inferred from close agreement in the ranges of living species. This hypothesis has been argued at length, however, and strong cases have been made for opposing conclusions in both the Neotropics and Africa (62). Other geographic factors, moreover, appear also to have exerted significant influence on speciation patterns (3-2). The Zaire River system, for example, is believed to have exerted considerable influence on speciation in the Cuvette Centrale region. Major rivers cited as serving as hydrological barriers at the species level for primates, for example, include the Zaire-Lualaba, Lomani and Itimbiri, while the Aruwimi-Ituru, Lindi, Maiko, Lowa and Ulindi rivers have been cited as barriers at the subspecific taxonomic level (Colyn 1987 cited in (36)).

Nonetheless, and regardless of their evolution, the fact remains that such core areas constitute centers of unusual species richness and in some case also constitute areas of very high relative endemism. Such areas in Africa generally coincide today with the areas of highest rainfall, but their delimitation remains imprecise and is typically based on assessment of how the

numbers of plant (e.g., 31) and animal (e.g., 42,45) species found in different areas change geographically. It currently appears likely based on both herpetozoan (45) and passerine bird (42) data, however, that such a core area occurs in eastern Zaire in an area roughly defined by the 1 degree north and 4 degree south latitude lines and the 27 and 30 degree east longitude lines. A minor but very small core area provisionally delimited on passerine bird data alone is centered on about the 9 degree south latitude and 34 degree east longitude lines (42), and a much larger core area delimited primarily on herpetozoan data (45) occurs between about 2 and 5 degrees south latitude and 18 and 27 degrees east longitude.

While the flora and fauna of tropical Africa are considered "rich" by temperate standards, they are generally considered overall to be relatively poor in relation to the Indo-Malaysian and Neotropical regions of the world in terms of number of taxonomic groups present (Table 3-1), especially the bird, reptilian and amphibian faunas (31). These comparisons must be considered rather preliminary, however, since estimates of the total number of species on the African continent vary from about 150,000 to about 500,000 and could rise tenfold if one current estimate of 30,000,000 species worldwide (14) is approached.

The flora and fauna of Zaire especially remain very poorly known. A search of eight data bases listing 1382 technical documents on forestry and biodiversity in Zaire published since about 1974, for example, provided rough data on newly discovered taxa from Zaire as summarized in Table 3-2. These data indicate that there were well over 400 taxa identified from Zaire which were new to <sup>not =</sup> science during the period 1974-1987, including 2 families, 1 subfamily, 30 genera, 5 subgenera, 367 species and 16 subspecies among which were included 2 mammals, 2 birds, 4 amphibians, 11 fish, 2 molluscs, 369 insects and other invertebrate animals, and 26 plant species. It is unlikely that more than 30% of all naturally occurring taxa in Zaire have been described to date, but the vast majority of those remaining undescribed should consist of invertebrates,

fungi and nonvascular plants (40): of about 1.4 million species currently known to science, about 71% are invertebrate animals and about 18% are plants (98).

### 3.2.1 Vegetation

Tropical Africa is considered particularly poor in certain families of plants generally regarded as characteristically tropical, such as the orchids, palms (although there are at least 9 endemic genera), laurels, Myrtaceae and Myristicaceae (78). Oaks, abundant in both central America and Indo-Malaysia, are absent from Africa and similar comparisons have been made for the number of species found in savannas, deciduous forests and certain coastal formations such as mangroves as well as purely marine groups in West Africa such as the marine algae (78)(Table 3-1). In addition, the level of endemism is also believed to be significantly lower in Africa than in other tropical areas of the world for most but not all taxonomic groups. Tropical Africa is estimated to contain 30,000 seed plant species, however, and the Guineo-Congolese "center of endemism" alone is estimated to contain 8000 species of plants 80% of which are endemic (31). Tropical African plant species also tend to have wider areas of distribution than in other tropical regions and a much greater number of them exhibit disjunct distributions (78). It has been argued strongly that these comparisons are not an artifact of relative unexploration of tropical Africa west of the Cameroonian highlands (78), and it appears likely that this argument would hold generally true for the central Congo Basin as well.

The best summary quantitative data currently available on the natural vegetation of Zaire are those developed by GEAF (21) from a 1:5,000,000 scale

vegetation map of Zaire, Rwanda and Burundi, in turn developed by Devred (11) who described and mapped 37 distinct vegetation types in Zaire from satellite imagery (Fig. 3-1). (A more detailed quantitative analysis of the vegetation of Zaire is expected to be completed by ERTS/Zaire, the national teledetection service, in late 1988). A summary of those data, as expanded upon and revised during this analysis, are presented in Tables 3-3, 3-4, and 3-5.

Eleven of Devred's 37 vegetation types (11) are classified here as true forests. Characterized by a closed canopy and an absence or near absence of grass in the understory, these include montane, submontane, transitional and lowland types; swamp and terra firma types; evergreen and semi-deciduous types; and equatorial, subequatorial and guinean types. Most are found in the two provinces of Equateur and Haut-Zaire, with substantial blocks also found in Kivu and Bandundu.

The Guineo-Congolese forest dominates the northwest, eastcentral and southcentral portions of the country. It typically occurs between about the 1200 and 3000 mm isohyets and consists of continuous stands up to about 50 m in height. Evergreen forest in Zaire occurs where rainfall generally exceeds 2000 mm and tends to be localized in the center of the Congo Basin where there are extensive developments of swamp forest. Semi-evergreen forest occurs where rainfall is between about 1200 and 2000 mm, and where rainfall is either well distributed and/or dry seasons are characterized by continuous high humidity or are tempered with moist air from the sea. Swamp forest is probably more well developed in Zaire than in any African country. Found on low lying sites which are permanently waterlogged, this forest type is characterized by trees of up to 40 m in height and it is perhaps the system least impacted by human activity in Zaire (34).

Based on the data in Table 3-3, there were originally about 1.235 million km<sup>2</sup> of forest in Zaire covering about 53% of the country (Table 3-4); if accurate, this figure would include about 47% of all of the closed tropical forest found

in Africa and over 10% of all such forest remaining worldwide (49). The only published deforestation rate estimates available for Zaire are 1650 km<sup>2</sup>/yr (ca. 0.16%/yr) for 1967-80 (36) and 1820 km<sup>2</sup>/yr (ca. 0.2%/yr) for 1981-85 (99), but solid quantitative substantiation of this figure is unavailable.

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rates

To put this in its global perspective, Lugo (49), estimates the world's closed forest area in 1980 at about 11,950,000 km<sup>2</sup> of which 9.85 million km<sup>2</sup> is undisturbed and 2.10 million km<sup>2</sup> has been logged; of this, an estimated 75,000 km<sup>2</sup> is cleared annually (0.63%/yr) of which 34,000 km<sup>2</sup> (0.28%/yr) reverts back to forest fallow. This issue of mass deforestation in Zaire is addressed in greater detail in Sct. 9.0, but what appears certain is that deforestation rates in Zaire are some of the lowest in the world and in the same category with the western half of Brazilian Amazonia, parts of Papua New Guinea, and the Guyana Shield of northern South America (62,76).

The other vegetation types of Devred (11) include two woodland, four savanna, one mangrove and one papyrus swamp type as well as 18 other types characterized by various admixtures of forest, woodland, savanna and aquatic vegetation (Table 3-3). Woodland vegetation, found most extensively in Shaba and to a lesser extent in Haut-Zaire, originally covered an estimated 717,000 km<sup>2</sup> or about 31% of the country (Table 3-4). Woodland systems primarily include wetter Zambezian miombo and undifferentiated sudanian types, and typically consist of open stands of trees with canopies of 8-20 m in height covering at least 40% of the surface. Woodlands are distinguished from other vegetation types by the dominance of trees with typically light open canopy and the presence of typically heliophilous grasses. Ground cover includes mostly herbaceous geophytes, hemicryptophytes and chamaephytes. The most extensive type of vegetation in Africa, woodlands are extremely variable in height, density, deciduousness and thorniness (34).

Zambezian Miombo woodland dominates most of southeastern Zaire, and consists primarily of the genera Brachystegia, Isoberlinea and Julbernardia. Its distribution is partly determined by climate and soil, but there is typically

a marked dry season for 5-6 months of the year and annual rainfall is typically 750-1500 mm. Undifferentiated sudanian woodland is found in areas long inhabited, where virtually all of the vegetation has been modified by cultivation, cutting, fire and grazing. It typically occurs as a remnant formation with trees 8-12 m high on rocky hills or ironstone plateaus (34).

Savanna vegetation originally covered an estimated 381,000 km<sup>2</sup> or about 16% of Zaire, and is also found most extensively in Shaba (Table 3-4).

('Grasslands,' taken here as vegetation types with a canopy dominated by grass and grasslike species, subject to periodic drought, and generally characterized by the presence of less than 10-15 trees per hectare (79), can for the purposes of this analysis be considered to be included in the savanna vegetation types of Devred (11)). Savannas are particularly well developed and grade into nearly pure or unwooded grasslands on the Bateke, Kwango and high Katanga plateaus, but are also found to a limited degree near the coast (34).

Other vegetational systems are extremely limited in Zaire, but include about 200 km<sup>2</sup> of mangrove vegetation near the coast and about 10,000 km<sup>2</sup> of papyrus swamp.

### 3.2.2 Fauna

"There is a much told story...about the great biologist, J.B.S. Haldane, who was not exactly an apostle of religion. Haldane was asked what his years of studying biology had taught him about the Creator. His rather snide reply was that God seems to have an "inordinate fondness for beetles".

--David Ehrenfeld

The fauna of tropical Africa is also considered relatively poor in taxa in comparison to the Indo-Malaysian and Neotropical regions (Table 3-1) although there are some notable exceptions such as among the mammals (31,59). Among the invertebrates, endemic ant genera are believed to be only about half as numerous as in the other two major tropical regions even though there are at least 31 such genera (9). As noted earlier, however, the invertebrate fauna of Zaire is poorly known and most undescribed species likely to be identified in the future can be expected to be invertebrates, fungi and nonvascular plants (40): an estimated 40% of all species in the world are beetles alone (98).

The fish fauna of the Zaire Basin exclusive of the rift valley lakes is less diverse than that of the Amazon Basin but it is still one of the two richest in the world and contains an extraordinary number of endemics. This is generally attributed to environmental stability over long periods, a wide range of habitats, and prolonged periods of isolation (26). The fish fauna of the upper Zaire Basin is largely isolated from the rest of the basin but contains both Zambezian and, surprisingly, Sudanian species which suggests a connection with the Zambezi and Nile watersheds at some point in the past; capture of a portion of the Nile watershed by the Zaire River, for example, is postulated to have occurred near the Gates of Hell on the Lualaba River at Kongolo (e.g. 55). While only 560 species of fish had been identified in the Congo basin exclusive of the rift valley lakes as of 1967 (80), 669 species had been documented about 15 years later (26) of which 558 were endemic. It is estimated that the total will ultimately exceed 1000 species exclusive of the rift valley lakes (28) with as many as 70% being endemics.

The rift valley lakes themselves contain the world's richest palustrine fish fauna, one family of which (Cichlidae) contains over 900 species (31). There is considerable variation, however, between lakes; in Lake Tanganyika alone there are an estimated 250 fish species of which 216 are endemic (31), and this lake is also well known for speciation of such groups as molluscs, crabs,

planktonic copepods and crustacea. Lake Kivu, conversely, has only 16 fish species with an additional 16 species found in streams and pools within the catchment (26).

The herpetozoan fauna of the Zaire Basin also contains fewer taxonomic groups than the Amazon Basin, although there are some notable exceptions such as the arboreal Elapidae, aquatic Colubridae and skink faunas. There is also a large number of endemics, including 16 frogs and 6 reptiles in the eastern Zaire refugium and 8 amphibians and 12 reptiles in the central Zaire refugium identified as of about 1973 (45).

Zaire is known to contain at least 1086 species of birds (36). The Guineo-Congolese center of endemism is estimated to contain 655 bird species, 36% of which are endemic (31), and the mountain and transitional forests of eastern Zaire contain at least 7 species known from only 1-3 sites each (69) but the lowland rain forest avifauna of the Zaire Basin for the most part is comparable to or contains somewhat fewer species than that of the Amazon Basin. Again, however, there are notable exceptions such as the Phasianidae, owls, kingfishers and barbets. There are an estimated 212-266 species of birds in the Congolese forest block alone, depending upon interpretation of forest habitat reliance (1,26), but the major difference between the two tropical areas appears to be a near absence of mesomyodian passerine taxa (only 3 species) in the Congo Basin, vs. an extremely rich fauna (ca. 275 species) in Amazonia. It has been noted, moreover, that no forest passerine bird species is known to be confined to the central Zaire Basin (26) although there are said to be a number of endemics in the montane and transitional forests of eastern Zaire (72).

There are an estimated 756 species of mammals in Africa (6), at least 409 of which are believed to occur in Zaire (28). In contrast to most other orders, there does not appear to be a great difference between the faunal richness and diversity of terrestrial and arboreal lowland rain forest mammals between

Africa and the Neotropics (6), nor does there appear to be a great difference on a continental scale. Excluding areas in Africa with less than 120 mm of rainfall per year, the number of families and species per 100,000 square miles in Africa (0.63 and 9.39) is comparable to the Neotropics (0.70 and 11.3) (6). In general, the bat fauna is much more diverse in the Neotropics whereas the savanna primate fauna and all ungulate faunas are far more diverse in Africa (Table 3-1). The Guineo-Congolese center of endemism is estimated to contain 58 species of ungulates and diurnal primates alone, 45% of which are endemic (31). Zaire in particular has more primate genera (13-15) than any other country in the world, and ranks second in the number of species (29-32), but contains no endemic genera and ranks only sixth in endemic primate species (59). There are, nonetheless, at least 16 endemic species or subspecies of primates in the cuvette region alone (36).

Important differences exist between the mammal faunas of the Upper Guinean, Cameroon-Gabon and Central African Congolese rain forest blocks including 1) the relatively large number of endemic species given the minor nature of the presently occurring geographical obstructions and the relative ecological homogeneity of the forest; 2) the relatively few number of endemics in the Zaire Basin south of the Zaire River (26,42); and 3) the lack of large endemic mammals in the forests of eastern Zaire (72). Many African forest mammals, in addition, show disjunct distributions between the West African and Central African forest blocks, and a similarity in disjunct distributions between some savanna organisms to the north and south of the forest zone have also been noted (26).

# DES PAYS DE LA COMMUNAUTE ECONOMIQUE DES PAYS DES GRANDS LACS

par  
R DEVRED

sur la base des documents de R DEVRED, P LUYIGNEAU,  
C GERARD, P GERARD, R GERMAIN, G GEERT, J GILLARDON,  
J LEHRUN, J LECLERCQ, L LIBEM, A MICHEL, W ANZLEDERER,  
H ROUILLON, A SIVANI, A TAYEN, J WACZEMAN

REPRODUITE PAR LE BUREAU DU PRESIDENT-FRANCOIS  
DU MPR, PRESIDENT DE LA REPUBLIQUE DU ZAMBIE  
PROGRAMME ERTS-ZAMBIE

ECHELLE: 1:5,000,000

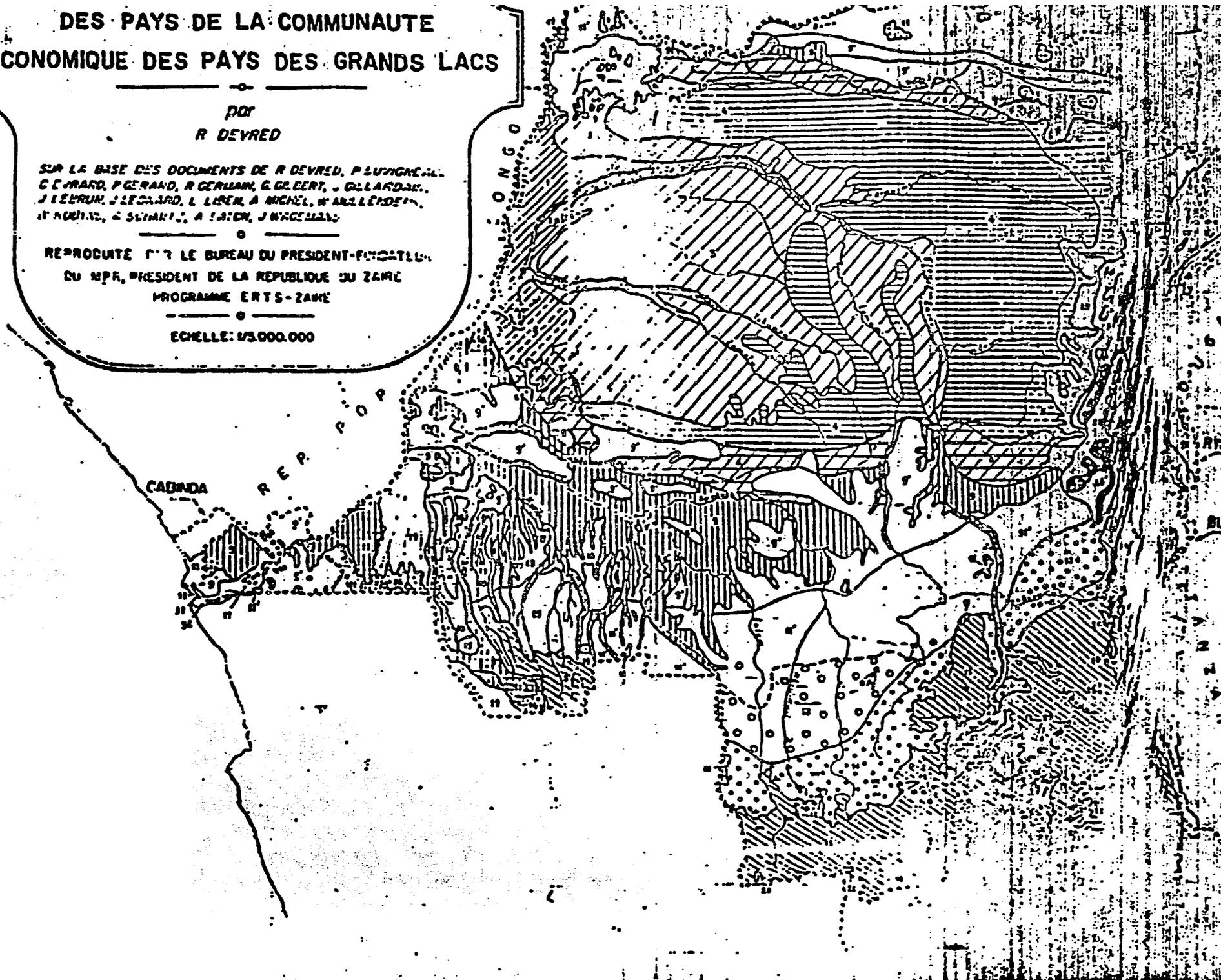


Fig. 3-1. The vegetation of Zaïre, Rwanda and Burundi. Scale 1:5,000,000. Vegetation types as per Table 3-3 Notes section. Source: (11).

TAXONOMIC COMPARISON, AFRICA, THE NEOTROPICS AND INDO-MALAYSIA

<u>TAXONOMIC GROUP</u>	<u>AFRICA</u>			<u>NEO TROPICS</u>			<u>INDO-MALAYSIA</u>			<u>Ref</u>
	<u>Families</u>	<u>Genera</u>	<u>Species</u>	<u>Families</u>	<u>Genera</u>	<u>Species</u>	<u>Families</u>	<u>Genera</u>	<u>Species</u>	
<u>PLANTS</u>										
Angiosperms	25			40			53			84
Palms		16 (9)	117		64 (33)	837		97 (92)	1385	61
Cynometrae		8	42		6	83				44
Oaks		Absent			Abundant			Abundant		78
Orchidaceae		58/1	403/1		57/3			107/2	800/2	78
Lauraceae		3/1	11/1		Common			Very Abundant		78
Epiphytes		Relatively Scarce/3			Relatively Abundant			Relatively Abundant		78
Lianas		Relatively Scarce			Relatively Abundant			Relatively Abundant		78
Marine Algae		Relatively Scarce/6			Relatively Abundant			Relatively Abundant		78
Mangrove/1		5/8	7/8		5/10	10/10		18/11	51/11	82
		8/9	9/9							82
Seed Plants/12		108	746		111	4017				78
Angiosperms		ca. 7000/1				ca. 2000/15			ca. 20,000/13	78
Bromeliaceae		1/1	1/1		Family Center				ca. 9,000/14	78
Rapateaceae		1/1			Most Species					3
Vochysiaceae		1/1			Most Species					3
Hypoxidaceae/15		Most Species				15		5		3
<u>ANIMALS</u>										
<u>Ants</u>	(31)			(65)			(54)/17			9
<u>Fishes</u>		ca. 560				ca. 1300				80
<u>Amphibians &amp; Reptiles</u>										
Cocilians			Far less common			Far more common				45
Sphaerodactylinae			Few			ca. 20				45
Amphisbaenians			Scarce			Rather Common				45
Arboreal Colubridae	9			Fewer	ca. 9	Many More				45
Arboreal Elapidae	3					0				45
Aquatic Colubridae			ca. 12			ca. 5				45
Terrestrial Colubridae		ca. 20			ca. 40					45
Aquatic Turtles/18	2		ca. 5	3	ca. 8	ca. 18				45
Skins		Fairly Numerous				Few Species				45
Frogs/19			(16)							45
Reptiles/19			(6)							45
Reptiles/20			(8)							45
Amphibians/20			(12)							45

3-14

3

## TAXONOMIC GROUP

## AFRICA

## NEO TROPICS

## INDO-MALAYSIA

	<u>Families</u>	<u>Genera</u>	<u>Species</u>	<u>Families</u>	<u>Genera</u>	<u>Species</u>	<u>Families</u>	<u>Genera</u>	<u>Species</u>	<u>Re:</u>
<u>Birds/18,21</u>										
Herons			1			1				1
Ibises			1-2			1-2				1
Ducks			ca. 1			ca. 2				1
Accipitridae			6			ca. 20				1
Phasianidae			ca. 6			ca. 2-3				1
Rails			1-2			1-2				1
Columbidae			ca. 5			ca. 7-8				1
Parrots			2			ca. 30				1
Cuckoos			ca. 10			ca. 10				1
Owls			ca. 9			ca. 6				1
Nightjars			ca. 2			ca. 8				1
Swifts			ca. 3			ca. 6				1
Trogon			1			ca. 6				1
Kingfishers			4			ca. 1				1
Barbets			12			4				1
Woodpeckers			7			ca. 20				1
Mesomyodian Passerines			3			ca. 275				1
Thrushes		2	11			6				1
Sylviidae			11			2				1
Common Groups	18	94		18		134				1
Uncommon Groups	19	118		31		458				1
Endemic Groups	(2)			(17)						1
Total Birds	37		212	49		592				1
			<u>266/23</u>			<u>269/22</u>				6
			<u>182/24</u>							6
<u>Mammals</u>										
Total/25	51	240	756	50	278	810				6
Bats/26		35	115		56	98				6
Bats/27		86	212		111	252				6
Rodents/26	11	44	92	9	40	95				6
Primates/28	5	14	44	2	16	42				6
Primates/29	1	2	5	0	0	0				6
Ungulates/28	6	14	37	3	4	9				6
Ungulates/29	7	31	66	2	5	6				6

Table 3-1

NOTES

( ) = Endemic Groups; /# = Note number

1. West Tropical Africa, i.e., West of the Cameroonian highlands, only.
2. Malay Peninsula only.
3. Panama Canal Zone only.
4. Jamaica only.
5. African Lowland Forests.
6. West Africa only.
7. Includes shrubs, trees and palms exclusive to mangrove systems.
8. West Africa only. 1 species introduced.
9. East Africa only.
10. Includes all Neotropics.
11. Includes all Indo-Malaysia and Australia.
12. Includes only 111 Genera "Essentially restricted to America and to Africa and/or Madagascar" (88), but data provided here only on "American" and "African" (i.e., excluding Madagascar) species. In the case of three genera (Andira, Ocotea, and Stigmaphyllon) numbers are averages between high and low estimates. Total species = 4756.
13. Malaysia only.
14. Malay Peninsula only.
15. Panama Canal Zone only.
16. Total species worldwide = ca. 90.
17. Includes Australia.
18. Rain forest only.
19. Northeast Zaire Basin refugium.
20. Central Zaire refugium.
21. In Africa, refers to the Zaire Forest only.
22. 2.0 km<sup>2</sup> of forest in Costa Rica only.
23. "Congo forest" only.
24. "West African forest block" only.
25. "Continental scale".
26. Zaire vs. Brazil.
27. West Africa and Zaire vs Brazil and Mexico.
28. Africa vs. American forest.
29. Africa vs. American Savanna.

TABLE 3-2

NEWLY DISCOVERED TAXA FROM ZAIRE, CA. 1974-1987

Classification.

<u>Taxonomic Group</u>	<u>Family</u>	<u>Subfamily</u>	<u>Genus</u>	<u>Subgenus</u>	<u>Species</u>	<u>Subspecies</u>	<u>TOTAL</u>
Plants	1	0	1	0	24	0	26
Molluscs	0	0	0	0	2	0	2
Insects/Other Invertebrates	1	1	28	5	318	16	369
Fish	0	0	0	0	11	0	11
Amphibians	0	0	0	0	4	0	4
Birds	0	0	0	0	2	0	2
Mammals	0	0	0	0	2	0	2
Undeterminable	0	0	1	0	4	0	5
<b>TOTAL</b>	<b>2</b>	<b>1</b>	<b>30</b>	<b>5</b>	<b>367</b>	<b>16</b>	<b>421</b>

SOURCE: Preparer review of 1382 listings from computer search of 8 data bases.

3-17

310

VEGETATION OF ZAIRE (Kc2)

Region

Veg. Type	Bas-Zaïre	Bandundu	Equateur	Haut-Zaïre	Kivu	Kasai-Or.	Kasai-Occ.	Shaba	Area Total	Z
1		9,200	58,000						67,200	2.87
2		23,900	13,200						37,100	1.58
3		38,000	234,900	69,500	14,700	16,500	12,400		386,000	16.47
4		15,400	40,600	161,200	70,200	32,700	6,500		326,600	13.94
5				20,600	25,100				45,700	1.95
6		16,600	800	28,200	18,300		10,400		74,300	3.17
7				8,600	3,600				12,200	0.52
8			2,800						2,200	0.11
9	6,900	92,500	2,100	6,900	18,300	17,700	54,300		208,700	8.91
9'	18,900	43,000	34,900	66,100	18,900	27,400	13,500		222,700	9.50
10					24,600				24,600	1.05
11	17,900	3,300	14,700	104,500	22,700	59,900	49,900	4,200	277,100	11.83
11'	3,900		1,300	3,900					9,100	0.39
12								25,300	25,300	1.08
13	100								100	0.00
14	2,000								2,000	0.09
15		8,900			2,200			279,600	290,700	12.41
16					5,600			81,000	87,700	3.74
17						14,000		48,100	62,100	2.65
18		18,000							18,000	0.77
19	11,700	26,900							38,600	1.65
20								38,600	38,600	1.65
21								10,000	10,000	0.43
22								9,400	9,400	0.41
23									A	0.00
24					25,900			700	26,600	1.14
25					4,700				4,700	0.20
26					900				900	0.04
27					F				P	0.00
28					F				P	0.00
29					F				P	0.00
30									A	0.00
31									F	0.00
32				21,100					21,100	0.90
33				3,000					3,000	0.13
34				8,600					8,600	0.37
35				1,600					1,600	0.04
36	200								200	0.01
37	300								300	0.01
<hr/>										
Total	61,500	295,700	403,500	503,200	256,700	168,200	157,000	497,000	2,343,000	100.01
<hr/>										

3-18

31

TABLE 3-3

NOTES

Values for areas of administrative regions taken from (32), rounded off to nearest 100 km<sup>2</sup>. Does not include Kinshasa region (2000 km<sup>2</sup>). Vegetation types taken from (11). Vegetation values by region derived from data presented in (21) annexes 7-14, corrected as follows: 1) Annex 7 value for Type 36 taken as 0.4 (vs. 4.5) to coincide with known value and to reduce sum of percents from 106.6 to 102.5; 2) Annex 8 value for Type 18 taken as 6.1 (vs. 61.3) to reduce sum of percents from 155.3 to 100.1 and since Type 18 clearly constitutes a very minor portion of the region; 3) Annex 9 value for Type 6 taken as 0.2 (vs 0.02); 4) Types 27,28,29 and 31 noted as "present" in Kivu region based on (11); 5) Final figures rounded to nearest 100km<sup>2</sup> and proportionally modified to account for deviation of sums of percents for each region from 100. Reference (11) does not discriminate water, i.e., sum of all areas plus Kinshasa = 2,350,000 km<sup>2</sup> = total area of country including ca. 78,000 km<sup>2</sup> of inland water.

P = Present; A = Absent

Vegetation types as follows:

Vegetation Type

Description

1. Edaphic forests, including over 80% swamp forest and periodically inundated forest, mixed with herbaceous formations and inclusions of evergreen forest on terra firma. Dominants: Entandrophragma palustre, Uapace guineensis, Micaranga saccifera, Mitragyna stipulosa.
2. Over 50% edaphic forest mixed with dense, humid evergreen forest. Dominants: Entandrophragma sp., Milletia Laurentii, Chlorophora excelsa.
3. Over 60% dense humid evergreen forest and degraded dense humid semi-deciduous forest, mixed with swamp forest and forest periodically inundated along the hydrographic network. Dominants: Entandrophragma sp., U. guineensis, C. excelsa.
4. Dense humid evergreen forest and degraded dense humid semi-deciduous forest. Dominants: Entandrophragma sp., M. Laurentii, C. excelsa, U. guineensis.
5. Dense humid evergreen forest with some semi-deciduous submontane forest components. Dominants: C. excelsa, M. Laurentii, Khaya anthotheca.

6. Dense humid evergreen forest mixed with dense humid semi-deciduous sub-equatorial and guinean forest. Dominants: M. Laurentii, C. excelsa, Brachystegia sp., Xylophia sp.
7. Dense humid semi-deciduous subequatorial and guinean forest dominated by Cynometra alexandri. Dominants: Cynometra alexandri, M. Laurentii, C. excelsa, Brachystegia sp.
8. Dense humid semi-deciduous subequatorial and guinean forest mixed with swamp forest. Dominants: Entandrophragma sp., M. Laurentii, Chlorophora sp., K. anthotheca.
9. Dense humid semi-deciduous subequatorial and guinean forests and dense secondary forests with savanna inclusions, including dense secondary forests with guinean savanna inclusions. Dominants: Entandrophragma sp., M. Laurentii, C. excelsa, Terminalia superba, Musanga cecropoides.
10. Dense humid semi-deciduous transitional submontane forests. Dominants: Entandrophragma sp., Milletia sp., Chlorophora sp., K. anthotheca, Puntumia latifolia.
11. Dense humid semi-deciduous subequatorial forests and peri-guinean gallery forests which at isolated massifs in the guinean savanna grade into sudano-zambezian elements, including guinean savannas with sudano-zambezian elements. Dominants: Entandrophragma sp., Milletia sp., Chlorophora sp., K. anthotheca.
12. Dense dry "Muhulu" forest. Dominants: Afromosica sp., Brachystegia sp., Albizia sp.
13. Coastal thickets and hardwood forests including mangrove. Dominants: Avicennia nitida, Rhizophora racemosa.
14. Dense humid semi-deciduous subequatorial and meandering forests mixed with tropophilic clear forest and transitional guinean wooded savanna with sudano-zambezian elements. Dominants: Milletia sp., Chlorophora sp.
15. Degraded dense dry forest replaced by tropophilic clear forest and zambezian savanna inclusions. Dominants: Dalbergina sp., Chrysobalenus orbicularis.
16. Degraded tropophilic clear forest on massifs or as islands surrounded by zambezian wooded savanna or chameaphytic savanna. Dominants: No information.

Dense humid semi-deciduous subequatorial and peri-guinean forest in galleries and guinean and sudano-zambezian wooded transitional savannas with inclusions of clear tropophilic forest. Dominants: Entandrophragma sp., Milletia sp., Chlorophora sp., Afromosia sp., Brachystegia sp.

18. Guinean and sudano-zambeian savannas, wooded on valley slopes and grassy on plateaus. Dominants: Hymenocardia sp., Bidelia ferruginea.
19. Zambeian steppe-savannas of the Bateke Plateau and the central Kwango Plateau. Dominants: Hymenocardia acida in association with Hyparrhenia sp.
20. Zambeian steppe-savannas of the high Katanga plateaus. Dominants: Hymenocardia acida in association with Hyparrhenia sp.
21. Wooded Acacia savannas on alluvial soils. Dominants: Acacia sp., Hymenocardia sp. in association with Hyparrhenia sp.
22. Swamp and marsh formations with Cyperus papyrus. Dominants: Cyperus papyrus.
23. Dense humid semi-deciduous subequatorial and peri-guinean forest as relict islands, and clear tropophilic forests and eastern and zambeian herbaceous savannas. Dominants: No information.
24. Dense humid montane forests, dense dry subalpine forests, and replacing herbaceous formations. Dominants: Olea-Chrysophylla, Jusminum abyssinicum, with Peridium aquilinum and Pennisetum purpureum.
25. Dense dry submontane forests and hardwood forests of alluvial plains, with wooded Acacia savannas and eastern-zambeian herbaceous savannas characterized by the presence of swamps or marshes. Dominants: Brachystegia sp., Pterocarpus angolensis, Hymenocardia acida, Acacia sp.
26. Dense dry submontane forests and hardwood forests on lava. Dominants: Brachystegia sp., Afromosia sp., P. angolensis.
27. Dense humid montane forests completely replaced with short Exotaeca abyssinica or crops.
28. Dense humid semi-deciduous submontane forests completely replaced with Hyparrhenia eastern savanna.
29. Dense humid semi-deciduous submontane transitional forests replaced by Brachyaria platynota grass.
30. Dense dry submontane and hardwood forest replaced by Brachyaria eminii.
31. Dense humid semi-deciduous submontane and transitional hardwood forest replaced by Pennisetum clandestinum.
32. Dense humid semi-deciduous transitional submontane forests replaced by herbaceous and wooded savannas. Dominants: Anardia sp., H. acida.

33. Wooded eastern savanna with sudanian elements. Dominants: Annona senegalensis, Albizia sp.
34. Guinean-eastern transitional wooded savanna with sudanian elements. Dominants: H. acida, Albizia sp.
35. Wooded sudanian savanna.
36. Mangrove.
37. Herbaceous Atlantic savanna.

TABLE 3-4

PERCENT BREAKDOWN OF VEGETATIONAL STRUCTURE IN ZAIRE  
BY VEGETATION TYPE

Veg. Type	<u>Percent</u>					<u>Notes</u>
	<u>Forest</u>	<u>Woodland</u>	<u>Savanna</u>	<u>Mangrove</u>	<u>Papyrus</u>	
1	100					
2	100					
3	100					
4	100					
5	100					
6	100					
7	100					
8	100					
9	70	20	10			
9'	20	70	10			
10	100					
11	10	70	20			
11'	10	20	70			
12		100				
13	20	40		40		
14	50	30	20			
15		80	20			
16		20	80			
17	20	20	60			
18		40	60			
19			100			
20			100			
21			100			
22					100	
23	10	50	40			(Absent in Zaire)
24	50	50				
25		60	30		10	
26		100				
27	100					
28	100					
29	60	40				
30		80	20			(Absent in Zaire)
31	50	50				
32	60	40				
33		20	80			
34		20	80			
35		10	90			
36				100		
37			100			
<hr/>						
<u>Total</u>						
%:	52.7	30.6	16.3	0.0+	0.4	
km2:	1,235,150	716,960	380,780	240	9,870	= 2,343,000 km2

Source: Preparer's estimate based on (11), data in (21), and Table 3-3.

TABLE 3-5

PERCENT BREAKDOWN OF NATURAL VEGETATIONAL STRUCTURE IN ZAIRE  
BY ADMINISTRATIVE REGION

Vegetational Structure

<u>Region</u>	<u>Percent</u>					<u>Total</u>
	<u>forest</u>	<u>Woodland</u>	<u>Savanna</u>	<u>Mangrove</u>	<u>Papyrus</u>	
Bas Zaire	19.1 (1.0)	46.1 (4.0)	34.4 (5.6)	0.4 (100.0)		100.0
Bandundu	59.8 (14.3)	22.1 (9.1)	18.2 (14.1)			100.1
Equateur	89.4 (29.2)	8.8 (4.9)	1.9 (2.0)			100.1
Haut-Zaire	65.5 (26.7)	26.3 (18.5)	8.2 (10.8)			100.0
Kivu	73.4 (15.2)	20.5 (7.3)	6.0 (4.0)		0.2 (4.8)	100.1
Kasai-Or.	45.1 (6.1)	40.1 (9.4)	14.8 (6.5)			100.0
Kasai-Occ.	52.2 (6.6)	36.5 (8.0)	11.3 (4.7)			100.0
Shaba	2.1 (0.8)	56.0 (38.8)	40.1 (52.3)		1.9 (95.2)	100.1
<b>Total zaire</b>	<b>52.7</b>	<b>30.6</b>	<b>16.3</b>	<b>0.0+</b>	<b>0.4</b>	<b>100.0</b>
<b>Total Percent</b>	<b>(99.9)</b>	<b>(99.9)</b>	<b>(100.0)</b>	<b>(100.0)</b>	<b>(100.0)</b>	<b>(100.0)</b>

Source: Tables 3-1, 3-3 and 3-4.

#### 4.0 HUMAN GEOGRAPHY

"We cannot tell the needy of the world that they must cease and desist in the struggle for survival to prevent a catastrophe whose dimensions, consequences, or mitigating conditions we cannot define with any certainty."

—Ariel E. Lugo

#### 4.1 BASIC RELEVANT NATIONAL STATISTICS

Basic national statistics relevant to the conservation and management of tropical forests and biodiversity in Zaire are presented in Tables 4-1, 4-2, 4-3 and 4-4. Certain of these statistics are of particular importance in developing an empirical framework within which fundamental pressures on tropical forests and biological resources can be evaluated, since it is largely the traditional agricultural sector which is responsible for deforestation in most of the world (62,98) as well as in much of Africa (24) and in Zaire (Sct. 9.0).

Zaire is about a third the size of the continental United States (15) and had a 1984 population size of about 29.4 million, giving a 1984 average national population density of only about 12.7/km<sup>2</sup>. The rural population density of the country, however, was only about 10.6/km<sup>2</sup> in 1984 and varied considerably according to region. Bas-Zaire, Kivu and Kasai-Occidentale had rural population densities well in excess of the norm, especially along the axis from the coast to Mbuji-Mayi (ca. 300,000 km<sup>2</sup>, 25/km<sup>2</sup>); along the eastern mountain axis (ca. 70,000 km<sup>2</sup>, 50/km<sup>2</sup>); and along a northern axis from about

Gemena to Isiro (ca. 120,000 km<sup>2</sup>, 19/km<sup>2</sup>) (43). This constitutes only about 21% of the country, however, and population densities over most of the rest of Zaire, especially in Shaba, Equateur and Haut-Zaire, are low to extremely low (6.3-8.1/km<sup>2</sup>; Table 4-3); indeed, densities in the central rain forests and in about 30% of Shaba often fall below 1/km<sup>2</sup> (Fig. 4-1)(43). To put this into perspective, and while there remains considerable debate about what levels of population density can be supported under a shifting agricultural system, published estimates vary from 56/km<sup>2</sup> to as high as 123/km<sup>2</sup> which could be supported "without destroying the environmental balance" depending upon the fertility of cultivable land (91).

Both the low overall population size of Zaire in relation to its natural resources and the extremely low densities prevailing over vast areas of the country have led to speculation as to why the Congo Basin in general supports a human population that is far lower than similar habitats elsewhere in tropical Africa. Miracle (58), for example, in discussing the extremely low population densities found in Zaire's rain forests, notes that similar forests in Nigeria support over 25 times as many people per square kilometer even where agricultural practices are extremely similar.

Here as elsewhere in Africa, statistics related to the two megatrends of rural-urban migration and movement from the agricultural to other economic sectors are particularly important in this respect. The percent of the Zairean population that is considered urban increased from about 1% in 1900 to about 45% in 1988, with about 24% of the population currently living in cities of over 100,000 population. While the average annual population growth rate of Zaire is now about 2.9%/yr, the urban growth rate is on the order of 5.2% and rural growth rates currently average only about 1.3%/yr. Related to this phenomenon is a prevailing shift out of the agricultural sector, with the percent of the Zairean labor force working in agriculture declining from about 83% in 1960 to about 67% currently (Table 4-1).

G.R. = 2.9%

45% urban

4-2

45'

The fact that overall population pressure on biological resources in Zaire is for the most part minimal (with notable exceptions such as the montane and urban halo areas) is also reflected in the land use statistics. Of the entire country, about 78% was woodland or forest, 4% pasture, 2.7% farmland, 15% "other land," and 3.3% inland water in the early 1980's (Table 4-1). More precise figures for 1981 show that only 2.1% of all land was in agricultural production, 90% of which was under traditional crops (72), and one particularly detailed study found that less than 0.5% of the geographical square degree of latitude and longitude around the city of Lubumbashi was under crop production (53). Moreover, the average rural Zairean, including men, women and children, had an average of about 13.6 ha at his or her disposal in 1970, varying from 5.4 ha in Bas-Zaire to 27.0 ha in Shaba, and probably has on the order of about 12 ha at his or her disposal today (Table 4-4). agric

The facts of low overall national population and very low general rural population densities are also reflected in the extremely low estimated deforestation rate currently prevailing in Zaire, ca. 0.15-0.50%/yr (see Sct. 9.4). While from the global mass deforestation perspective the current situation in Zaire is therefore probably one of the 'least bad' found anywhere in the world (62), in order to evaluate biodiversity issues it is necessary to assess the distribution of human impact in relation to important biological resources. There exist in Zaire, for example, areas where rural population densities are relatively high and where fallow periods are said to be significantly declining as a result of local population pressure and/or increasingly sedentary agricultural practices. There are also other areas where deforestation is relatively significant as a result of urbanization, mining or other activities, and some of these areas such as parts of Kivu, the Kisangani region and certain areas affected by mining and industrial activities in Shaba happen to coincide with areas of particular global biological concern. These issues are discussed in greater detail in Sct. 8.0.

## 4.2 AGRICULTURE AND ANCILLARY ACTIVITIES IN ZAIRE

"One person's 'habitat destruction' will almost certainly be another's source of food or income."

—Peter M. Vitousek

### 4.2.1 Agriculture

Zaire is an extraordinarily diverse country from the topographical, edaphic, hydrological and climatic perspectives, and agricultural systems in Zaire are concomitantly diverse. Agriculture can generally be broken down, however, into the traditional, semi-traditional and mechanized subsectors. Major crops produced in Zaire are listed in Table 4-5, along with information on the principal subsector (industrial vs. traditional) producing those commodities and their end use. Traditional agriculture is the primary rural economic activity prevailing throughout Zaire. It accounts for about 78% of total agricultural production, it is generally characterized by no use of pesticides, fertilizers or improved genetic stock, and it is typically carried out in its entirety by manual labor (71). "Traditional agriculture," "slash and burn agriculture," and "shifting agriculture" here refer, following UNFAO convention, to systems "in which relatively short periods of continuous cultivation are followed by relatively long periods of fallow"; while no longer as common in Africa as it once was, shifting cultivation remains the dominant form of farming in much of the Zaire river basin (91).

Most rural groups have always adopted and produced a wide range of agricultural commodities in Zaire. For example, at least 16 crops were grown in Bas-Zaire in 1948, at least 16 by the Bemba in the 1930's, 30 by the Mandja in 1911, 52 by the Azanda in 1945 and 60 by the Banda in 1953. From 1830-1960 alone, moreover, there is documentation of the introduction of 73 crops or domestic animals. Nonetheless, cassava (manioc) and corn (maize) are the most important of these crops since they have become dietary staples and often account for over 60% of total caloric intake (58). While intercropping predominates, there is also said to be an increase in monocropping of manioc because of its higher production yields (71). Savanna fallows are said to currently average about 3-4 years and forest fallow about 7-10 years in Zaire, in spite of considerable variability (71).

Semi-traditional agriculture is said to be increasing in many parts of Zaire, e.g., 6 of the 18 zones of Kivu. It is typically characterized by 1) greater intensivity and lesser extensivity than traditional agriculture; 2) shorter fallow periods; 3) increased use of leguminous crops and composting; 4) a general absence of mechanization; and 5) a general lack of use of pesticides. Increasingly common in the more fertile mountainous areas of eastern Zaire, semi-traditional agriculture will probably continue to replace traditional agriculture in areas of higher population density. Zaire ranks 17th worldwide in coffee production (1.7% of the world's crop (36)) and approximately 70% of the nation's coffee is said to be produced in village plantations (71). This represents, along with increased planting of cocoa and other tree crops, a shift from a purely traditional to a semi-sedentary or sedentary agricultural subsistence base.

The mechanized agricultural subsector in Zaire is characterized as in most of Africa by some degree of mechanization, use of fertilizers and pesticides, increasing use of improved genetic stock, and modern planting techniques. A major constraint to the mechanized subsector includes poor transportation infrastructure, high cost and low availability of farm machinery, and high

recurrent costs (71). Major mechanized agricultural operations in Zaire include 1) dairy, egg, swine, vegetable, corn, rice and pineapple production in the urban Kinshasa, Lubumbashi and Mbuji-Mayi areas; 2) maize and soya production in Shaba, especially destined for mining centers; 3) 10,000 ha of sugar cane in Bas-Zaire and 1200 ha in Kivu; 4) production of 50% of Zaire's palm tree plantations (30,000 ha), 5000 ha of rubber, 3000 ha of cocoa and 500 ha of tea throughout Zaire; and 5) 10,000 ha of coffee plantation at Nogueira (71).

#### 4.2.2 Hunting and Fishing

Fishing is the main occupation (58) of only a handful of the 500+ ethnic groups found in the Zaire Basin (43), but hunting occurs almost everywhere. It has been estimated that 75% of all animal protein consumed by Zaireans is bush meat (28) and that an estimated 80,000-100,000 tons of game meat and 40,000 tons of insect protein are consumed annually (36, 81). Wild herbivores (e.g., Sylvicapra, Redunca, Tragelaphus, Hippotragus, Alcelaphus) and rodents (e.g., Cricetomys) are said to be particularly favored and wild game meat prices in cities and towns are said to be typically higher than for domestic beef (30). Studies in Haut-Zaire found that an average of 2-4 meals per week include game meat for most families in Kisangani; that at least 73.1% of all inhabitants in Bukavu (Kivu) consume bush meat (36); and that after closing of the hunting season in Shaba prices for game meat escalated dramatically and poaching increased (30). The role of insects and molluscs is also substantial, and they are said to be the second dish of choice in many areas. Of particular importance are certain types of larvae, termites and grasshoppers, whose protein content may vary from 31-70% (30).

Game populations in Zaire have been severely depleted during the last 50 years due to better availability of firearms, although no data on firearms more recent than 1952 are available (72). Shot for food, sport and animal

products, the loss of game has probably meant a significant loss in the production potential of the environment in some areas. This is especially true where cattle cannot be kept because of trypanosomiasis (a disease spread by at least 18 species or subspecies of Glossina and occurring in every administrative region of Zaire (51)), and where game is a major source of meat. The relative impact of hunting on wildlife populations, however, is extremely variable depending upon population density, the nature of the game populations hunted, and game population dynamic phenomena in relation to hunting pressure.

tsese

#### 4.2.3 Livestock

Until recently, relatively few Zairian ethnic groups kept cattle except in scattered locations in the west, northwest, southwest and southeast of the country. Large estates and ranches have long engaged in livestock raising, however, and the subsector employed about 364,000 workers in 1970 (81). While the total amount of used pasture in Zaire is unknown, it was estimated in 1985 that 15.5 million ha or about 6.6% of the country consisted of "available pasturage" (72). Goats, sheep and chickens are widely found, and swine are raised in the southwest, parts of the southeast and in some northcentral and eastern portions of the watershed. Pigeon raising, in addition, is also said to occur in southcentral portions of the country (58).

#### 4.3 INDUSTRY IN ZAIRE

Industry in Zaire is important to conservation and management of tropical forests and biodiversity primarily insofar as the geographical distribution of industrial activities occurs in relation to important biological resources. Of particular importance are the mining, hydroelectric, petroleum, ancillary manufacturing and timber industries.

Mining in Zaire is concentrated in four general areas. The first is in southernmost and to some extent central Shaba (along an axis from Kolwezi to Kalemie) where copper, cobalt, zinc, manganese, gold, silver, cadmium, tin and coal are mined. The predominant vegetation here is wetter Zambezian miombo woodland with some Acacia grassland and gallery forest inclusions. The second is the Mbuji-Mayi area of Kasai-Orientale and the Tshikapa area of Kasai-Occidentale where diamonds are mined from kimberlite and alluvial deposits respectively. These two areas were both formerly characterized by a mosaic of lowland rain forest and secondary grasslands. The third area of mining concentration is in central and eastern Kivu, characterized generally by evergreen and semi-evergreen lowland rain forest and a montane forest-secondary grassland mosaic. The final area of mining concentration is in eastern Haut-Zaire, characterized generally by the presence of lowland and montane forests in a mosaic with secondary grasslands (34,43,81).

The greatest hydroelectric capacity in Zaire is in Bas-Zaire, where the Inga I and II facilities exist on the lower Zaire River. There are approximately 30 other small to medium sized hydroelectric plants, however, concentrated in Shaba and eastern Zaire on the Lufira, Lualaba and Zaire rivers and their major tributaries, many of which were developed to serve the mining centers. A transmission line to move power from Bas-Zaire to Shaba, the Inga-Shaba DC line, was also completed in the early 1980's and transected a broad range of forest, woodland and savanna vegetation types (34, 43, 81).

Petroleum production in Zaire is limited to offshore production near Matadi, and all domestic refining of imported crude oil for gasoline, kerosene and fuel and gas oils also occurs on or near the coast. Two vegetation types of extremely limited national but far greater worldwide extent occur in this area, i.e., mangrove and Atlantic herbaceous savanna (34,43,81).

Ancillary manufacturing occurs in scattered locations throughout the country, but is very heavily concentrated in Kinshasa, Bas-Zaire and Shaba with secondary concentrations along the Kananga to Mbuji-Mayi axis and an axis from

northeastern Haut-Zaire through eastern Kivu that again corresponds roughly with the main concentration of mining centers. Ancillary manufacturing industries primarily include those related to food, beverages, tobacco, textiles, leather, shoes, chemicals and non-metallic metals (34,43,81).

The timber resources of Zaire are vast, ranking second in the world with about 50% of total African reserves (41) and 6.5-ca. 10.0% of total world reserves in the late 1970's (41,81). About 76% of these forest resources are considered exploitable, but only about 0.03% were exploited in 1985 (36). All forested lands and the growth thereon belong to the state according to the Zairean constitution, and cutting permits are issued for one year to small operators to cut areas of up to 100 ha. Although most numerous of all timber exploiters, such operators typically produce less than 1000 m<sup>3</sup>/yr each. Their activities are widely scattered in remote parts of the country and while locally important are negligible in terms of volume cut. About 90% of all of the logs, sawwood and veneer in Zaire is cut by 7 companies, one of which accounts for nearly half of all production (41). It has been estimated (Mbaelele cited in (36)) that for every cubic meter of commercial wood exploited about 3 m<sup>3</sup> of non-commercial timber is lost directly as a result of the cutting and extraction processes.

Not  
same  
system  
as  
above?

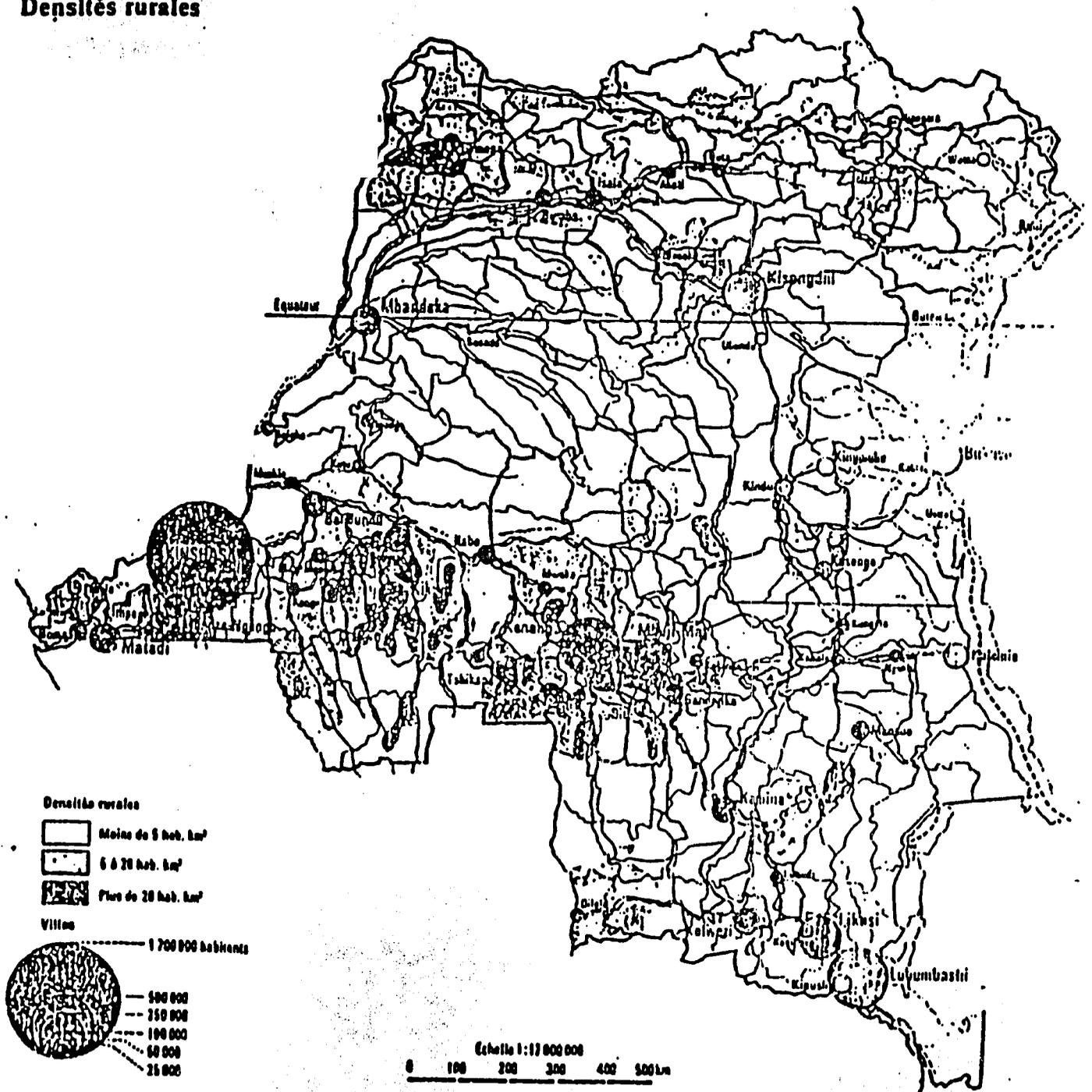
Most timber exploitation was originally carried out in the Mayombe forest area of Bas-Zaire due to lower transportation costs associated with the Mayombe's proximity to the coast, but this 2500 km<sup>2</sup> area was seriously depleted by the mid-1960's and production was restricted in about 1969 (81). Two other areas of concentration are the Mai-Ndombe lake area in northern Bandundu and an area in northern Equateur between the Zaire and Ubangi rivers, both of which are located close to the transportation facilities along the Zaire River. In the vast Cuvette Central, however, only about 60% of the timber has been considered accessible and desirable species are more well intermixed with less desirable species increasing the harvesting cost of marketable varieties. In the mid 1970's total production in Zaire was only about 500,000 m<sup>3</sup>/yr, in

52

contrast to the 9-30,000,000 m<sup>3</sup>/yr potential depending on species used; this considerable underutilization of the resource in relation to its potential was reflected in the fact that the timber industry accounted for only about 0.3% of Zaire's GDP in the late 1970's (81). It has been estimated that current offtake levels affect about 100,000 ha/yr, in contrast to a total reforested area of about 22,500 ha as of the end of 1981 (36).

The timber industry continues to be constrained by relatively poor transportation infrastructure, particularly roads, and concomitantly high transport costs. Although there is considerable reliance upon the Zaire and Kasai rivers for roundwood transportation, access into much of the central rain forest remains extremely limited (81).

**Densités rurales**



**Fig. 4-1. Geographical distribution of population density in Zaire.**  
 Source: (39).

TABLE 4-1

**BASIC NATIONAL STATISTICS RELEVANT TO THE CONSERVATION AND MANAGEMENT OF  
TROPICAL FORESTS AND BIOLOGICAL DIVERSITY  
IN ZAIRE**

(Data in parentheses correspond to references in parentheses)

<u>PARAMETER</u>			<u>REFERENCE</u>
<u>Land Area:</u>	2,268,000 km <sup>2</sup>		99
<u>Water Area:</u>	78,000 km <sup>2</sup>		99
<u>TOTAL:</u>	2,345,000 km <sup>2</sup>	(2,345,236 km <sup>2</sup> ) (2,344,885 km <sup>2</sup> )	99, 33 (35) (81)
		<u>POPULATION</u>	
<u>Size</u>			
1937:	10,000,000		43
1958:	12,770,000		43
1960:	17,775,000	(17,664,000)	99 (33)
1970:	21,640,000		43
1974:	24,320,000		43
1975:	21,637,867		81, 32
1977:	26,300,000	(25,915,000)	81 (15)
1980:	29,443,000		72
1981:	30,261,000		72
1982:	30,700,000		33
1984:	29,671,407		69
1985:	33,052,000	(33,100,000)	99 (70)
2000:	52,410,000	(52,400,000)	99 (70)
2020:	93,300,000		70
<u>Urban as Percent of Total</u>			
	1900:	1.0	58
	1960:	22.3	99 (33)
	1982:	38.0	33
	1984:	30.0	36
	1985:	44.2	99
		(16.0)	
<u>Percent Population in Cities Over 100,000</u>			
	1960:	10.0	99
	1970:	14.9	81
	1980:	23.1	99
	1984:	24.0	70
<u>Average Annual Growth Rate, Total</u>			
	1960-65:	1.90%	99
	1970-75:	2.65%	99
	1980-85:	2.94%	99 (70)
	2000-05:	3.10%	99
		(2.9%/1985)	
<u>Average Annual Growth Rate, Urban</u>			
	1960-65:	5.0%	99
	1980-85:	5.2%	99
<u>Average Annual Growth Rate, Rural</u>			
	1960-65:	0.9%	99
	1980-85:	1.3%	99

PARAMETERREFERENCEMiscellaneous Rates

Crude Birth:	45	70
Crude Death:	16	70
Total Fertility:	6.1	70
Infant Mortality:	106	70
Natural Increase:	2.9% Annual	70
Doubling Time (1984):	24 years	70
<u>Life Expectancy:</u>	56 years	70
<u>Percent of Population Under 15:</u>	45	70
<u>Percent of Population Over 64:</u>	3	70

ECONOMICS

<u>GNP, Total, 1981:</u>	US\$ 5.05 billion	99
<u>GNP, Per Capita, 1983:</u>	US\$ 160 (US\$ 740)	99 (70)

Average Annual Growth Rate of GNP

1960-65:	4.0%	99
1975-83:	0.0%	99

LABOR

<u>Total Labor Force, 1983:</u>	12,717,000	99
---------------------------------	------------	----

Percent Labor Force In

Agriculture (1960):	83%	33
Agriculture (1965):	81%	99
Agriculture (1970):	74.5%	32
Agriculture (1980):	75%	33
Agriculture (1981):	75%	99
Agriculture (1986):	67%	36
Industry (1965):	10%	99
Industry (1981):	13%	99
Industry (1986):	15%	36
Services (1965):	9%	99
Services (1981):	12%	99
Services (1986):	18%	36

Average Annual Growth Rate

1965-73:	1.8%	99
1973-83:	2.2%	99
1980-2000:	3.0%	99

LAND USEForest and Woodland (% of Total)

1964-66:	80	99
1981-83:	78	99

Meadows and Permanent Pasture (% of Total)

1964-66:	4	99
1981-83:	4 (6.6)	99 (72)

<u>PARAMETER</u>		<u>REFERENCE</u>
<u>Arable and Permanent Cropland (% of Total)</u>		
1964-66:	2.42	99
1974-76:	2.61	99
1981-83:	2.73 (2.07)	99 (72)
<u>Other Land (% Of Total)</u>		
1964-66:	13	99
1981-83:	15	99
<u>Water (% of Total)</u>		
	3.3	99
<u>AGRICULTURE</u>		
<u>Farm Size</u>		
Savannas		
(1978):	1.5-2.5 ha	81
Forest		
(1978):	0.5-1.0 ha	81
<u>Number of Traditional Farms</u>		
(1970):	2,941,294	32
(1978):	ca. 3,000,000	81
<u>Average Number of People Per Farm</u>		
(1970):	5.48	32
<u>Irrigated Land as Percent of Cropland</u>		
1974-76:	0%	99
1981-83:	0%	99
<u>Kg. Fertilizer/Ha of Cropland</u>		
1964-66:	0	99
1974-76:	1	99
1981-83:	1	99
<u>Calories Domestically Produced as Percent of Supply</u>		
1967-70:	102	99
1977-80:	96	99
<u>Tractors/1000 ha of Cropland</u>		
1964-66:	0.2	99
1974-76:	0.2	99
1981-83:	0.3	99
<u>Traditional vs. Commercial Crops (1981)</u>		
Traditional:	4,348,000 ha (1.85%)	72
Commercial:	497,000 ha (0.2%)	72

PARAMETER

REFERENCE

FORESTS, WOODLANDS AND WOOD PRODUCTS

Forest Area

1,000,000 km2	(42.6%)	(1977)	87
1,023,000 km2	(43.6%)	(1981)	28
1,057,500 km2	(45.1%)	(1984)	61
1,059,750 km2	(45.2%)	(1980)	99
1,378,700 km2	(58.8%)	(1980)	36

Woodland Area

718,400 km2	(31.7%)	1980 (All woodland)	99
95,000 km2	(4.2%)	1977 (Miombo woodland only)	87

Plantations

600 km2	(0.03%)	1977	87
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Deforestation Rate

1967-80:	1650 km2/yr	(0.16%/yr)	36
1981-85:	1820 km2/yr	(0.17%/yr)	99
Recent:		(0.15-0.50%/yr)	t. 9.4

Roundwood Production (m3)

1972:	23,424,000		41
1977:	26,432,000		41
1981-83: Total:	30,400,000	(100%)	99
	Industrial:	2,410,000 (8%)	99
	Fuelwood and Charcoal:	27,990,000 (92%)	99
1987:	30,391,000		41

Fuelwood and Charcoal Production

1973:	21,800,000 m3		99
1983:	28,800,000 m3		99
Percent Increase:	7		99

Forest Area as Percent of All African Forest

47%			99
51%			87

COASTAL RESOURCES

<u>Length of Coastline:</u>	37 km		99
<u>Area of Mangroves:</u>	200 km2		99
<u>Area of Seagrass Beds:</u>	0 km2		99
<u>Area of Coral Reef:</u>	0 km2		99
<u>Average Annual Fish Catch:</u>	1000 metric tons	(Marine only)	99

TABLE 4-2

BASIC REGIONAL AREA AND POPULATION

STATISTICS FOR ZAIRE

<u>Region</u>	<u>Area (km2)</u>	<u>%Area</u>	<u>1984 Pop</u>	<u>% Pop</u>	<u>1984 Pop Den</u> (#/km2)
Kinshasa	9,965	0.4	2,653,558	8.9	266.3
Bas Zaire	54,078	2.3	1,971,520	6.6	36.5
Bandundu	295,658	12.6	3,682,845	12.4	12.5
Equateur	403,292	17.2	3,405,512	11.5	8.4
Haut Zaire	503,239	21.5	4,206,069	14.2	8.4
Kivu	256,803	11.0	5,187,865	17.5	20.2
Shaba	496,977	21.2	3,873,019	13.1	7.8
Kasai-Or.	168,216	7.2	2,402,603	8.1	14.3
Kasai-Occ.	156,967	6.7	2,287,416	7.7	14.6
<b>TOTAL</b>	<b>2,345,195</b>	<b>100.1</b>	<b>24,671,407</b>	<b>100</b>	<b>12.7</b>

All Data from (69).

TABLE 4-3

URBAN AND NON-URBAN POPULATION DATA

<u>Region</u>	<u>Urban Sites</u>	<u>Area (km2)</u>	<u>1984 Pop</u>	<u>Urban Density (/km2)</u>	<u>Non-Urban Density (/km2)</u>
Kinshasa	Kinshasa	9,965	2,653,558	266.3	N.A
Bas Zaire	Matadi	110	144,742	1315.8	33.8
Bandundu	Kikwit	200	146,784	733.9	11.8
	Bandundu	222	63,189	284.6	
Eguateur	Mbandaka	460	125,263	272.3	8.1
Haut Zaire	Kisangani	1,910	282,650	148.0	7.8
Rivu	Bukavu	60	171,064	2851.7	19.5
Shaba	Lubumbashi	747	543,268	727.3	6.3
	Likasi	235	194,465	827.5	
Kasai-Or.	Mbuji-Mayi	64	423,363	6615.0	11.8
Kasai-Occ.	Kananga	378	290,898	769.6	12.8
<b>TOTAL Urban</b>		<b>14,351</b>	<b>5,039,244</b>	<b>351.1</b>	
<b>TOTAL Non-urban</b>		<b>2,330,844</b>	<b>24,632,163</b>		<b>10.6</b>
<b>TOTAL</b>		<b>2,345,195</b>	<b>29,671,407</b>		<b>12.8</b>

1984 population data from (69); cities over 50,000 only. Area data from (81), except for Kinshasa (from (69)). The area and population of Maluku, Kinshasa's only rural zone, was included in the Cataracts Subregion of Bas-Zaire.

TABLE 4-4

BASIC TRADITIONAL FARM DATA FOR ZAIRE

<u>Region</u>	<u>Farm Pop.</u>	<u>No. of Farms</u>		<u>No of Forest Farms (1985)</u>	<u>Mean No. of People/Farm</u>	<u>No. Farms/km2 Non-urban land</u>	<u>Ha/Capita</u>
		<u>1970</u>	<u>1985</u>				
Bas-Zaire	1,151,217	215,584	290,147	55,419	5.34	3.49	5.37
Bandundu	2,180,356	387,964	522,200	312,276	5.62	1.31	13.58
Equateur 19.35	2,079,858	366,172	492,868	440,624	5.68	0.91	19.35
Haut-Zaire	2,738,714	570,565	767,980	503,027	4.80	1.14	18.27
Kivu	2,896,765	445,656	599,853	440,292	6.50	1.74	8.84
Shaba	1,841,928	368,386	445,848	10,413	5.00	0.74	27.03
Kasai-Or.	1,469,268	290,369	390,837	176,268	5.06	1.73	11.42
Kasai-Occ.	1,767,723	296,598	399,221	208,393	5.96	1.89	8.88
<b>TOTAL</b>	<b>16,125,829</b>	<b>2,941,294</b>	<b>3,958,954</b>	<b>2,146,712</b>	<b>5.84 (mean)</b>	<b>1.26 (mean)</b>	<b>13.59</b>

Source: Ref. (32)

1985 Data on No. of farms assumes 2.0% increase in rural population per year, 1970-1985, and no change in mean number of people per farm, i.e., 1970 figure plus 34.6%.

1985 Data on No. of forest farms assumes number of farms in forests is proportional to the amount of each region which is forested.

TABLE 4-5

AGRICULTURAL PRODUCTION, SELECTED COMMODITIES, 1984

<u>Crop</u>	<u>Production (1000's mt)</u>	<u>Subsector/End Use</u>
Cassava	15,038	Traditional
Bananas/Plantain	1,438 (1981)	Traditional
Maize	704	Industrialized, domestic
Other Roots and Tubers	430 (est. 1972)	Traditional
Groundnuts	376	Industrialized, domestic
Rice, Paddy	286	Industrialized, domestic
Palm Oil	93	Industrialized, export
Fibers	125 (est. 1972)	Traditional
Tomatoes, squash, vegetables	100 (est. 1972)	Traditional
Coffee	89	Industrialized, export
Fish	70 (1972)	Industrialized, domestic
Millet and sorghum	57 (1972)	Traditional
Peas and Beans	156	Traditional
Sugar	61	Industrialized, domestic
Oil Cakes	49 (1972)	Industrialized, export
Rubber	16	Industrialized, export
Palm Kernel Oil	18	Industrialized, export
Meat	86	Industrialized, domestic
Cotton (fiber)	7	Industrialized, domestic
Tea	5	Industrialized, export
Cocoa	4	Industrialized, export
Groundnut Oil	1 (1972)	Industrialized, domestic

Sources: Production figures from Ref. (68) for 1984 and from (67) and (32) for other years. Figures rounded to nearest whole number. Subsector/end use information from Ref (32).

## 5.0 STATUS AND MANAGEMENT OF PROTECTED AREAS

"Biotic diversity is not linked to the distribution of elephants, rhinos, and other so-called charismatic megaherbivores. The massive investment in conservation campaigns directed at these species does more for the souls of the donors and the egos of the elephant experts than it does for biotic diversity, which is centered on less exciting communities."

—Brian J. Huntley

The creation and management of protected areas in Zaire is a priority recognized at the highest levels of government, and on 20 May 1970 the President of the Republic established a goal of 12-15% of the country to ultimately be set aside as "natural reserves". To date, and in addition to ex-situ zoological and botanical gardens, about 181,000 km<sup>2</sup> or 9.6% of the country is believed to have some official protected status and establishment of an additional 1.0% of the country as national park is considered "imminent" (Table 5-1).

Of Zaire's existing protected areas, about 10 covering circa (ca.) 87,600 km<sup>2</sup> (3.7% of the country) can be considered major conservation areas. To put this into its global perspective, there are about 3500 major conservation areas worldwide covering ca. 4,250,000 km<sup>2</sup> (2.9% of the Earth land surface) and including about 178 of the 193 biogeographical provinces recognized by IUCN (41). Also from the global perspective, no biogeographical provinces occur in Zaire which are either without protection worldwide or which contain less than 5 protected areas or less than 100 protected square kilometers worldwide (27).

Such a global mass appraisal, however, ignores the numerous minor biotic communities characterized by extremely high biotic diversity for which a determination of the adequacy of their inclusion in Zaire's protected area system is currently impossible. This issue is discussed further in Sct. 9.1. Zaire's protected areas currently include six principal types of conservation sites: 1) national parks, 2) MAB Biosphere Reserves, 3) nature reserves, 4) forest reserves, 5) hunting reserves, and 6) 'secteurs sauvegardés' or safeguarded sectors (Fig. 5-1). IZCN is charged with management of national parks, nature reserves and hunting reserves, DGRNR is charged with management of forest reserves, and the MAB/Zaire Program is charged with management of Zaire's biosphere reserves.

In describing problems of conservation peculiar to different countries in West and Central Africa, IUCN (34) noted that "Zaire has a good network of national parks and reserves and continues to promote an effective policy for the conservation of natural environment and fauna. Special attention should be given to the suppression of poaching and trans-frontier trafficking in, for instance,...large quantities of ivory and leopard skins..." The legislative status and effective management of these various types of protected areas in Zaire, however, is extremely variable. Significant problems include lack of technical knowledge regarding the natural resources of the areas, lack of or inadequate legislative or statutory protection for some areas, and especially lack of funding to adequately manage a protected area system of this size and diversity in a nation the size of Zaire given prevailing infrastructural and especially transportation limitations.

5.1 NATIONAL PARKS 4.6%

Basic data for eight existing and three proposed national parks in Zaire are presented in Table 5-1 along with information on the Swa-Kibola area

whose status has yet to be defined. Covering about 107,360 km<sup>2</sup> or about 4.6% of the country, these existing and proposed parks appear to include most of the major vegetation types and biotic communities of Zaire as defined by Devred (11) and IUCN (34). Of the 14 major types of biotic communities of West Africa as defined by IUCN found in Zaire, for example, 12 occur within the boundaries of existing national parks. These include 1) Guineo-Congolese Evergreen Lowland Rain Forest; 2) Guineo-Congolese Semi-evergreen Lowland Rain Forest; 3) African Submontane and Transitional Rain Forest; 4) Swamp Forest; 5) Mosaic of Swamp Forest and Evergreen Lowland Rain Forest; 6) Guineo-Congolese Lowland Rain Forest-Secondary Grassland Mosaic; 7) Montane Forest-Secondary Grassland Mosaic; 8) Wetter Zambezian Miombo Woodland; 9) Wetter Zambezian Miombo Woodland-Secondary Grassland Mosaic; 10) Acacia polycantha Secondary Wooded Grassland; 11) East African Evergreen Bushland-Acacia Wooded Grassland Mosaic; and 12) Edaphic Grassland on Kalahari Sands (34). An additional community type, West African Coastal Mosaic which is dominated by mangrove vegetation, is included in the proposed Moanda NP. The last type, IUCN's Undifferentiated Sudanian Woodland, occurs only in a very isolated location of Zaire near Lake Mobutu, is well represented in parks in other countries in Africa (e.g., Senegal), and in any case is characterized by vegetation almost all of which has been modified by cultivation, cutting, grass fires and grazing as a result of centuries of habitation by man (34).

Floristic surveys are extremely limited or nonexistent for most of Zaire's national parks, however, and it is impossible to ascertain which of the 36 major vegetation types of Devred (11) found in Zaire are not included or are not adequately included in the national park system. This of course also holds true for the many minor vegetation types such as those associated with copper or other mineral outcrops, as well as for animal species. About 29 or 47% of the non-marine threatened or endangered species listed by U.S. Department of Interior (US/DOI), IUCN, or CITES (see Table 6-1) are known from available literature to occur in one or more of the national parks, however, and most are likely to occur somewhere within the national park system.

The best available references on disturbances and management effectiveness in Zaire's NP's are (35), (36), (37), (38) and (39). In general, the most important problem cited is poaching (7 parks), with other important problems including perimeter population pressures, illegal settlement, illegal mining, tree felling and general habitat destruction, grazing by cattle, fire, fishing and declining tourist revenues (Table 5-1).

Production of management plans for Zaire's national parks and creation of new parks are priorities under the 1986-1990 Five Year Plan for Zaire. Management plans are expected to be founded on data bases of plant and animal distributions and to emphasize management zones as a function of key ecological variables. In accordance with the UN Five Year Action Plan for Tropical Forests, 1986-1990, priority has been accorded to parks including humid forest ecosystems (56). Activities in five particular national parks, three existing and two proposed, are of particular note.

The Salonga NP, the largest national park in the world dominated by true forest at 36,000 km<sup>2</sup> and located near the center of what is considered by some as the largest Pleistocene refugium in the central Zaire Basin, saw the creation of the Salonga National Park Foundation by the GOZ in collaboration with UNESCO in 1987 (56). This action, designed to solicit necessary funds to inventory, manage and protect the park, followed the International Conference on the Future of the Salonga NP held in Mbandaka, Zaire. Significant interventions are currently planned for this park by IUCN (36).

In the Virunga NP, basic ecological and management studies undertaken with Belgian cooperation are now being followed up by a five year, US\$ 10,000,000 development project funded by the EEC. The Frankfurt Zoological Society (FZS) and WWF have also established a program to improve tourism, public education and wildlife protection here, focussing especially on the mountain gorilla and chimpanzee, and an archeological and natural history museum is being established in the park in cooperation with the Virginia Natural History

Museum. This park is of extreme interest from the global biodiversity perspective; containing at least 177 mammal species, it is considered one the richest, especially for its size, found anywhere in the world (36).

In the Kahuzi-Biega NP, located in one of the most densely populated regions of the country, efforts are being undertaken by the GOZ and West Germany to promote integration of conservation with rural development and public education (56). This park, originally created to protect the mountain gorilla, is said to be significantly threatened by population pressure (36).

Also in accordance with the Five Year Plan for Zaire, IZCN is undertaking studies leading to the selection of new areas suitable for establishment of two new national parks. The Mangrove or Moanda NP is expected to be created at the estuary of the Zaire River to protect this nationally important habitat from "the risk of development and pollution" (56). Surveys supported by UNESCO in 1984 have identified appropriate park boundaries, and the proposal is now being completed for submission to the President of Zaire for approval. The New York Zoological Society is undertaking studies of the okapi in the Ituri Forest, one of the largest intact rain forests in Zaire and with exceptionally rich flora and fauna, and WWF with support from the Zaire-based company Taba Zaire will finance with US\$ 300,000 over 3 years the development of a national park there. Additional support for this project is said to be forthcoming from the FZS and from the American company Animals in Motion (56).

## 5.2 BIOSPHERE RESERVES

Zaire has three UNESCO MAB Biosphere Reserves encompassing an area of 267,414 ha or about 0.1% of the country (Table 5-1). These include 1) the Yangambi Reserve in Haut-Zaire and the Luki Reserve in Bas-Zaire, where research on the ecological effects of human development impact on humid

3 MAB  
reserves

forests is carried out, and 2) the Lufira Valley Reserve in Shaba where research on interactions between human activities and pastoral resources is carried out with a view towards developing a method to control soil erosion. For all practical purposes, these reserves were established by UNESCO under ad hoc deliverance of attestation after which preliminary boundary delimitation and feasibility studies were undertaken. There is, however, no adequate legislation relative to the creation and operation of these reserves such as occurs in many other countries where UNESCO action on biosphere reserves is legislatively institutionalized. These reserves in Zaire, moreover, are funded at a level of only about US\$ 10-12,000 per year (39).

### 5.3 NATURE RESERVES

There are said to be 5 nature reserves in Zaire protected by IZCN (Table 5-1). Data is extremely limited on them, however, and information on their current legal and management status as well as their biological resources is currently unavailable (39).

### 5.4 FOREST RESERVES

In 1953 there were 181 forest reserves in Zaire (72) and today there are an estimated 117 forest reserves encompassing an area of at least 517,169 ha or 0.2% of the country (Table 5-1). Most occur in the Shaba, Bas-Zaire, Kasai-Occidentale and Haut-Zaire regions respectively, but there are virtually no available data on their biological resources or the pressures affecting them. All of these reserves were established prior to 1960, and most have been abandoned in the last 20 years. They were originally created for silvicultural research and to promote the production of industrial wood and charcoal.

In principle there exists no current legislation creating these reserves since the limited legislative protection that they were originally established during the colonial period. Their continued existence is predicated upon official letters and circulars issued by the Commissaire d'Etat (43), and the relatively moribund state of the national forest reserve system is considered to be a significant weakness related to the future conservation and management of tropical forests in Zaire. While DGRNR plans a future inventory of still viable reserves, additional high priorities measures include: 1) a survey and inventory of the reserves for resource content, viability, and income-generating potential; 2) selection of a subset of those reserves with the most important resources for concentrated attention; 3) provision of statutory or legislative protection for this subset; 4) development of management plans for the reserves; and 5) identification and acquisition of funding for DGRNR to effectively manage the reserves.

#### 5.5 HUNTING RESERVES

There are an estimated 57 hunting reserves that exist on paper in Zaire (Table 5-1). Most were created during the mid and later colonial era, specifically from 1937-1960, most have been abandoned for financial or other reasons since independence in 1960, and most currently have no or no well-defined legislative status. Of the 57 listed, only about 19 are said to be currently operational or functional, i.e., to be controlled to some extent by IZCN. These include 8 in Haut-Zaire, 2 in Bandundu, 1 in Kinshasa, 3 in Kivu, 4 in Shaba and 1 in Kasai-Occidental (39).

Hunting reserves in Zaire are considered to represent significant potential economic as well as ecological resources (39). Major future GOZ and Donor priorities should be to 1) conduct a survey of the reserves; 2) determine which still contain sufficient wildlife to warrant reestablishment as managed

hunting areas; 3) provide legislative or statutory protection to those areas;  
4) obtain the funding necessary for IZCN to effectively manage those reserves;  
and 5) promote the reserves internationally. Highest priority for on-site management by IZCN should be those reserves occurring in areas relatively accessible to international hunters, and those occurring in proximity to national parks such as Upemba/Kundelungu to encourage private sector development of hunting and/or tourist facilities. Hunting and tourism activities in proximity to each other have proven to be both a viable approach for attracting private sector interest and a more manageable development scenario for surveillance and enforcement of hunting laws given limited human and economic resources in Africa (e.g., in Zambia).

#### 5.6 SAFEGUARDED SECTORS

Since passage of the 1975 law creating the legislative framework by which safeguarded sectors may become established (Sct 2.1.2), no such protected areas have been created in Zaire (39).

#### 5.7 AREAS PROPOSED FOR PROTECTION

IUCN (36) has proposed a number of additional areas for protection in Zaire, described briefly as follows:

- 1) Abumonbazi (Mobaye). Located in Equateur, this area is of principal interest due to the probable presence of okapis, its location in a significant forest ecotonal region, and its location between the fluvial zoogeographical barriers represented by the Zaire, Oubangui and Itimbiri rivers.

2) **Monts Itombwe.** Located in Kivu, this area is of principal interest due to the presence of gorillas; extreme ornithological richness (83 mountain forest species; 98 of 104 species found in the mountain-graben transitional forest; 32 of 36 endemic species found in the transitional forest; 2 species known only from this site); very high amphibian diversity (including 4 endemic species); and the presence of the largest area of high altitude forest found in any one location anywhere in the central African mountains.

3) **Mont Kabobo.** Located in Kivu and Shaba, this area is of principal interest due to the presence of Colobus polykomos priogoginei and at least 60 bird species, 18 of which are endemic to the mountain forests of the region and one species and several subspecies of which are endemic to this site.

4) **Lomako-Yekokora.** Located in Equateur, this area is of principal interest due to the presence of the pygmy chimpanzee and Cercocebus aterrimus. Both of these species are of very restricted distribution and may not be adequately protected in other national parks.

5) **Lomani-Lualaba.** Located in Haut-Zaire and Kivu, this area is of principal interest due to its presence in a region constituting one of the principal zoological barriers to primate speciation and the presence of two endemic primates (Cercopithecus mitis maesi and Colobus rufomitratu parmentieri) not elsewhere protected.

6) **La Luo Scientific Reserve.** Located in Equateur, this area is of principal interest due to the presence of the pygmy chimpanzee and Cercopithecus salongo, the latter of which was only discovered in 1975 and is known only from this one site. The area is said to be in the process of being declared as an "animal reserve".

7) **National Mangrove Park.** Located in Bas-Zaire, this area is of principal national interest because of the presence of manatees.

8) Maniema/South Kivu. This area, located in Kivu, is of principal interest due to the presence of two primates of extremely limited distribution, which are endemic to the region and not believed to be otherwise adequately protected.

9) South Masisi-West Lake Kivu. This area, also located in Kivu, is of principal interest because of the presence of at least nine bird species of very restricted distribution.

10) Ngiri. Located in Equateur, this area is of principal interest because it consists largely of wetlands and is believed to contain one of the most important freshwater ichthyological faunas in Africa.

11) Okapi National Park. Located in Haut-Zaire, this area is of particular interest because of its unusual richness both floristically and faunistically. It contains at least 13 species of primates, several endemic bird species, and a large number of plant species only poorly known from collections.

12) Lower Semliki Valley. Located in Haut-Zaire, this area has been proposed for inclusion in the Virunga NP. The area still contains a sizeable population of lions, as well as two "spectacular" sites of touristic potential (Gety Falls and Sinda Canyon).

13) Tongo Forest. Located in Kivu, this area has also been proposed for inclusion into the Virunga NP primarily because of the presence of chimpanzees here.

In addition to these 13 sites of national or international importance, IUCN (36) has described an additional four sites of "local importance."

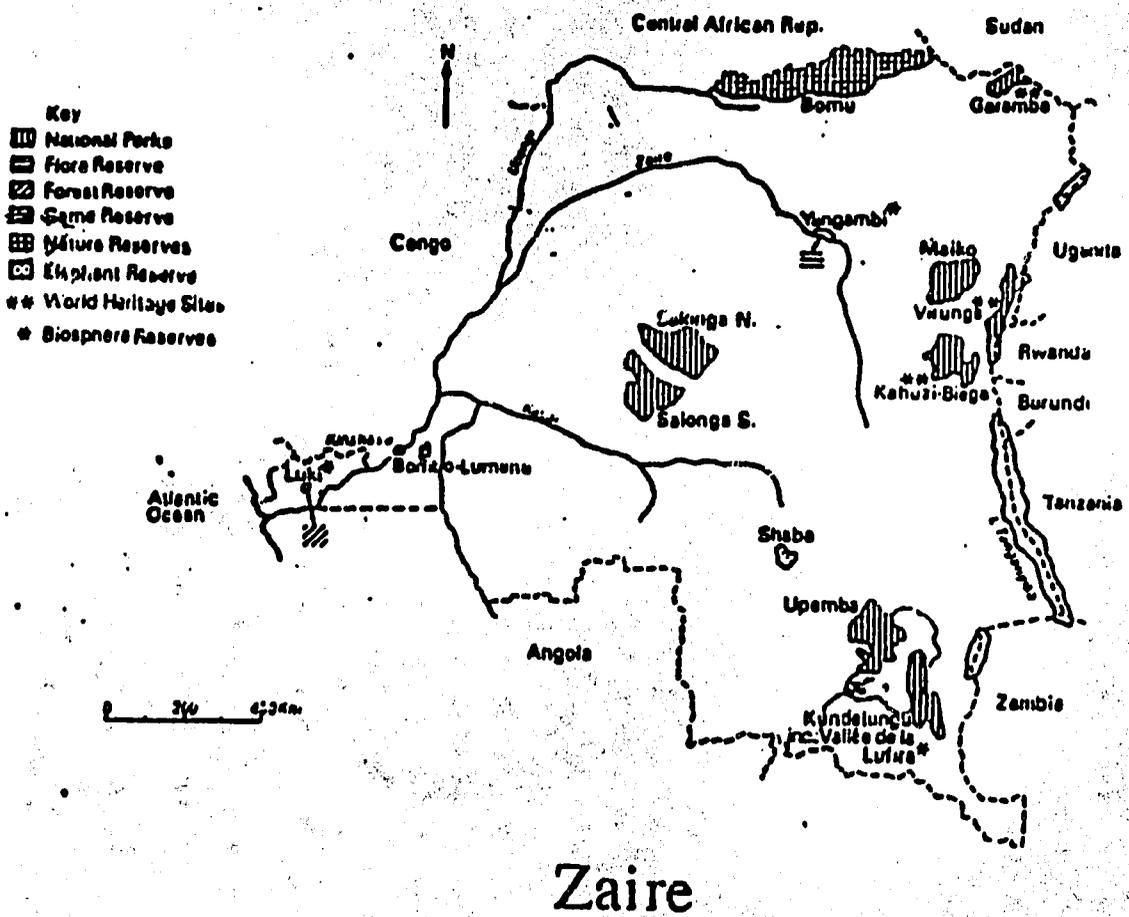


Fig. 5-1. Geographical distribution of major protected areas in Zaire. Source: (33).

TABLE 3-1

## BASIC DATA, PROTECTED AREAS OF ZAIRE

Area	Size (ha)	Region	Principal Vegetation	Rare Vertebrates	Major Disturbances	Tourism Status
<b>National Parks (Existing)</b>						
Caramba (278 Guards)	492,000	Mât-Saire	Grassy savanna Light savanna Dense savanna Papyrus swamp Gallery forest	White rhinoceros Elephant Chimpanzee Leopard Yellow-backed Duiker	Poaching	Operational
Upemba (176 Guards)	1,173,000	Shaba	Grassland Savanna Woodland Gallery forest Papyrus swamp	Elephant Roan Sable Cheetah Red lechwe Wild dog Leopard Spotted Ground Thrush Black-lored Waxbill Slender-snouted Crocodile	Poaching Illegal settlement	Semi-operational
Kundelungu (57 Guards)	760,000	Shaba	Woodland Dense savanna Grassy savanna Gallery forest	Roan Sable Leopard Cheetah Wattled crane Elephant	Poaching Grazing incursion Illegal settlement Fire Mineral exploitation	Semi-operational
Kahuzi-Biega (61 Guards)	600,000	Kivu	Primary forest Bamboo forest Woodland Grassland (alpine) Papyrus swamp	Gorilla Chimpanzee Owl-faced Guenon Red Colobus Elephant Rockefeller's Sunbird Grauer's Swamp Warbler Afr. Green Broadbill	Poaching Perimeter pressures Declining tourism	Operational
Salonga (166 Guards)	3,600,000	Kasai-Occ. (10%) Equateur (75%) Bandundo (15%)	Swamp forest Riverine forest Terra firma forest Grassland (0.5%)	Chimpanzee Pygmy chimpanzee Red Colobus Pangolin (2 spp.) Elephant Yellow-backed Duiker Slender-snouted Crocodile	Poaching Habitat destruction Perimeter pressures	None
Maiko (29 Guards)	1,083,000	Kivu Mât-Saire	Equatorial forest	Elephant Leopard Gorilla Sairean Peacock*	Poaching Tree felling Illegal gold mining Illegal settlement	
Virunga (511 Guards)	780,000	Kivu (95%) Mât-Saire	Bamboo forest Hagenia forest Equatorial forest Woodland Wooded savanna open savanna Swamp Steppe Heath	Elephant Gorilla Chimpanzee Nahan's francolin Forest ground thrush Papyrus yellow warbler(?) Pangolin	Poaching Fishing Potential dam construction Perimeter pressures	None
President Mobutu	3,000	Kinshasa	n.d.	n.d.	n.d.	n.d.
<b>Subtotal:</b>	<b>No. Areas: 8</b>			<b>Area: 8,491,000 ha</b>		<b>% of Country: 3.6%</b>

Area	Size (ha)	Region	Principal Vegetation	Rare Vertebrates	Major Disturbances	Tourism Status
<b>NATIONAL PARKS (Proposed)</b>						
Moanda	60,000	Bas-Zaïre	Mangrove	Sea Turtles	n.d.	n.d.
Otapi	1,372,525	Haut-Zaïre	Equatorial forest	Okapi	n.d.	n.d.
Mondjo	812,000	Equateur	Forest	Elephant	n.d.	n.d.
Swa-Kiboua	n.d.	n.d.	Savanna Gallery Forest	Roan	n.d.	n.d.

Subtotal: No. Areas: 4 Area: 2,244,625 % of Country: 1.0

**Biosphere Reserves**

Luki Forest Res.	32,714	Bas-Zaïre	Sub-equatorial forest (primary + secondary) Savanna	Elephant	Logging Cultivation	None
Lufira Valley (in KMP)	14,700	Shaba	Woodland Wetlands Gallery forest	Lechwe Elephant	Poaching Grazing Illegal settlement Fire	n.d.
Yangambi Flora Res.	220,000	Haut-Zaïre	Woodland Semi-deciduous forest Forest	Elephant	Agriculture Poaching	n.d.

Subtotal: No. Areas: 3 Area: 267,414 ha % of Country: 0.1

**Nature Reserves**

Bomu	n.d.	Haut-Zaïre	Woodland Savanna	Elephant	Poaching	n.d.
Eaux Delcommune	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Lac Fua	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ubunda	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mangai	36,000	n.d.	n.d.	n.d.	n.d.	n.d.

Subtotal: No. Areas: 5 Area: 36,000 ha % of Country: 0.01

**Forest Reserves (Number)**

1	88,985	Bandundu	n.d.	n.d.	n.d.	n.d.
26	45,588	Bas-Zaïre	n.d.	n.d.	n.d.	n.d.
3	35,199	Equateur	n.d.	n.d.	n.d.	n.d.
20	281,642	Haut-Zaïre	n.d.	n.d.	n.d.	n.d.
21	43,799	Kasai-Occ.	n.d.	n.d.	n.d.	n.d.
15	2,676	Kasi-Or.	n.d.	n.d.	n.d.	n.d.
n.d.	n.d.	Kinshasa	n.d.	n.d.	n.d.	n.d.
n.d.	n.d.	Kivu	n.d.	n.d.	n.d.	n.d.
31	19,280	Shaba	n.d.	n.d.	n.d.	n.d.

Subtotal: No. Areas: 117 Area: 517,169 ha % of Country: 0.2

**Hunting Reserves**

Bill-Oere	6,000,000	Haut-Zaïre	n.d.	Elephant	n.d.	Yes
Azandes	440,000	Haut-Zaïre	n.d.	n.d.	n.d.	Yes
Mondo Nissa	163,281	Haut-Zaïre	n.d.	Elephant	n.d.	Yes
Cangala-Nabodio	260,625	Haut-Zaïre	n.d.	n.d.	n.d.	Yes
Maika-Penge	750,000	Haut-Zaïre	n.d.	n.d.	n.d.	Yes

75

		Vegetation	Vertebrates	Disturbances	Source Status
Abitele	n.d.	Haut-Zaïre	n.d.	n.d.	Yes
	908,000	Haut-Zaïre	Forest	Elephant	n.d.
			Woodland		Yes
Abali-Yuri	n.d.	Haut-Zaïre	n.d.	n.d.	Yes
Hippopotame de Ubundu	n.d.	Haut-Zaïre	n.d.	n.d.	No
Samiki-Kasenyl	n.d.	Haut-Zaïre	n.d.	n.d.	No
Iva-Kibulu	140,000	Bandundu	n.d.	n.d.	Yes
Hippopotame de Mangai	1,176,875	Bandundu	n.d.	n.d.	Yes
	386,000	Bandundu	n.d.	Elephant	n.d.
Kuku-Kjongo	n.d.	Bandundu	n.d.	n.d.	No
otende	982	Equateur	Forest	Elephant	n.d.
				Pygmy Chimpanzee	Agriculture
					Fishing
					Poaching
Lac Kwada	63	Equateur			n.d.
La Mole	32,400	Equateur	n.d.	n.d.	n.d.
Madekere	n.d.	Equateur	n.d.	n.d.	n.d.
	n.d.	Equateur	n.d.	n.d.	n.d.
Libenge	n.d.	Equateur	n.d.	n.d.	n.d.
Bombo Lumene	350,000	Kinshasa	Savanna	Cosypha heinrichi	n.d.
					Agriculture
					Poaching
					Woodcutting
les aux Singes	n.d.	Kinshasa	n.d.	n.d.	n.d.
Kutshuru	100,000	Kivu	Woodland	n.d.	n.d.
			Swamps		
			Forest		
ud Ouest de	n.d.	Kivu	n.d.	n.d.	n.d.
Ishero					
Mont-Hoyo	n.d.	Kivu	n.d.	n.d.	n.d.
Lwama/Kivu	343,500	Kivu	Forest	Elephant	n.d.
			Woodland		Poaching
			Papyrus Swamp		Fishing
eni (Oiche)	n.d.	Kivu	n.d.	n.d.	n.d.
Matalinga	n.d.	Kivu	n.d.	n.d.	n.d.
Rizi	n.d.	Kivu	n.d.	n.d.	n.d.
les de Kifumbue	n.d.	Kivu	n.d.	n.d.	n.d.
Hippopotame de Luulaba	n.d.	Kivu	n.d.	n.d.	n.d.
Hippopotame de Loma	n.d.	Kivu	n.d.	n.d.	n.d.
acs Nokoto	n.d.	Kivu	n.d.	n.d.	n.d.
vama/Shaba	n.d.	Shaba	n.d.	n.d.	n.d.
Kundelungu	n.d.	Shaba	n.d.	n.d.	n.d.
Lubudi Sauxwe	9,200	Shaba	n.d.	n.d.	n.d.
ufufya	72,500	Shaba	n.d.	n.d.	n.d.
alemie	n.d.	Shaba	n.d.	n.d.	n.d.
ziba-Baluba	n.d.	Shaba	n.d.	n.d.	n.d.
Sakanya	n.d.	Shaba	n.d.	n.d.	n.d.
Basse Kando	n.d.	Shaba	n.d.	n.d.	n.d.
lumbu	n.d.	Shaba	n.d.	n.d.	n.d.
undas-	n.d.	Shaba	n.d.	n.d.	n.d.
Tutshokwes	n.d.	Shaba	n.d.	n.d.	n.d.
Tshikamba	n.d.	Shaba	n.d.	n.d.	n.d.
Elephant	n.d.	Shaba	n.d.	n.d.	n.d.
ibia	n.d.	Shaba	n.d.	n.d.	n.d.
ppo (Kolwezi)	n.d.	Shaba	n.d.	n.d.	n.d.
alule	n.d.	Shaba	n.d.	n.d.	n.d.
Mwakaji	n.d.	Shaba	n.d.	n.d.	n.d.
Mwene Musona	n.d.	Shaba	n.d.	n.d.	n.d.
ndoa	n.d.	Shaba	n.d.	n.d.	n.d.
twaba	n.d.	Shaba	n.d.	n.d.	n.d.
Mwanza	n.d.	Shaba	n.d.	n.d.	n.d.
Bukama	n.d.	Shaba	n.d.	n.d.	n.d.
lvesi	n.d.	Shaba	n.d.	n.d.	n.d.
shimie	350,840	Kasai-Occ.	n.d.	n.d.	n.d.
Hippopotame de	n.d.	Kasai-Occ.	n.d.	n.d.	n.d.
Luba Izeba	n.d.	Kasai-Occ.	n.d.	n.d.	n.d.

Subtotal:	No. Areas: 57	Total Area: 10,984,266 ha	% of Country: 4.7
<b>Safeguarded Areas</b>			
None Designated			
Subtotal:	No. Areas: 0	Total Area: 0 ha	% of Country: 0.0
<b>GRAND TOTAL:</b>	<b>No. Areas: 188</b> (existing)	<b>Total Area: 22,493,060 ha</b>	<b>% of Country: 9.6</b>

Data from (35), (36), (37), (38) and (39). N.d. = no data. Species listed under "rare vertebrates" column include only those protected by US/DOI, CITES or listed by IUCN unless marked by an asterisk (\*). Grand Total: Number of areas includes only existing protected areas and does not double count for Lufira Valley Biosphere Reserve. Lufira Valley also not included in calculation of Total Area and % of Country.

5-14

## 6.0 STATUS OF ENDANGERED AND PROTECTED SPECIES

### 6.1 ANIMAL SPECIES

Table 6-1 provides a breakdown of Zairian animal species listed by US/DOI, CITES, IUCN and/or the GOZ as being endangered, threatened, rare or otherwise protected. It also provides basic and abbreviated information, where known, on the principal habitats of the listed species and whether their occurrence has been documented in Zaire's national park system. Of those taxa listed by USDOL, CITES and/or IUCN, i.e., those known or believed to be rare, threatened or endangered, there are 36 mammals, 28 birds, 8 reptiles, 1 amphibian, 1 fish and 8 invertebrates. Because rarity is common in most ecosystems (48), however, there must exist in Zaire hundreds if not thousands of additional plant and especially invertebrate animal species just as rare as those listed in Table 6-1 which are either currently unknown to science or for which little or no basic range, distribution, habitat or population data are available. The occurrence of 82 species on this list must therefore be regarded at the same time as a reflection of the biological richness of the country and as an artifact of the (relatively) very limited basic systematics work which has occurred in Zaire to date.

A general breakdown of the number of listed species from Table 6-1 occurring in each major habitat type in Zaire is provided in Table 6-2. The number of threatened species found in different types of vegetation in Zaire increases with ecosystem structure and complexity, a phenomenon consistent generally with overall global species richness patterns (77): 8 species are found in grasslands, 16 in savannas, 19 in woodlands and 39 in forests (over 50% of all African birds listed by IUCN are forest species (31)). Freshwater wetland and coastal/marine systems contain 9 and 14 species respectively, with the latter category heavily weighted by marine mammals and sea turtles.

None of the species listed in Table 6-1 have officially designated "critical habitats" per US/DOI criteria. Most, however, are believed to occur within the boundaries of existing Zairian national parks although only 29 or 47% of all non-marine vertebrates listed by US/DOI, IUCN or CITES are documented as occurring in the national park system.

Reasons why species listed on Table 6-1 are classified as threatened or endangered vary considerably. Habitat destruction is the most commonly cited cause, but many have population sizes and geographical ranges which are naturally very small (e.g., Preuss' red colobus monkey, lechwe), while others occur in habitats which are of extremely limited distribution and/or are very specialized (e.g., Blind fish of the caves of Mbanza-Ngungu). Many are of commercial importance either for their skins or shells (e.g., cheetah, Congo clawless otter, leopard, the crocodiles and sea turtles), for other products (e.g., elephant ivory, rhinoceros horn), for traditional medicinal purposes (e.g., pangolin), and/or for research purposes (e.g., chimpanzee, although offtake of wild populations is believed to be minimal (4)). Finally, most of the mammals, reptiles and sea turtles are taken commercially and/or non-commercially for consumption as food.

Endangered species with particularly high visibility, i.e. the so-called "charismatic megavertebrates" (97) and for which survival plans are being developed in Zaire, include the gorilla, elephant and Northern white rhinoceros. The latter is particularly vulnerable; extinct throughout its range except for a small area in Zaire, poaching had reduced it from about 1300 animals in 1963, to 260 in 1976, to 100 in 1979, and to a population of about 13-20 animals in 1983 (72). Since 1984, IZCN, WWF, IUCN, UNESCO and FZS have succeeded in protecting this population although continued monitoring and protection are considered essential in spite of recent births and the elimination of poaching (56). As noted by Huntley (31), however, "...the massive investment in conservation campaigns directed at these species does more for the souls of donors and the egos of the elephant experts than it does

for biotic diversity, which is centered on less exciting communities." It is nonetheless true that "less exciting communities" generate far fewer funds than do efforts to save the charismatic megavertebrates; it is also often true that efforts to save the latter result in preservation of the former, even if only inadvertently, by virtue of the existence of the former in areas set aside as elephant, rhino or gorilla reserves. In any case, a major issue which should be addressed in this respect by the GOZ, donor and NGO communities is the rational prioritization of conservation alternatives on scientific grounds.

## 6.2 PLANT SPECIES AND BIOTIC COMMUNITIES

No officially threatened or endangered plant species are currently listed by any source for Zaire. Hedeberg (29) noted in 1979 that it was too early to establish a list of threatened Zairian plants because very little is currently known about the distribution of plants in Zaire and because a number of vegetation types either await a first survey or need to be studied in greater depth. There is, moreover, no good available technical information to suggest that this situation has changed appreciably in the interim. Examples provided by Hedeberg of vegetation types requiring much greater study include rocky slopes on the sides of high plateaus, high plateau peat bogs, pools, and dambos (seasonally inundated savannas). Examples of vegetation types requiring better distributional data include copper/cobalt-associated communities, high plateau steppe vegetation, riparian forest and high termitaria. To these lists IUCN (36) has added the vegetation of the Itombwe Plateau and the Lomani-Lualaba areas as well as the Salonga NP and Maiko NP areas.

Vegetation types listed by Hedeberg (29) as generally believed to be threatened include 1) the 'Muhulu' or dry evergreen forest, scattered throughout southeastern and eastern Zaire, which includes a number of species

found nowhere else (e.g., Entandrophragma defevoyi, Cratérosiphon schmitzii, Grewia schmitzii); 2) some types of riparian forests; 3) some species that appear to be paleoendemics on the high plateaus and may be threatened by cattle-raising activities (e.g., Encephalartos marunguensis and E. schmitzii); and 4) some copper outcrops (29). About 100 copper-cobalt deposits totalling ca. 20 km<sup>2</sup>, scattered throughout an area of about 20,000 km<sup>2</sup> in Shaba, appear to be of particular economic and biodiversity importance. Supporting a very distinct vegetation, one study found that 42 of 220 taxa found on these outcrops were endemic to them, with some occurring on only one outcrop, some occurring also on adjacent outcrops, and some apparently occurring on all of the outcrops (53).

### 6.3 CONSERVATION PRIORITIES

While Zaire is an enormous country with extremely low human population densities throughout most of its area, and an extremely low overall current deforestation rate, the best hope for ultimate conservation of the genetic resources that these and other rare species represent is through effective establishment, conservation and management of a representative array of sufficiently large habitat types in which they naturally occur. The next steps for the GOZ and the Donor Community to take in development of an effective in situ conservation program in Zaire are: 1) completion of a floral and faunal survey of Zaire of sufficient scope and depth as to ensure that basic data is acquired about the distribution and extent of plant and animal communities, including rare communities; 2) establishment of an institutionalized gap analysis system to focus priorities on inclusion of non- or underrepresented communities in the national protected area system; and 3) development of an effective method for establishing technically credible priorities among conservation alternatives upon which limited funds can be concentrated. It should be noted that these next steps in developing an effective national in situ system are likely to be complicated by the fact of

extreme heterogeneity in Zaire's biotic communities. On the one hand for example, most indigenous rain forest species can probably be conserved through the conservation of stable climax rain forest areas (e.g., Salonga NP); on the other hand, however, there are undoubtedly drier and/or more heavily impacted community types in Zaire which, as with some communities associated with Mediterranean climates, exhibit high diversity associated with a mosaic of seral stages (either natural or human-induced) and which can probably only be effectively conserved by maintaining such 'unstable' conditions (60).

TABLE 6-1

RARE, THREATENED, ENDANGERED AND PROTECTED SPECIES OF ZAIRE

<u>COMMON NAME</u>	<u>US/DOI</u>	<u>CITES</u>	<u>IUCN</u>	<u>GOZ</u>	<u>HABITAT</u>
<u>Mammals</u>					
1. Cheetah*	E	1	V	1	Grassland, savanna, thin open woodland
2. Cameroon Clawless Otter	E	1			Small streams and adjacent dense forest areas
3. N. White Rhinoceros*	E	1	E	1	Grassland, open scrub savanna, woodland
4. Black Rhinoceros*	E	1	E	1	Dry bush, thron scrub
5. L' Hoest's Monkey	E		V		Montane and priary or mixed forest
6. Preuss' Red Colobus Monkey	E		E	2	High forest
7. Gorilla*	E	1	V/E	1	Lowland and montane forest, bamboo forest
8. Chimpanzee*	T	1	1		Forest, woodland and savanna
9. Pygmy Chimpanzee*	T	1	V	1	Rain and swamp forest
10. Giant Sable Antelope*	E	1	E	2	Light woodland, mixed bush, savanna
11. Red Lechwe*	T	2	V		Swamps and wetlands
12. African Elephant*	T	2	V	1	Grassland to forest
13. African Wild Dog*	E	V	2		Grasslands, savannas, woodlands
14. Pangolin*	T	1	2		Savannas, woodlands and forests
15. Leopard*	T	1	V	2	Grassland to forest
16. African Manatee	T	2	V	1	Rivers, estuaries and coastal lagoons

<u>COMMON NAME</u>	<u>US/DOI</u>	<u>CITES</u>	<u>IUCN</u>	<u>GOZ</u>	<u>HABITAT</u>
17. Blue Whale	E	1	E		Marine
18. Finback Whale	E	Y			Marine
19. Right Whale	E				Marine
20. Humpback Whale	E	1	E		Marine
21. Sei Whale	E				Marine
22. Sperm Whale	E				Marine
23. Black-striped Duiker		2			Dense forest
24. Blue Duiker		2			Forests and woodlands
25. Yellow-backed Duiker*		2		2	Forests and woodlands
26. Caracal		1		1	Savannas and woodlands
27. Serval		2		2	Savanna to forest
28. Roan Antelope*		2		2	Savannas and woodlands
29. Armadillo*		2		1	Savanna to dense woodland and light forest
30. Allen's Swamp Monkey			K		Swamp forest
31. Black Mangabey			K		High forest
32. Dryas Guenon			K		High forest (?)
33. Owl-faced Guenon*			K		High forest
34. Salongo Guenon			K		High forest (?)
35. Foa Red Colobus*			K	2	High forest, galleries
36. Oustalet's Red Colobus			K	2	High forest, galleries

(ADDITIONAL SPECIES PROTECTED BY THE GOZ)

Southern Impala	1	Savanna to woodland
Lewel Hartebeest	2	Savanna, light woodland
Lichtenstein's Hartebeest	2	Savanna to woodland
Bongo	2	Dense forest
Blue Monkey	2	High forest

<u>IMON NAME</u>	<u>US/DOI</u>	<u>CITES</u>	<u>IUCN</u>	<u>GOZ</u>	<u>HABITAT</u>
Topi				2	Savanna to woodland
Tsessebe				2	Grasslands, floodplains and savannas
Burchell's zebra				1	Grassland to open woodland
Golden Cat				1	Forest to savanna
Thick-tailed Galago				2	Savanna to woodland
Giraffe				1	Savanna to dense woodland
Hippopotamus				2	Streams, lakes, ponds
Water Chevrotain				1	Dense forest
Giant Forest Hog				2	Dense forest to woodland
Defassa Waterbuck				2	Woodlands, floodplains
Buffon's (Western) Kudu				2	Savannas, floodplains
Black Lechwe				1	Swamps and wetlands
Nile Lechwe				2	Swamps and wetlands
Giant Pangolin				1	Savanna to forest

<u>COMMON NAME</u>	<u>US/DOI</u>	<u>CITES</u>	<u>IUCN</u>	<u>GOZ</u>	<u>HABITAT</u>
Klipspringer				1	Rocky hills and mountains typically wooded
Aquatic Civet				1	Dense forest
Oribi				2	Grassland, light woodland
Lion				2	Grassland to woodland
Warthog				2	Savanna to woodland
Bush Pig				2	Dense woodland to forest
Rock Dassie				2	Rocky areas, savanna to woodland
Southern Reedbuck				2	Grassland and savanna
Bohor Reedbuck				2	Grassland, floodplains
Nile Buffalo				2	Savanna
Cape Buffalo				2	Savanna and Woodland
Pygmy Cape Buffalo				2	Dense forest
Giant Eland				1	Woodland
Livingston's Eland				1	Grassland to dense woodland
Bushbuck				2	Woodland, light forest
Statunga				2	Swamps, flooded forest
Greater Kudu				1	Woodland, light forest
<u>birds</u>					
Peregrine Falcon*	E	1			All habitats
Flamingo(s)		2		2	Wetlands
Grey Parrot*		1		1	Forest
Kungwe Apalis			R		Forest edge/bamboo

<u>COMMON NAME</u>	<u>US/DOI</u>	<u>CITES</u>	<u>IUCN</u>	<u>GOZ</u>	<u>HABITAT</u>
41. Kabobo Apalis			R		Montane Forest
42. Grauer's Swamp Warbler*			V		Swamps
43. Prigogine's Greenbul			V		Woodland to forest
44. Papyrus Yellow Warbler*			R		Papyrus swamps
45. White-headed Robin Chat			I		Savanna to forest
46. Slaty Egret			I		Wetlands
47. Turner's Eremomela			R		Forest
48. Black-lored Waxbill*			K		Grassland to savanna
49. Nahan's Francolin*			R		Forest
50. Albertine Owlet			R		Forest
51. Cape Vulture			R		Grassland to woodland
52. Chapin's Flycatcher			R		Forest
53. Marunga Sunbird			E		Riparian forest
54. Rockefeller's Sunbird*			R		Forest
55. Itombwe Owl			I		(No available data)
56. Golden-naped Weaver			I		Forest
57. Yellow-legged Weaver			V		Forest
58. Lake Lufira Weaver			K		Wetlands
59. Loango Slender-billed Weaver			K		Wetlands, savanna (?)
60. African Green Broadbill*			R	1	Forest
61. Schouteden's Swift			I		Forest (clearings)
62. Damara Tern (?)			R		Coastal areas
63. Spotted Ground Thrush*			R		Forest
64. Forest Ground Thrush*			R		Forest

ADDITIONAL SPECIES PROTECTED BY THE GOZ

Zairian Peacock	S	1	Forest
Shoebill	S	1	Swamps
Crowned Crane		1	Grassland to woodland
Cattle Egret		2	Woodland to forest
Abyssinian Ground Hornbill		1	Savanna to woodland
Ground Hornbill		2	Savanna to woodland
Wattled Crane	S	1	Grasslands, savannas and swamps
Yellow-billed Oxpecker		2	Savanna to woodland
Nightjar(s)		2	Woodland to forest
Great White Egret		2	Wetlands
White Stork		1	Grassland to savanna
Maccoa Duck		2	(No available data)
Eagle(s)		2	(Depends on species)

<u>DN NAME</u>	<u>US/DOI</u>	<u>CITES</u>	<u>IUCN</u>	<u>GOZ</u>	<u>HABITAT</u>
Marabou Stork				1	Savanna to woodland
Yellow-eyed Black Flycatcher				2	Forest
Martinet(s)				2	(No available data)
Yellow Helmet Shrike				1	(No available data)
Martin(s)				1	(No available data)
Secretary Bird				1	Grassland to woodland
Sacred Ibis				1	Wetlands and pastures
Owl(s)				2	(Depends on species)
Vulture(s)				1	(Depends on species)

Reptiles

55. Nile Crocodile	E	1	V	1	Freshwater wetlands
56. Slender-snouted Crocodile	E	1	I	1	Freshwater wetlands
57. Zairian Dwarf Crocodile	E	1	I	1	Freshwater wetlands
58. Loggerhead Turtle	T	1	E	1	Marine
59. Green Turtle	T	1	E	1	Marine
70. Leatherback Turtle	E	1	E	1	Marine
71. Hawksbill Turtle	E	1	E	1	Marine
72. Kemp's Ridley Turtle	E	1	E		Marine

Amphibians

73. African Viviparous Toad(s)	E	1			(No available data)
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Fish

74. Blind Fish of Mbanga-Ngungu		2		1	Bas-Zaire caves
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<u>COMMON NAME</u>	<u>US/DOI</u>	<u>CITES</u>	<u>IUCN</u>	<u>GOZ</u>	<u>HABITAT</u>
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Invertebrates

75. <u>Anax georgius</u>			I		(No available data)
76. <u>Anectothemis apicalis</u>			K		(No available data)
77. <u>Congothemis longistyla</u>			K		(No available data)
78. <u>Cornigomphus guineensis</u>			I		(No available data)
79. <u>Enallagma camerounense</u>			I		(No available data)
80. <u>Graphium aurivilliusi</u>			K		(No available data)

<u>COMMON NAME</u>	<u>US/DOI</u>	<u>CITES</u>	<u>IUCN</u>	<u>GOZ</u>	<u>HABITAT</u>
<u>Orthotrum rubens</u>			I		(No available data)
<u>Papilio antimachus</u>			R		(No available data)

Notes  
 US/DOI, CITES and IUCN species known from available literature or preparer's experience to occur or to have occurred in one or more national parks in Zaire. The black rhinoceros, however, is believed to be extirpated from Zaire's park system.

US/DOI: E: Endangered; T: Threatened.

Notes: 1: Animals listed on Annex 1, i.e. threatened with immediate extinction and which cannot be imported or exported; 2: Animals listed on Annex 2, i.e., species threatened with possible extinction if trade is not limited.

Notes: E: Endangered, i.e., taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating; V: Vulnerable, i.e., taxa believed likely to move into the endangered category in the near future if the causal factors continue operating; R: Rare, i.e., taxa with small world populations that are not at present endangered or vulnerable, but are at risk; I: Indeterminate, i.e., taxa known to be endangered, vulnerable or rare but where there is not enough information to say which of the three categories is appropriate; K: Insufficiently known, i.e., taxa suspected but not definitely known to belong to any of the above categories due to lack of information; S: "of special concern."

Notes: 1: Animals listed on Annex 1, i.e., which are totally protected; 2: Animals listed on Annex 2, i.e., which are partially protected.

References: (10, 12, 50, 57, 64)

**TABLE 6-2**

**PRINCIPAL HABITAT PREFERENCES OF RARE, THREATENED AND ENDANGERED**

**ANIMAL SPECIES IN ZAIRE**

**PRINCIPAL HABITAT**

	<u>Grassland</u>	<u>Savanna</u>	<u>Woodland</u>	<u>Forest</u>	<u>Wetland</u>	<u>Coastal/Marine</u>	<u>Caves</u>	<u>N/D</u>
<u>SS</u>								
malia (36)	5	12	15	21	3	6	0	0
s (28)	3	4	4	18	7	2	0	1
tillia (8)	0	0	0	0	3	5	0	0
hibia (1)	0	0	0	0	0	0	0	1
ces (1)	0	0	0	0	0	0	1	0
ertebrata (8)	0	0	0	0	0	0	0	8
<b>AL</b>	<b>8</b>	<b>16</b>	<b>19</b>	<b>39</b>	<b>13</b>	<b>13</b>	<b>1</b>	<b>10</b>

es: Data from Table 6-1; includes only those species listed by US/DOI, CITES and/or IUCN.  
: No available data. A single species may occur in more than one habitat type category.  
ber after class name (n) indicates total number of species of that class.

290

## 7.0 EX-SITU CONSERVATION

"Unfortunately, such collections are often dismantled or simply deteriorate after the specialists who built them up are no longer active at the respective institutions... Although they are often of very great value internationally, they may if they are not actively utilized come to be viewed as a drain upon the limited resources of the institution where they are housed. Even when financial considerations are not limiting, it is difficult to provide for such collections the meticulous and sustained care that is essential for their survival without the attention of a specialist who is deeply concerned with them."

--Peter H. Raven

Ex-situ conservation has been described as an ancillary to rather than an alternative to in-situ conservation, and as a "high risk refuge of last resort" (2). This is considered by the preparer to currently apply to most of Africa, including Zaire, and it is unlikely that ex-situ conservation activities will play a major role in biological resource conservation in Zaire in the near future.

Ex-situ activities currently existing in Zaire primarily include those associated with botanical gardens, zoological parks, natural history museums, herbaria, captive breeding facilities and seed banks, and are addressed below under the general headings of botanical activities and zoological activities. The most important Zairian institution with respect to ex-situ conservation is the IJZBZ, created by Presidential Ordinance in 1978 (65).

## 7.1 BOTANICAL ACTIVITIES

IJZBZ includes three botanical conservation services. The Botanical Service deals with taxonomic research, ecological, phytosociological and phenological floral studies, and herbarium maintenance. The Agronomic Service deals with fruit, vegetable and other consumable plant culture, grafting, and introduction and extension of economically important species in rural areas. The Horticultural Service primarily deals with the culture, multiplication and improvement of ornamentals through grafting (65).

There currently exist three botanical gardens in Zaire for which IJZBZ has management responsibility. The Jardin Botanique de Kisantu in Bas-Zaire was created in 1900 and since that time has amassed about 2500 species from all tropical regions of the world on the 220 ha site. Currently said to be managed by a dynamic and conscientious team focussing on both touristic and scientific goals, including multiplication of rare species, the facility includes nurseries, a seed collection, an arboretum of about 200 species and a herbarium with about 5000 specimens. The Jardin Botanique de Mbandaka in Equateur includes an area of about 370 ha with a herbarium and an arboretum of fruit trees. Little information is available on this site, but it said to maintain only a limited number of species. The Parc de la Revolution, created in 1936 on 6 ha of land in Kinshasa, has about 300 species of plants for which there is no current inventory. After several years of "lethargy," activities are said to have improved here since about 1986 and there have been recent introductions of leguminous species and ornamental seeds (65).

There exist three other herbaria of note in Zaire. The most important is located at Yangambi and contains 10,771 herb, 7953 vascular plant, 1399 flower, 1969 grain, 141 bark and 918 tree specimens representing 111 families and 1454 species in 1983. Institut National de Recherche Agronomique (INERA) also runs a herbarium at the University of Lovanium (now University of Kinshasa) which has 19,884 herb specimens representing 186 families, 1452

genera and 4584 species. The third herbarium, established in 1958 in Kinshasa, includes 8313 specimens, 5267 of which are from the Kinshasa area, representing 140 families, 806 genera and 1546 species in 1982 (65).

Other minor arboretums in Zaire are found in Yangambi, Mioka, Mulungu, Kipoko and Mvuosi. The most important of these is at Yangambi, established in 1935, which includes 112 species of trees and serves for studies on the evolution and adaptation of seeds. SNR also established an arboretum in 1982 at the Kinsono Forest Center on the Bateke Plateau that is used for studying tree growth and yield and includes 73 species (65).

Plant seeds are collected in several locations in Zaire. Maize, rice, bean, soja, peanut and vigna seeds are laboratory tested in Kinshasa and are provided to private individuals, firms and research institutions. The International Board of Plant Genetic Resources (IBPGR) harvests certain cultivated species for development of a seed collection, and forsee the future collection of wild plants as well. The seat of IBPGR is in Burundi, but there are four field stations in Zaire at Yangambi, Mvuosi, Mulungu and Gandajika. The Belgo-Zairoise Agristology Project maintains a climatized seed collection facility which includes both Zairian and exotic species, and which sells seeds. IJZBZ also maintains a seed collection at its Kisantu and Mbandaka facilities, primarily including those species collected at the facilities for exchange with other botanical institutions and for multiplication purposes (66). In addition, USAID in cooperation with the Ministry of Agriculture has developed or improved 22 varieties of maize, manioc and legume seeds at stations in Shaba, Bandundu and Kasai-Oriental provinces.

There exist in addition several projects dealing with seed production or seed multiplication relevant to biodiversity conservation. The Fruits et Legumes Autochtones dans le Bas-Zaire Project, financed by UNFAO, concentrates on domestication of fruits and legumes. Another project run by the Belgian NGO FUCID in Kwango-Kwilu is also involved in domestication of selected species

with high food value. One activity formerly undertaken by them was a screening of 42 species of mushrooms collected from 22 villages and the markets of Kinshasa for food value with an eye towards cultivation. Another project funded by UNICEF and run by the UK Biology Department is working on the introduction of exotic food plants in gardens in Kinshasa (66).

A number of organizations and projects are also involved in importation and propagation of exotic tree species, especially including species of Acacia, Eucalyptus, Cyperus, Pinus, teak and Terminalia, and a number of forage plants are also propagated. These include both local and exotic species, including Brachiaria ruziziensis, B. decumbens, Penisetum purpureum, Psophocarpus scandens, Hymenocardia ulmoides and a number of trees and shrubs of potential forage use (66).

## 7.2 ZOOLOGICAL ACTIVITIES

IJZBZ has three services related to ex-situ zoological conservation. The Zoological Service is responsible for identification, systematics, nutrition and behavioral research on animals, the Veterinary Service is responsible for health, hygiene and autopsies, and the Documentation Service is responsible for records (65).

Since 1986, a convention between IZCN and IJZBZ has existed relative to the capture of wild animals for the repopulation of zoos. This program got under way in 1988 with the capture of elephant and okapi stock in the national parks and improvement of holding areas. A census of the number of animals in zoos in Zaire in 1986 gave a figure of 386, including 87 different species of which 156 individuals were mammals, 141 were birds and 89 were reptiles (65).

There currently exist three major captive zoological facilities in Zaire, one of 16 ha with 125 animals in Lubumbashi and one of 81 ha in Kisangani with 55 animals. The former was created in 1932 and the latter in 1951. The third and most important is the Parc President Mobutu on 17 ha near Kinshasa with 188 animals in 1986. Created in 1971, LJZBZ took over operation of the latter facility in 1978 and in 1981 a private company overtook active management and opened the park to the public in 1983. Since 1987 the park has been under the effective management of DAFECN. Breeding successes here have included lion, civet, jackal, mongoose and some species of primates and ungulates, but significant difficulties have occurred with breeding of chimpanzees, baboons, parrots, snakes and crocodiles. The facility includes a botanical garden largely run to supply food for the animals, and future plans for the park include an artisanal fish-rearing operation, creation of an arboretum, and creation of a natural history museum including taxidermy and tanning capabilities (65).

Captive breeding activities with wild animals are extremely limited in Zaire outside of the Parc President Mobutu. There has been some limited experimentation with breeding of the Gambian rat, however, by the Department of Biology at the University of Kinshasa (UK); this species is interesting because of its naturally high fecundity, primarily vegetarian diet and small size requiring minimal infrastructure in the rural milieu. Elephants have been captured for breeding purposes to a very limited extent in the Garamba NP in the last few years, and for the purpose of attempted domestication. There are also a number of fisheries projects in Zaire which address artisanal, semi-industrial and industrial fishery management activities. Located throughout the country and supported by a joint USAID/Peace Corps effort, these activities appear to be concentrated in the Bandundu and Bas-Zaire regions and on species of Tilapia, Clarias and Ophrocephalus (65).

There are few zoological collections in Zaire, but perhaps the best known are those at the University of Kinshasa's Department of Natural Sciences which

include mammal, reptile, fish and butterfly collections (65).

No sperm banks per se exist in Zaire for either wild or domestic animals. The only sperm stocks known to be commonly used are for artificial insemination of livestock, especially in the Kamina, Tanganyika, Boma and Bunia regions and at the Domaine Presidencial de la N'Sele (DAIPN). These sperm stocks are primarily European and Canadian in origin and are used for insemination of African races of livestock, but they do not constitute a collection (65).

## 8.0 DISTRIBUTION OF DEVELOPMENT PROJECTS IN THEIR REGIONAL CONTEXTS

"For every complex problem there is a simple answer and it is wrong."

—H.L. Mencken

A 1988 evaluation by the Groupe d'Etudes et d'Assistance en Gestion des Affaires (GEAFA) of development projects in Zaire provided information on 35 agricultural, 4 mining and 2 barrage projects in Zaire's Priority Investment Program (PIP) funded by 22 different donors and/or the PIP Executive Council (EC)(21). These 41 projects included only those found in the available PIP data base, however, and only those considered by GEAFA to have an impact on the environment. Since the data available on projects in the Zaire PIP data base are not all-inclusive, a number and perhaps a significant number of donor projects are not included in the GEAFA evaluation. Only one of USAID's five road rehabilitation projects, for example, are known to have been included in this data base. The GEAFA evaluation provided sufficient information, however, to allow the preparer to break down these 41 projects into 154 individual components by region (Table 8-1). A general discussion of the distribution of these specific project components by region, along with basic relevant regional statistics, is found in Sect. 8.1 and a discussion of GOZ and donor environmental regulations is found in Sect. 8.2.

## 8.1 PROJECT AND REGIONAL RESOURCE DISTRIBUTION

### 8.1.1 Bas-Zaire

The Bas-Zaire Region includes 2.6% of the total land area of Zaire, 1.0% of its forests, 4.0% of its woodlands, 5.6% of its savannas, and 100% of its mangroves (Table 8-2). About 1.5% of Bas-Zaire is or will be in the national protected area system, including one proposed national park (Moanda NP) and one MAB Biosphere Reserve (Luki), and in addition there occur in principle 26 forest reserves in the region (Table 5-1).

Because of its proximity to Kinshasa and the elevated non-urban population density found there (33.8/km<sup>2</sup> in 1984) vs. Zaire as a whole (12.7/km<sup>2</sup>), the natural vegetation of the region has undergone considerably greater modification than is found in most parts of Zaire. In the Bas-Fleuve Subregion of Bas-Zaire, overexploitation of the Mayumbe forests, growth of traditional agriculture and agro-industrial development, and fuelwood cutting have all been associated with reduction of the primary Terminalia superba forests to relict fragments and replacement of those forests with cropland, fallow land and secondary forest dominated by the Marantaceae (21, 72). Deforestation as a result of burning and cutting for fuel wood in the Cataracts Subregion of Bas-Zaire, and leaching, erosion and laterization of soils in certain valleys there, are also said to be significant problems (21).

There are 22 major project activities occurring in Bas-Zaire, mostly concentrated in the Bas-Fleuve and Cataracts subregions. These projects are heavily weighted towards agricultural development (14 projects), although there exists 1 capital development, 2 transport infrastructure and 5 miscellaneous projects (Table 8-1)(20).

### 8.1.2 Bandundu

The Bandundu Region contains 12.6% of the total land area of Zaire, 14.3% of its forests, 9.1% of its woodlands and 14.1% of its savanna (Table 8-2). With about 12.4% of the national population in 1984, Bandundu had a non-urban population density (11.8/km<sup>2</sup>) very close to the national norm (12.7/km<sup>2</sup>). About 1.8% of the region is in the national park system (15% of Salonga NP) and in principle there are 1 forest reserve and 4 hunting reserves in Bandundu (Table 5-1).

Principal economic activities in the northern forests of the Mai-Ndombe and Kwilu subregions include industrial and artisanal forest exploitation and traditional slash and burn and agro-industrial activities. Deforestation and depletion of forest resources, as well as a reduction in agricultural land potentials have been said to occur, especially in the Kwilu Subregion (21). In savanna formations, loss of wood biomass due to slash and burn agriculture and exploitation of wood for fuelwood and charcoal production are said to exist, especially in the Kwango and Kwilu subregions where a number of agricultural and pastoral activities are occurring. Agricultural use of the Kalahari sands characteristic of the region, especially on hilly lands, is said to have resulted in erosion and leaching of minerals and organic matter and pasture lands are said to be degraded in some areas due to the effects of fire, woodcutting and overgrazing (21).

There are 21 major development project components occurring in Bandundu (Table 8-1); these are heavily weighted towards agricultural development (15 projects) although there are 1 road maintenance and 5 miscellaneous projects (20).

### 8.1.3 Equateur

The Equateur Region contains 17.2% of the total land area of Zaire, 29.2% of its forests, 4.9% of its woodland and 2.0% of its savanna (Table 8-2). With about 11.5% of the national population in 1984, Equateur had a non-urban population density (8.1/km<sup>2</sup>) substantially below the national norm (12.7/km<sup>2</sup>). About 8.7% of the region is in or is proposed for inclusion in the national park system (Mondjo NP and 75% of the Salonga NP) and in addition there are 3 forest reserves and 6 hunting reserves in Equateur (Table 5-1). Artisanal and industrial agriculture are said to have resulted in some deforestation and adverse soil impacts especially in the Gemena, Bumba, Businga and Libenge zones of the region.

There are 13 major development project components occurring in Equateur (Table 8-1), including 10 agricultural, 2 road maintenance and 1 barrage construction activity (20). The larger agricultural projects are said to be located in the north and south Ubangui subregions of Equateur (21).

### 8.1.4 Haut-Zaire

The Haut-Zaire Region contains 21.5% of the total land area of Zaire, 26.7% of its forests, 18.5% of its woodlands, and 10.8% of its savannas (Table 8-2). With about 14.2% of the national population in 1984, Haut-Zaire had a non-urban population density of 7.8/km<sup>2</sup> vs. a national norm of 12.7/km<sup>2</sup>. About 4.5% of the region is or will be in the national park and biosphere reserve system (100% of the Garamba NP, the proposed Okapi NP, the Yangambi Flora Reserve, about 10% of the Maiko NP and about 5% of the Virunga NP), and there also occur in principle 1 nature reserve, 20 forest reserves and 10 hunting reserves in Haut-Zaire (Table 5-1).

Most of the forests of this region are said to be little affected by development, although increased deforestation is said to have resulted from artisanal and modern agricultural and forestry exploitation in the Haut-Uele and Tshopo subregions. In the savanna regions, where there is a relatively high population density and high agropastoral potential, prevailing problems are said to include deforestation, other loss of wood biomass, soil laterization, soil erosion, general soil degradation, fire, and social conflicts between herders and farmers (21).

There are 18 major development project components occurring in Haut-Zaire (Table 8-1), including 15 agricultural, 1 mining, 1 road maintenance and 1 livestock activity (20). The largest agricultural and livestock projects are said to be concentrated in the savanna subregions of Haut-Zaire, especially the Ituri Subregion (20).

#### 8.1.5 Kivu

The Kivu Region contains 10.9% of the total land area of Zaire, 15.2% of its forests, 7.3% of its woodlands, 4.0% of its savannas and 4.8% of its papyrus swamps (Table 8-2). With about 17.5% of the national population in 1984, Kivu had a non-urban population density (19.5/km<sup>2</sup>) well in excess of the national norm (12.7/km<sup>2</sup>). About 7.9% of Kivu is in the national park system (100% of Kahuzi-Biega NP, 95% of Virunga NP and 90% of Maiko NP) and there occur in principle 11 hunting reserves in the region (Table 5-1). This region has excellent potential for both agricultural and pastoral land uses, but it also contains the greatest topographical relief and some of the most important biological resources found in Zaire. Loss of trees in the mountains and overgrazing of pasture are said to have resulted in considerable soil erosion in the Masisi and Uvira zones, and intensive deforestation for agricultural and fuelwood purposes is said to have reached a point in some areas where the population has been cutting into forest reserves designed for

the conservation of soils particularly vulnerable to erosion (20,60). Other biological problems cited include 'savanization,' leaching and general degradation of pasture soils, and land use conflicts (21).

There are 16 major development project components in Kivu, including 12 agricultural, 2 road maintenance, 1 livestock and 1 fisheries activity (Table 8-1)(20).

#### 8.1.6 Kasai-Orientale

The Kasai-Orientale Region contains 7.1% of the total land area of Zaire, 6.1% of its forests, 9.4% of its woodlands, and 6.5% of its savannas (Table 8-2). With about 8.1% of the national population in 1984, it had a non-urban population density (11.8/km<sup>2</sup>) slightly less than the national norm (12.7/km<sup>2</sup>). None of this region occurs within the national park or biosphere reserve system, but there exist in principle 15 forest reserves in Kasai-Orientale (Table 5-1).

There are 17 major development project components here (Table 8-1), including 13 agricultural, 2 road maintenance, 1 fisheries and a rural water supply activity, as well as an industrial diamond production operation in the region of Mbuji-Mayi (20). Most of the agricultural projects are located in the Tshilenga and Kabinda subregions, where prevailing environmental problems are said to include deforestation of gallery and secondary forest via slash and burn agriculture, and reduction of woody biomass in woodlands as a result of bush fires, agriculture and exploitation for fuelwood and charcoal (21).

### 8.1.7 Kasai-Occidentale

The Kasai-Occidentale Region contains 6.7% of the total land area of Zaire, 6.6% of its forests, 8.0% of its woodlands and 4.5% of its savannas (Table 8-2). With a 1984 population of about 7.7% of the national total, it had a non-urban population density (12.8/km<sup>2</sup>) higher than any other region in Zaire except for Bas-Zaire. About 2.3% of the region is in the national park system (10% of Salonga NP) and in principle there also occur 21 forest reserves and 1 hunting reserve here (Table 5-1). There are only 11 major development project components in the region, however, all of which with the exception of 3 road maintenance and 1 fisheries project are related to agriculture (Table 8-1). The largest of these are said to occur in the Lulua area, a region characterized by relatively high deforestation and fire incidence in the savannas and woodlands as a result of agricultural and hunting activities (20).

### 8 1.8 Shaba

The Shaba Region contains 21.2% of the total land area of Zaire, 0.8% of its forests, 38.8% of its woodlands, and 52.3% of its savannas in addition to 95.2% of its papyrus swamps (Table 8-2). With a 1984 population of about 13.1% of the national total, it had a non-urban population density (6.3/km<sup>2</sup>) lower than any other region in Zaire. About 3.9% of the region is in the national park or biosphere reserve system (Upemba and Kundelungu NPs) and about 31 forest reserves and 22 hunting reserves exist here in principle (Table 5-1). Deforestation problems have been cited in Shaba as a result of both agricultural and fuelwood cutting, especially in the Kipushi, Lubumbashi, Likasi and Kolwezi areas (21). Soil erosion, laterization and related problems have also been cited as problems in regions where development projects are taking place, and pollution problems have been cited in the area of mining activities (21).

There are 27 major development project components in Shaba, including 20 agricultural, 3 road maintenance, 3 mining and 1 fisheries activity (Table 8-1). The agricultural projects and major road activities occur in the Tanganyika, Haut-Lomami, Lualaba and Haut-Shaba/Kolwezi subregions of Shaba (21). The Shaba region ranked second nationally in direct adverse impact from development projects, first in indirect beneficial impact, and first in impact on population redistribution (Table 8-3).

## 8.2 HOST COUNTRY AND DONOR ENVIRONMENTAL REGULATIONS

### 8.2.1 Government of Zaire

While there exists no systematic and institutionalized project environmental review system or related legislation in Zaire, there are several legal instruments relative to activities having an impact on the environment. The most important of these is probably GOZ Ordinance 75-231 (1975) which charges DAFECN with promoting and coordinating activities relative to the environment including, in urban areas, providing advice on all industrial or other projects likely to improve or degrade the quality of life and, in rural areas, to create and manage nature reserves, capture stations, and water and forest ecosystems.

Other legal instruments include 1) Ordinance 41-88 (1953) relative to dangerous, unhealthy or noxious establishments; 2) Ordinance 69-041 (1969) relative to the conservation of nature, establishment of nature reserves, and establishment of the IZCN; 3) Law 82-002 (1982) developing hunting regulations; 4) the Decree of 21 April 1937 as amended regarding hunting and fishing; and 5) Ordinance-Law 85-211 (1985) establishing the FRCF. In addition, DAFECN and UNESCO are currently developing a Plan of Action for the Management of Human Establishments with the goals of 1) establishing an

environmentally-related data bank; 2) establishing an environmental code; and 3) developing a plan for the protection and continued monitoring of major ecosystems to be operated through the Teledetection Technical Division (TTD) of the Presidential Studies Service (PSS), university laboratories and similar institutions. (The EC has, parenthetically, entered into an agreement with UNESCO for pilot projects which are integrated with and complement ecological research, training, and demonstration activities in tropical forest areas.) Legislation project has also been prepared by UNDP under the auspices of the Department of Environment, but is limited to water, air, noise, industrial nuisance and waste management problems, and other select activities affecting urban areas.

While there exists no systematic, institutionalized system of project environmental review per se in Zaire, individual institutions and organizations have the opportunity and/or responsibility to provide environmental input to the project development process. The 'lead agency' in this process is essentially DAFECN, which has a permanent representative on the multi-departmental Commission on Investments (COI) under the Department of Plan. The COI, which also has the authority to employ the services of individual technical specialists to consult on environmental and related matters, theoretically controls such review by virtue of their authority to examine projects within the territory for conformity with respect to their management and coordination and to issue 'exploitation permits.'

### 8.2.2 Multilateral Donors

Multilateral donors with the most active programs involving projects having an impact on the environment include the African Development Bank (AFDB), IBRD, Fonds Européen de Développement (FED), UNDP, UNFAO and UNICEF (20).

The AfDB as of this writing had no firmly institutionalized system of project environmental review. There are, however, three full time professional environmental and/or ecological staff members and among their principle roles is the responsibility to review projects for environmental impact. The AfDB is also in the process of developing an institutionalized review system which it expects to have in place by 1990.

The World Bank has a longstanding policy related to environmental review of its international assistance activities, and project environmental review has been institutionalized into the Bank's project cycle. In addition, the Bank promulgated in 1985 a major new policy regarding 'wildlands' or natural land and water areas in a state virtually unmodified by human activity. This policy is designed generally to avoid eliminating wildlands, and is currently implemented through a series of six policy elements. The first policy element states that the Bank normally declines to finance projects involving conversion of wildlands of special concern; the second relates to wildlands other than those of special concern; the third concerns deviation from the policy; and the fourth applies where development of wildlands is justified as in the case where less valuable wildland conversion is preferable to more valuable wildland conversion. The fifth element applies where significant conversion (i.e., more than 100 km<sup>2</sup>) is explicitly justified, and involves mandatory compensation by inclusion of a wildland management component in the project which usually finances directly the preservation of an area similar in size and ecological characteristics to that converted. In general, four types of development projects need compensatory wildland management components under the Bank's fifth policy element, i.e., agriculture and livestock projects, transportation projects, hydroelectric projects and industrial projects. The Bank's sixth policy element concerns projects in which conversion of wildlands is not contemplated. The Bank's list of wildlands of "special concern" does not include any areas in Zaire, but areas considered applicable to the wildlands policy are not restricted to that list and Bank staff are said to

consult with government agencies with jurisdiction over wildland management during the project cycle (22).

UNDP is the most important financing instrument of the UN and often uses other UN institutions, including UNFAO, UNICEF and UNDIO, as executing agencies. While none of these organizations are known to have a systematic project environmental review system, all are involved to some extent in specific, environmentally-related projects (20).

UNDP plays an important role in ensuring the environmental acceptability of UN projects by providing institutional and technical assistance for the development of studies, and by providing funds to improve projects proposed by the EC. In addition, it directly supports natural resource projects such as rural resource planning in the Bandundu Region and the Programme d'Etude des Ressources Terrestres par Satellite (ERTS). UNFAO typically undertakes project environmental review incidentally at the design, mid-point and end-of-project stages, although such review per se is not an institutionalized process. Nonetheless, UNFAO is involved with development of a tropical forest action plan, legislative projects related to the protection of nature and the environment, and a number of biological issues related to agriculture in Zaire. These latter include the absence of a national soil conservation service; amelioration of soil problems; the absence of cultural means for environmental protection; limited use of fertilizers and the consequent shortening of fallow periods in some areas; and overgrazing, overcropping and fire impacts. UNDIO is currently said to be in the process of developing a system for following the impact of its projects in the developing world along with the EEC and other organizations. Currently involved in Zaire with an industrial planning activity, UNDIO has restricted its analyses to the macroeconomic effects of industrialization. UNICEF currently has no know system for systematically evaluating environmental impacts, but most of its activities in Zaire are restricted to furnishing goods and logistical support to the rural hydrological sector (20).

The activities of the Fonds European de Developpement (FED) in Zaire are concentrated on the agricultural and rural development sectors in the Kivu, Kinshasa, Bas-Zaire and Bandundu regions. At the point where requests for financing are submitted, the FED is said to typically require inclusion of environmental impact review in the scope of feasibility studies. Where prevention or mitigation is advised, the FED has included sub-project activities in final project designs, e.g., reforestation on the Bateke Plateau including replanting of palm and Eucalyptus plantations. The FED also participates in the plan of action for tropical forests (20).

### 8.2.3 Bilateral Donors

Bilateral donors with the most active programs involving projects having an impact on the environment include Belgium, Canada, China, France, Great Britain, Italy, Japan, West Germany and the U.S. (20). In general, bilateral development projects presented to the EC are analyzed by different commissions according to individual cooperative accords and conventions, taking account of priorities established by the EC. The EC is therefore the main institution responsible for project initiation (20).

Belgian bilateral assistance is said to be characterized by a major concern for preservation of the environment as evidenced by foci on reduction of shifting agriculture, reforestation and remote sensing and by direct support to the IZCN. Canadian assistance is characterized by several systematic environmental review activities, including 1) analysis of project impacts for eligible criteria at the commission level; 2) mitigation of adverse impact through reforestation or the adoption of 'environmental preservation techniques;' 3) support to the Department of Plan (DOP) through SPIAF, the Appui aux Gestions Forestières (AGF), CATEB and FRCF; and 4) participation in the Plan of Action for the protection of tropical forests (20).

French assistance follows the same regulations as other EEC countries, but in addition to corrective actions taken on the ground France has provided substantial assistance to the Bureau d'Etudes d'Amenagement et d'Urbanisme (BEAU). Italy finances a number of projects, including energy, road rehabilitation and water quality projects, which have an impact on the environment but are said to undergo little or no environmental review. Most Italian agricultural activities, however, are said to be relatively sound environmentally by virtue of their impact on reducing bush fires, their use of live anti-erosion techniques and their incorporation of reforestation activities. Italy is also said to have undertaken a pre-feasibility study of the possibility of draining about 10% of the water volume of the Zaire Basin into Lake Chad, and has foreseen the need for a feasibility study regarding control of adverse environmental impacts which could result from that action (20).

Bilateral assistance from Great Britain is oriented primarily towards road infrastructure, the transport sector and education, and consists primarily of material support without intervention in the management of projects or project-specific environmental review. Japan assistance, primarily economic and social in nature, also does not undergo environmental review but the Japanese at the same time fund an ecological, limnological and ichthyobiological project for the Lake Tanganyika region and furnish waste management equipment for the city of Kinshasa. The West German project development process is said to have incorporated an environmental review form for projects for the last two years, indicating the level of impact projects are expected to have on the environment, and a negative impact determination is said to involve the possibility of elimination of the project from further consideration. West German assistance also includes a project for protection of mountain gorillas in the Kahuzi-Biega NP. No information is currently available on Chinese environmental review activities (20).

USAID regulations related to environmental review of international development assistance activities are embodied as 22 CFR 216, i.e., are federal, court-ordered regulations. The stated purpose of these regulations are 1) to ensure that environmental factors and values are integrated into the AID decision-making process; 2) to assign responsibility within the Agency for assessing the environmental effects of AID's actions; and 3) to implement the requirements of the National Environmental Policy Act as they affect AID programs. Under this system of environmental review, projects are examined for likely adverse environmental impact during the project design stage and, where such likely adverse impacts are identified as 'significant', monitoring and/or mitigation measures are developed as an integral part of the project. These regulations are widely considered to constitute one of the best institutionalized frameworks for environmental review of any of the major bilateral or multilateral donors at the current time, and in both Zaire and other African nations this review system has led to implementation of activities directly and positively benefitting tropical forest and biological diversity conservation and management.

ProjL	Administrative Region									
	KINSHASA	BAS-ZAIRE	BANDUNDU	EQUATEUR	HAUT-ZAIRE	KIVU	SHABA	KASAI-OR.	KASAI-OC.	TOTAL
<b>Capital Development</b>	<b>Subtotals:</b>									
Mining							3			6
Barrages (Power)				1			3			4
	1		1							2
<b>Transportation Infrastructure</b>	<b>Subtotals:</b>									
Roads, Bridges and Ferries	2	1	2	1	2	2	3	2	3	16
	2	1	2	1	2	3	2	3		16
<b>Agricultural Institutions/Ancillary</b>	<b>Subtotals:</b>									
Cooperatives and Rural Institutions	3	7	8	3	7	7	12	8	3	58
Research, Extension, Credit, Training	2	1	2	1	2	2	5	2	2	19
	1	6	6	2	5	5	7	6	1	39
<b>Agricultural Intensification</b>	<b>Subtotals:</b>									
General Agricultural Development	4	5	5	3	3	3	7	3	3	36
Fertilizers		2	2	1	1		2	1	1	10
Seed Improvement, Commercialization	1	1	1	1	1	1	1	1	1	9
Soil Restoration		1	1	1	1	1	4	1	1	11
Animal Traction, Mechanization	1									1
Crop Storage and Stockage	2	1	1							4
						1				1
<b>Industrial Agriculture</b>	<b>Subtotals:</b>									
Plantations	1	2	2	4	5	2	1	2		19
Rice	1	1	3	4	1	1	2			13
Cotton		1	1	1	1					5
Cocoa				1			1	2		5
Oil Palm				1	1					2
Irrigation and Drainage	1	1	1	1	1	1				6
<b>Miscellaneous</b>	<b>Subtotals:</b>									
Integrated Rural Development	1	5	5		1	2	1	2	2	19
Fisheries		1	2					1	1	4
Livestock	1	2	2			1	1	1	1	9
Rural Water Supply	2	1		1	1					5
										1
<b>GRAND TOTAL :</b>	<b>51</b>	<b>22</b>	<b>21</b>	<b>13</b>	<b>18</b>	<b>16</b>	<b>27</b>	<b>17</b>	<b>11</b>	<b>154</b>

Data in Table 8-1 derived by preparer from information on 35 agricultural, 4 mining and 2 barrages projects, broken down by project component and regional focus, as provided in Ref. (21). Ref. (21) information in turn derived from GEAF review of 35 projects listed in Zaire's PIP believed by GEAF to have an impact on the environment. See text for data limitations.

TABLE 8-2

SUMMARY OF VEGETATION TYPES AND MAJOR PROJECTS BY REGION

<u>Region</u>	<u>Land Area</u>	<u>Forest</u>	<u>Woodland</u>	<u>Savanna</u>	<u>Mangrove</u>	<u>Papyrus</u>	<u>Number of Major Project Activities</u>
Kinshasa	0.1	N.D	N.D	N.D	-	-	9
Bas Zaire	2.6	1.0	4.0	5.6	100	-	22
Bandundu	12.6	14.3	9.1	14.1	-	-	21
Equateur	17.2	29.2	4.9	2.0	-	-	13
Haut Zaire	21.5	26.7	18.5	10.8	-	-	18
Kivu	10.9	15.2	7.3	4.0	-	4.8	16
Shaba	21.2	0.8	38.8	52.3	-	95.2	27
Kasai-Or.	7.1	6.1	9.4	6.5	-	-	17
Kasai-Occ.	6.7	6.6	8.0	4.7	-	-	11
<b>TOTAL</b>	<b>99.9</b>	<b>99.9</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>154</b>

Data summarized from Tables 2-3 and 3-1.

8-16

112

## 9.0 MAJOR ISSUES IN BIOLOGICAL DIVERSITY AND FOREST CONSERVATION

"It seems that public opinion quite rapidly reflects expert opinion when the latter is confidently held and expressed with convincing argument. On the other hand, confusion, ignorance, and apathy among the laity typically reflect incomplete and dissonant signals from the specialists."

--Alan Randall

There are four major issues related to conservation and management of tropical forests and biodiversity in Zaire, in addition to a number of ancillary issues as discussed below.

### 9.1 PROTECTED AREA REPRESENTATION

A principal issue in any analysis of conservation biology is the adequacy of the representation of important biotic communities in a given protected area system. This question, different from the adequacy of management of that system, is for all practical purposes impossible to credibly answer for Zaire at the current time due to the near absence of solid quantitative information on even the most basic questions of extent and distribution of vegetational communities and species (36). While it appears that most major vegetation (11) and biotic community (34) types are represented in Zaire's national park system, it is impossible to estimate from available information whether the extent of types included are adequate for

their ultimate conservation. A basic system to evaluate the extent to which the national park system adequately includes representative vegetational and biotic community types in Zaire is a top priority. Given funding limitations, an appropriate technology approach to dealing with this issue would be the institutionalization of a systematic gap analysis system (5) under either IZCN or ERTS or, preferably, through a cooperative effort of the two institutions. While this is considered here as a top priority, it should be noted that a great deal of diversity is found associated with communities too restricted, narrow or patchy in distribution to be easily addressed by such an approach (31).

## 9.2 PROTECTED AREA MANAGEMENT

Management of protected areas, a second principle issue in any analysis of conservation biology, is a major, pervasive and fundamental weakness in Zaire although mitigated to some extent, particularly insofar as vegetational communities are concerned, by very low to low population densities and pressures in immediate proximity to most national parks. It appears clear that Zaire does not and will not have in the near future the economic and trained human resource capacity to systematically manage the existing park system so as to provide for full protection of its resources, much less protect a significantly expanded system. (Because of the vast remaining expanses of forest in Zaire, and the very limited rate of drawdown of those forests, diluting very limited resources for protection of newly or re-established forest reserves under any new legislative mandate would appear to be at the significant expense of protection of existing protected areas, especially the national parks. Establishment of such a legislative mandate and inclusion of forest reserves into the system is therefore not considered by the preparer of this document to be a major priority at this time.) A

phenomenon common to most of the developing and indeed developed world, this essentially leaves two active alternatives for exploration, i.e., increased donor and/or NGO assistance, and improved private sector participation.

As discussed in Sect. 2.2, 9 donors and at least 39 NGOs are directly involved in national park or other protected area conservation and management in Zaire. While many of these activities appear to be focussed on protection of the "charismatic megavertebrate" fauna, a significant number deal with broader issues related to the protected area system. Nonetheless, the focus of donor and NGO funding could be much improved by creating a GOZ/donor/NGO conservation coordinating council to, among other responsibilities, advise on priorities for protection of biodiversity in Zaire and attempt to influence the GOZ, donors and NGOs in their selection of activities to fund. Major priorities in this respect are 1) a national vegetation and biotic community survey based initially on satellite imagery analysis, which establishes quantitatively confirmable statistics on the distribution and areal extent of resources; 2) basic research on the composition, structure and function of these systems; and 3) establishment of an institutionalized gap analysis system to assess the adequacy of inclusion of such vegetational and biotic communities in the national park system.

Priorities

A second area where donors especially could be effective, given limited available funds, is in education and improvement of the overall level of technical qualification among Zairian park management personnel. UNESCO and Canada have been notably active in this respect. USAID should consider increased emphasis on conservating training through its regional support to Mweka Wildlife College and/or through use of HRDA and/or local currently funds.

educ & training

A third area, both low cost and high profile and of very substantial potential efficacy, even if slow and long term in producing results, is through conservation education. This is an area particularly appropriate for NGO involvement. Activities proven successful elsewhere have included radio and

conserv educ

television spots on conservation, profiling particular parks, species or locations; publication of conservation books and booklets for schools; publication and distribution of posters to schools, hospitals and other institutions; and sponsorship of contests, public awareness campaigns and special events.

A fourth and relatively new approach with great potential is 'debt for conservation swaps', wherein debt is bought by a third party from banking institutions at discount and traded to a host country government for agreements to set aside, protect and/or otherwise conserve particular areas. This is an interesting potential approach for Zaire, but does little to address the issues of limited resources available to manage what is already in the protected area system. If a method could be devised wherein this would actually generate new funds the potential would be greater, but in the absence of this the original funds would appear to be better spent in Zaire through direct application to existing protected area management problems.

*Debt*

The second major option for acquiring the resources required to improve management of the NP system in Zaire is through improved private sector involvement. Certain parks in this respect are clearly more suitable than others for targetting, although some novel ideas have been suggested in other countries for very remote and inaccessible parks (e.g., trade of logging rights in proximity to a park for park infrastructure construction, materials, or other non-monetary resources; direct targetting of offtake taxes in such areas to park management). Indeed, such support is already occurring to some extent in Zaire, i.e., provision of significant funds to the soon to be established Okapi NP by TabaZaire, presumably in part because of the very high profile of that organizations' Okapi brand cigarettes.

*Private Sector*

One particularly interesting potential in this respect would be a package operation involving 1) passage of current legislation protecting specific hunting reserves in proximity to specific NPs; 2) development of concessional

*116*

arrangements requiring private individuals or corporations to manage those reserves in exchange for exclusive rights to construct and operate hunting and tourist lodges; and 3) development of exclusive contracts in the associated NPs for operation and management of infrastructure and tourist facilities. A very high priority area in this respect is the Upemba/Kundelungu NP system in Shaba, with outstanding potential but some limitations (25). There is a recent history of this approach in Zaire (e.g., in Shaba) and considerable recent interest has been expressed for development of established tours by hotel chains operating in, e.g., Kinshasa and Lubumbashi. While African tourism development can be both an expensive and risky economic undertaking anywhere, certain NP regions in Zaire have truly world class potential (wildlife, scenery, history) and given a proper incentive system the private sector could probably be induced to (re-) consider alternative development scenarios and concessional arrangements.

### 9.3 FUELWOOD CONSUMPTION AND THE URBAN HALO EFFECT

An estimated 76-89% of all energy needs in Zaire are met by fuelwood although wood production for fuel varies considerably (ca. 73-98%) from region to region (36, 54). The balance consists of petroleum and hydroelectricity, which nonetheless dominate as energy sources for the industrial and transport sectors (36). Most recent concern about the effects of biomass offtake for fuelwood has concentrated on the increasing 'urban halo' of deforestation which typically develops around African urban areas. Such halos develop because of the high concentration of population and the economics of fuelwood transport, and they are most noticed because they represent areas of substantial offtake in relation to pre-impact conditions, because they are highly visible, and because virtually all urban dwellers are affected by fuelwood costs in one way or another.

Data on the halo effect in Zaire are summarized in Table 9-1, and indicate that under worst case conditions the total halo effect around the largest urban centers in Zaire has affected about 1% of the country. Based on these data it is also probable that the total halo effect for all urban centers in Zaire is probably less than 2% of the country. This represents a minimal impact from both the national and global mass deforestation perspectives, but it is important to both 1) look more closely at future trends in halo deforestation and the factors which may affect those trends, and 2) to assess the distribution of urban halo deforestation impact in relation to the distribution of important forest and biological resources.

In the first instance it is instructive to examine the case of deforestation around Lubumbashi which, while probably unique, also contains a number of elements common to the evolution of most urban areas which affect halo fuelwood offtake. In about 1900, the one square geographical degree around Lubumbashi consisted of 92% "forest" and woodland. Deforestation commenced noticeably about 1910 with copper exploitation, the creation of the towns of Lubumbashi and Kipushi, construction of a railroad, woodfueling of steam engines, creation of farms and rural centers around the towns, and the appearance on the market of wood fuels such as charcoal. While general increases in use of electricity and coal and in use of diesel fuel by trains has reduced fuelwood consumption over and above what it would otherwise have been in the interim, electricity has brought little reduction in medium and small scale industries and the homes (54). Rather the urban population has continued to grow as has with it the mass demand for fuelwood, at about 6.5%/yr in 1981 (85); as of 1983, Lubumbashi consumed 2800 sacks of charcoal, 550 m<sup>3</sup> of firewood, and over 100 m<sup>3</sup> of wood for construction and other purposes daily (53). The impact on various vegetation types as of 1984 had been uneven, however: about 97.9% of dense riparian forest, 60.5% of woodland, 60.5% of tree and shrub savanna, 17.6% of open forest and 15.4% of dense dry evergreen forest had been affected. In total, 21.6% of the woodland and forest of the square degree (ca. 212,162 ha) had been affected by urban fuelwood demand (54).

Most foreseeable trends here, however, suggest that deforestation rates in this geographical square degree should ultimately slow down over current conditions. These include 1) a general slowdown in immigration to the town; 2) increases in wages of the working masses, with a change in urban lifestyles, clearly encouraging use of petrol, natural gas and electricity; 3) some improvement in charcoal production techniques; 4) declining per capita consumption through improvement of domestic burners and conversion of industrial equipment; and 5) reforestation programs (54). All of these trends, with the exception of slowing immigration to the cities, appear to be occurring to greater or lesser degrees not just in the urban areas of Zaire but throughout most of the African continent. Any project or activity which addresses, supports and encourages these trends, either directly or indirectly, can therefore be expected to contribute to a decline in urban halo deforestation rates in relation to prevailing conditions.

The distribution of impact in relation to areas of particularly important biological resources, is difficult to assess because of the very high level of impact currently prevailing around urban areas and a lack of knowledge about the resources occurring there prior to impact. Three areas of particular future concern, however, appear to be 1) deforestation around Lubumbashi as it may affect the Muhulu and certain of the copper-cobalt vegetational associations with very high endemicity; 2) deforestation around Kisangani in general given its location in direct proximity to the eastern Zaire Basin refugium; and 3) deforestation around Bukavu, Goma and other population centers in and near the diverse and relatively densely populated montane systems of eastern Zaire. Another ancillary issue which should be looked at is the effect of deforestation in the Kinshasa region on surface and groundwater hydrology, particularly as it may affect important cave habitats for rare, threatened or endangered fish species in Bas-Zaire.

#### 9.4 DEFORESTATION EXTENT AND RATE

= ? itinerant ?

UNFAO and UNEP estimated in 1981 that about 1650 km<sup>2</sup> of true forest in Zaire were cut annually during the period 1967-1980, 81.8% of which was attributable to "itinerant" or shifting agriculture (cited in (36)). The former estimate is considered here to probably be accurate to within an order of magnitude, and the latter estimate to probably be accurate to within 10% of the true figure based on the preparer's experience with sources of deforestation impact in other African forest areas.

As of the time of this writing, however, inadequate quantitative data based on purely objective methodologies (e.g., aerial photography, satellite imagery) existed to reliably estimate either 1) the past areal extent of forest cover in Zaire at any point in time; 2) the areal extent of forest cover in Zaire at the current time; 3) the current areal extent of land use in forest areas (i.e., traditional agriculture, industrial agriculture, urbanism, non-urban industrial operations, roads, non-selective cut logging operations); or 4) deforestation rates for any period of time in either areal extent or percent drawdown. In the absence of such data, quantitative estimates are necessarily subject to considerable question. Indeed, estimates of deforestation rates have a tendency to far exceed actual values based on objective methodologies (25). Given such circumstance, it is useful to calculate an estimated maximum or worst-case scenario to define the upper limits of credible deforestation estimates and to evaluate changing trends in the status of Zaire with respect to the rest of the world in terms of forest extent and drawdown.

Pre-1900 forest cover in Zaire is taken in this analysis to equal the "forest" category of vegetational cover from Table 3-4, plus 100% of vegetation Type 32 of Devred (11) which is the only one of 6 vegetation types (Types 27-32) defined on the basis of human impact and found to an extent greater than 100 km<sup>2</sup> in Zaire. Pre-1900 forest cover in Zaire is therefore estimated and assumed to be equivalent to 1,243,590 km<sup>2</sup> or 53% of the country.

The estimated level of forest cover under a worst-case scenario was established by subtracting from this figure the following:

*forest cover*

- 1) 100% of the areal extent of Devred's (11) vegetation Type 32 (21,200 km<sup>2</sup>; Table 3-3), assumed to have been totally converted to savanna;
- 2) A worst-case (100% deforestation) urban halo value from published references for urban areas originally under forest cover, i.e., Kinshasa and Kisangani (15,708 km<sup>2</sup>; Table 9-1);
- 3) Two times the urban halo value of 2) above to account for urban halo deforestation around all other urban areas originally under forest cover in Zaire but for which no published data exist (31,416 km<sup>2</sup>);
- 4) The worst-case areal extent of traditional agriculture occurring in forest areas, derived assuming that a total of 2,146,712 forest farms existing in 1985 (Table 4-3) in addition to Devred's (11) vegetation Type 32 and assuming a worst-case average of 1.0 ha/forest farm (Table 4-1) (21,467 km<sup>2</sup>). (Using these figures, and adjusting the value for total 1981 traditional crop hectareage from Table 4-1 to 1985 at a rate of +2.0%/yr to account for rural population growth, would give a figure for total hectareage under non-forest traditional cropping of 2,559,703 ha or an average farm size in non-forest areas of 1.4 ha vs. an estimated mean of 1.5-2.5 ha in Table 4-1);
- 5) Fallow land resulting from traditional agriculture which has not yet regenerated to forest, assuming an equivalent area in fallow to that actively cropped per rural forest farm (1 ha) and 7 years to regenerate sufficient tree cover to preclude the continued existence of a grass stratum (21,467 km<sup>2</sup>);
- 6) 100% of all industrial agriculture occurring in Zaire, using the figure for total commercial crop hectareage for 1981 (Table 4-1) and adjusting that value to 1985 at a rate of +2.0%/yr (5380 km<sup>2</sup>);

7) 1.0% of the total forest area to account for direct road construction impacts, assuming comparability with a known figure for eastern Liberia (23) and estimated figures for portions of the Amazon Basin (89) (12,435 km<sup>2</sup>);

8) 1.0% of the total forest area to account for direct industrial impact outside of urban halo areas (12,435 km<sup>2</sup>); and

9) 1.0% of the total forest area to account for non-selective cut logging areas that will not regenerate to forest (12,435 km<sup>2</sup>).

All of the above items are considered significantly high in the Zairian context, with the possible exception of Items 4 and 5.

The above calculations give a worst-case deforestation value as of 1985 of 153,843 km<sup>2</sup> or 12.4% deforestation over pre-impact conditions. Remaining worst-case forest cover, therefore, based on a pre-impact cover of 1,243,590 km<sup>2</sup>, is 1,089,747 km<sup>2</sup> or equivalent to 46.5% of the country. This figure is comparable to but 2.8-9.0% higher than published figures in Table 4-1 of 1,000,000-1,059,750 km<sup>2</sup>.

12.4 %  
defor.

According to these calculations, traditional agriculture (Items 1, 4 and 5) had accounted for 41.6% of all deforestation and had affected an area equivalent to about 5.1% of the estimated forest remaining as of 1985. To put this traditional agricultural impact figure into perspective, it has been estimated that natural (i.e., treefall and limbfall) gaps in elfin forest in Costa Rica affect about 1.1% of the forest area per year (90), that about 5% of terra firma forest in Costa Rica may be in gap phase at any one time (46), and that 4-6% of any Amazon forest will be studded by canopy openings due to treefall (89). Assuming that the above calculations are approximately correct and that the areal extent of forest affected by natural treefall is approximately the same in Amazonian and Congo Basin forests, traditional agriculture in Zaire would therefore have only caused about the same amount of deforestation as of 1985 as that occurring under natural conditions.

The only available published deforestation rates for Zaire are 0.16%/yr (36) and "0.2%/yr (99)", based on "UNFAO, UNECE and/or UNEP" data. If one takes the estimated worst-case deforestation figure calculated above (12.4%), assumes that deforestation began in 1900, and assumes an equivalent rate of drawdown 1900-1985, this would give a mean 1900-1985 deforestation rate of 0.15%/yr. If one assumes, more appropriately, that deforestation rates have increased slowly but exponentially since 1900 and takes the base year 1950 as a statistical <sup>= 0.15%/p 7</sup> median, this would give a 1985 deforestation rate of 0.35%/yr. Calculation of an estimated worst-case rate scenario gives a 1985 deforestation rate of 0.50%/yr based on the following assumptions:

Where does this come from?

defor rate

1) Reduction due to the total urban halo effect assuming 30 years for urban halo areas to reestablish useable biomass equivalent to natural conditions in the absence of offtake, i.e., a "maintenance offtake" of 1570.8 km<sup>2</sup>/yr, plus 10% halo accretion, plus 5.32% due to the current urban population growth rate (1669 km<sup>2</sup>/yr);

2) A reduction due to traditional agricultural conversion of 1.0 ha/7 years (life of plot before fallow) per farm plus 1.3% or the estimated net rural population growth rate (Table 4-1) (3589 km<sup>2</sup>/yr);

3) A reduction due to industrial agriculture of 2% of existing commercial agriculture (43 km<sup>2</sup>/yr);

4) A reduction of 1.0%/yr each of existing impact due to road construction, non-urban industrial expansion and non-selective cut logging (total 372 km<sup>2</sup>/yr); and

5) An addition due to an estimated 45% of land deforested due to traditional agricultural production and logging which returns as fallow to forest cover each 7 years (49) (238 km<sup>2</sup>/yr).

To put this range of deforestation rate figures (0.15-0.50%/yr) into perspective, the global tropical deforestation rate is currently estimated from data presented in (49) at 0.63%/yr and other deforestation rates in Africa have been quantitatively estimated as follows:

Global  
0.63%/yr

<u>LOCATION</u>	<u>RATE</u>	<u>REFERENCE</u>
Liberia (1800-1979/82):	.27%/yr	(23)
Ghana (1800-1980):	.42%/yr	(23)
Madagascar (1977):	1.50%/yr	(87)
Sierra Leone (1800-1980):	2.30%/yr	(23)
Ghana (1977):	2.31%/yr	(87)
Côte d'Ivoire (All except SW, 1956-66):	2.58%/yr	(23)
Ethiopia (1977):	5.00%/yr	(87)
Côte d'Ivoire (1977):	7.14%/yr	(87)

Published data and data estimated here tend to substantially confirm the qualitative conclusion that Zaire has one of the lowest prevailing deforestation rates found anywhere in the world (62), and that it will therefore probably contain a significantly increasing percentage of the world's tropical forests in the years to come. It has been argued that this in and of itself is a major reason why Zaire is justifiably at and should remain among the world's top priority countries in terms of tropical forest and biodiversity conservation and management. It has also been argued however, that both the limited impact to date in Zaire and the prevailing trends in population size, distribution and resource depletion suggest the existence of a long to very long lead time prior to the development of a critical overall tropical forest and biodiversity situation in the country.

TABLE 9-1

SUMMARY OF AVAILABLE DATA ON THE URBAN DEFORESTATION HALO EFFECT IN ZAIRE

<u>City</u>	<u>Population (ref. year)</u>	<u>Halo Radius (km)</u>	<u>Halo Area (km<sup>2</sup>)</u>	<u>Firewood Volume (Mm<sup>3</sup>/yr)</u>	<u>Charcoal Sacks (1000's/yr)</u>
Kinshasa	2,000,000 (1979)	50	7854	1.2	n.d.
Kisangani	425,000 (1980)	15 50	707 7854	n.d. n.d.	n.d. n.d.
Kolwezi	218,000 (1982)	20+	1257	0.034	411
Likasi	200,000 (1982)	20	1257	0.031	376
Lubumbashi	534,000 (1980)	30 18 30	2827 1018 2827	n.d. 0.06 0.084	n.d. 418 1011
<b>TOTAL (Worst Case): 21,049 km<sup>2</sup> or 0.9% of Zaire</b>					

All data from (54).  
n.d. = no data.

## 10.0 RECOMMENDATIONS AND PROPOSED ACTIONS

"Action should be taken where it could have the best effect, not on lost causes--an all too common failing of conservation efforts based on sentiment rather than science."

--Brian J. Huntley

### 10.1 ACTIONS NECESSARY TO ACHIEVE CONSERVATION AND SUSTAINABLE MANAGEMENT OF TROPICAL FORESTS AND BIOLOGICAL DIVERSITY IN ZAIRE

Immediately pressing current constraints to effective conservation and management of tropical forests and biodiversity in Zaire are 1) lack of sufficient basic technical information on which to objectively and scientifically base establishment of conservation priorities; 2) lack of economic resources to protect those conservation areas already established within the national reserve system; and 3) insufficient well-trained technical and managerial personnel in principal GOZ institutions. In the short to mid term, limited available funds and human resources should focus on the national park system and management of specific associated hunting reserves. More specific recommendations for the GOZ, donor and NGO organizations in the near future are prioritized here as follows:

- 1) Establishment of a donor coordination committee to evaluate conservation intervention alternatives, identify and mobilize resources for conservation activities, and advise on ways to effectively focus limited human and economic resources in the conservation sector;

2) Basic national vegetational mapping from satellite imagery and/or aerial photography, and establishment of quantitatively confirmable statistics on the extent and distribution of biotic communities;

3) Establishment of an institutionalized system for identifying gaps in the representation of significant biotic community types in the national protected area system and for sharpening conservation priorities;

4) A study of the practicality of increasing the role of the private commercial sector in management of select national parks and hunting reserves;

5) Basic vegetational and biotic system inventory work and research on the composition of these communities;

6) Development of more precise information on the conservation activities of NGOs and PVOs;

7) Generation of specific legislation related to the formal protection of specific hunting reserves, and legislative guidelines permitting management and use of such reserves by the private sector; and

8) Expanded public conservation education.

**10.2 EXTENT TO WHICH ACTIONS PROPOSED FOR SUPPORT BY THE AGENCY  
MEET THE NEEDS IDENTIFIED TO ACHIEVE CONSERVATION OF  
BIOLOGICAL RESOURCES**

The current USAID/Zaire development assistance portfolio is as with all major conors tightly focussed both sectorally and regionally. Sectorally the programs are focussed upon private sector development, agricultural production, restoration of transportation infrastructure, and preventive health and population services primarily directed at child survival. The geographical foci include the Shaba and Bandundu regions, although health and some other project activities are scattered throughout Zaire.

USAID/Zaire over the last five years has allocated sectorally its development resources as follows (92):

**USAID ASSISTNACE LEVELS IN MILLIONS OF DOLLARS**

<u>GENERAL SECTOR</u>	<u>FY 84</u>	<u>FY 85</u>	<u>FY 86</u>	<u>FY 87</u>	<u>FY 88</u>
Commodity Imports for Private Sector	25.0	30.0	27.8	26.8	13.0
Agriculture	4.8	10.3	8.5	12.7	8.6
Transportation	6.1	1.9	14.2	11.1	9.5
Health and Population	4.9	13.4	11.8	8.5	9.2
Misc. (Education, PVO's Disaster Relief, etc.)	1.7	1.5	1.1	1.6	6.5
<b>Total.</b>	<b>42.5</b>	<b>57.1</b>	<b>53.4</b>	<b>60.7</b>	<b>46.8</b>

The effects of this program on tropical forests and biodiversity conservation and management are therefore primarily indirect. Nonetheless, USAID also has limited activities directly contributing to such resource conservation and management, including 1) regional bureau support to Mweka Wildlife College in Tanzania; 2) regional bureau support for natural resource management activities in sub-Saharan Africa; 3) limited project support of anti-poaching operations in the Upemba NP; and 4) local-currency and regional support for assessment of basic issues related to tropical forest and biodiversity conservation and management in Zaire.

128

While it is unrealistic to expect donors to dilute the focus of their programs given current economic realities and staffing constraints, there exist potential low cost/low management-intensive activities which could ultimately have significant positive impact on biological resource conservation in Zaire. These include provision of funds to 1) prepare a comprehensive assessment of the role of NGOs and PVOs involved with conservation-related activities in Zaire, using existing available data supplemented as necessary; 2) establish a donor coordination committee to carry out the functions described in Sect. 10.1; 3) fund specific NGO activities in conservation education; 4) fund a study of the practicality of increasing the role of the private commercial sector in management of NPs and hunting reserves; and 5) training of Zairois technical specialists at Mweka Wildlife College in Tanzania and/or in Cameroon, and/or at other regional conservation-related institutions. With additional USAID/staff all of these activities could be conducted both within the existing sectoral and geographical foci of the USAID/Zaire program and within USAID/Zaires existing project portfolio.

How about tomorrow?

1. assess — role of PVOs/NGOs
2. donor coord
- ✓ 3. NGO / Conserv educ
4. study — private sector role
- ✓ 5. tech training

2 & 5 : On the ground

Suggestions do not appear to meet the challenge

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