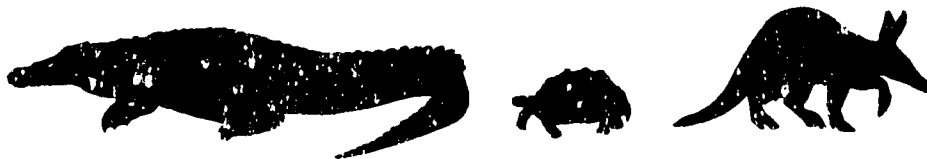
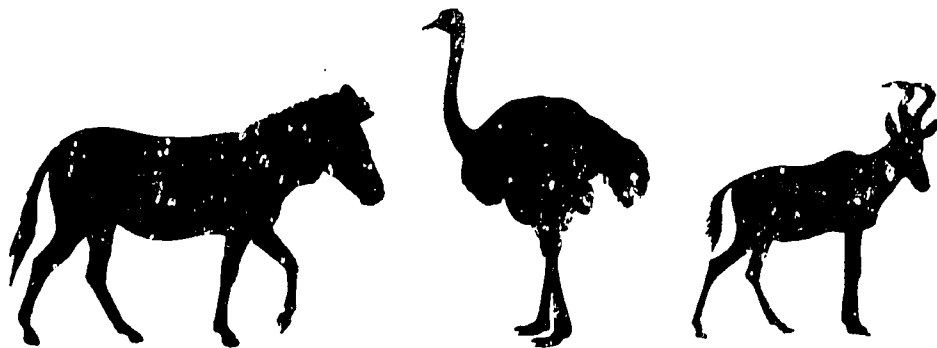
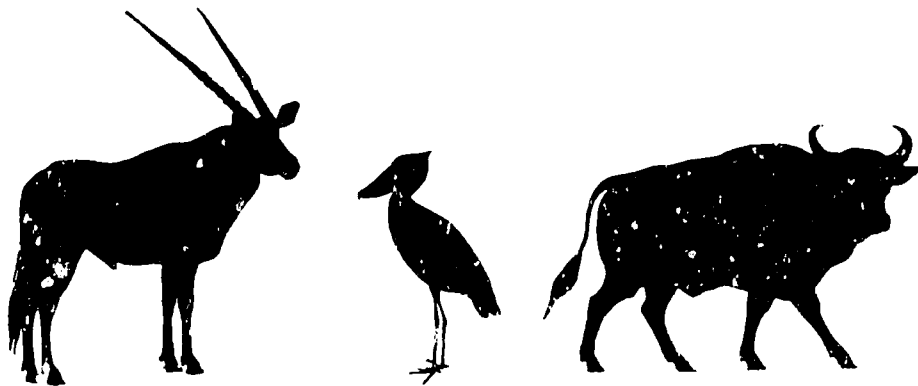


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# Botswana Biological Diversity Assessment



AGENCY FOR INTERNATIONAL DEVELOPMENT  
BUREAU FOR AFRICA

**BOTSWANA BIOLOGICAL DIVERSITY ASSESSMENT**

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## EXECUTIVE SUMMARY

### INTRODUCTION

Biological diversity is receiving increasing worldwide attention because of its scientific, cultural, and economic significance. This attention has been heightened because biological diversity is being lost at an increasingly rapid rate throughout the world.

Conservation of Botswana's biological diversity is possible through preservation in protected areas and through sustainable use involving sound development and management of biological resources. The legal and institutional framework for conservation of Botswana's biological diversity exists, and adequate protection of biological diversity in Botswana can be achieved with improvements in the ecosystem coverage and management of the protected areas system and with improved implementation of land use planning.

### STATUS AND MANAGEMENT OF THE PRESERVATION SYSTEM

Preservation of biological diversity involves preservation of representative samples of ecosystems, species, and genetic resources. Ecosystems are preserved in a protected areas system. Species are preserved through endangered species protection, special reserves, and zoos. Genetic resources are preserved in seed banks and programs to preserve important wild varieties of commercial plant and animal species.

Ecosystem level preservation in Botswana is quite good, but can be improved. Botswana has 14 major ecosystem types (Figure 2, p. 8, text), nine of which are represented in the nation's parks and game reserves (Figure 4, p. 11, text). Coverage of these protected areas would be improved by expansion to the additional five major ecosystem types.

Full protection of biological diversity would also benefit from corridors between the major parks and game reserves to allow for free passage of migratory and water-seeking wildlife (Figure 5, p. 12, text). The proposed multiple-use Wildlife Management Areas (WMAs) would provide several such corridors. Establishment of the proposed WMAs is therefore very important to the maintenance of biological diversity in Botswana. WMAs or other mechanisms (e.g. game ranches) should also be considered to provide additional corridors.

Species level preservation of biological diversity in Botswana consists primarily of endangered species protection. All vertebrates are protected by hunting regulations, and over fifty species are not allowed to be taken at all. This extensive legal protection for species should be reviewed periodically to ensure that it is current and biologically relevant.

Management of protected areas and enforcement of species protection laws is in need of significant improvement. Botswana has the lowest level of manpower assigned to



protection and management of its National Parks of any African country. Monitoring of hunting licenses and enforcement of conserved trees and animals is weak. The government is aware of these shortcomings and has begun to move to correct them with assistance from donors.

The major effort in conservation of genetic resources in Botswana is a government-sponsored breeding program for the local Tswana cattle type. Pure breeds of this Bos indicus strain have become rare due to cross-breeding with European types.

## CONSERVATION THROUGH SUSTAINABLE USE

Sustainable use of resources and sound development planning are key to maintaining biological diversity outside of preservation systems. The management of natural systems such as range, forest, and wetlands is of particular importance. The institutional structure and development planning process in a country also play key roles in this respect.

Botswana's development planning system is exemplary. Land use plans are developed at the local level in consultation with the central government, are adequately detailed, and reflect both local and national development priorities. This system could serve as an excellent model for many African countries.

Conversely, sustainable use of managed natural systems is not well developed. Current management practices in both forest and range use are doing little to promote sustainable use. Timber concessions permit harvest which is unlikely to be sustainable in the long term, minimizes economic multipliers in Botswana's economy, and is likely to result in local reduction of biological diversity. Range use is largely unmanaged, and serious local range degradation is occurring. If allowed to continue unchecked, this degradation will have serious consequences in loss of biological diversity and economic productivity.

Implementation of both natural system management and development planning can be markedly improved. The excellent national land use plans are not supported by adequate detailed management plans, monitoring, or enforcement. Range and forest management are both severely constrained by serious understaffing and lack of funding. Donor and government support to these sectors can result in vitally needed improvement in management, substantial increase in economic returns from range systems, and enhanced conservation of biological diversity.

## LEGISLATIVE AND INSTITUTIONAL STRUCTURES

Botswana has a strong legislative and institutional basis for the conservation of biological diversity. As discussed above, protected areas and species legislation is good, and development planning legislation is excellent. Donor and non-governmental organization involvement in the natural resources sector is increasing. Botswana's institutional framework for protecting biological diversity could be improved by signing the World Heritage Convention and the Ramsar Convention on Wetlands of International Significance.

## **ECONOMICS OF CONSERVING BOTSWANA'S BIOLOGICAL DIVERSITY**

Botswana's preservation system can easily pay for itself and generate additional revenues through wildlife tourism. Improved range management would result in higher economic return and better protection of biological diversity. Veld products and bushmeat are largely undeveloped potential contributors to the national economy.

Range degradation may reduce potential beef productivity by as much as 5-10 million dollars per year. Tourism generates 10-15 million dollars in foreign exchange annually and can produce more. Bushmeat and veld products have the potential to contribute 30-40 million dollars to the national economy. Together, these diversity-dependent sources of income have the potential to contribute as much to the national economy as agriculture and beef production combined.

### **SUGGESTED ACTIONS**

Conservation of biological diversity can be improved in Botswana by actions in both preservation and sustainable use. In preservation, the protected areas system can be expanded to provide representative ecosystem coverage and to include connecting corridors between major protected areas. Staffing in parks and game reserves can also be increased. In sustainable use, a program of effective borehole management would have a major positive impact. Approval of the proposed Wildlife Management Areas will be an important step in development of sustainable use consistent with conserving biological diversity. Improved implementation of land use plans and a study of the sustainability and economics of current forestry practices would also be beneficial.

The single greatest comprehensive step towards improving protection of biological diversity in Botswana is the implementation of the National Conservation Strategy. Donor and government support for the National conservation strategy is of vital importance to improvement of both preservation and sustainable use systems.

### **USAID/BOTSWANA OPTIONS TO ASSIST CONSERVATION OF BIOLOGICAL DIVERSITY**

USAID/Botswana has a history of supporting the National Conservation Strategy and small-scale natural resources activities. The Mission can enhance its impact on conservation of biological diversity by following one of three suggested program options.

#### **Option A - No Change**

USAID/Botswana may continue with no change in present programs and still make a number of positive contributions to preserving biological diversity.

### **Option B - Increased Emphasis within Present Activities**

A second option for the Mission is to maintain present activities, but increase emphasis on natural resources and biological diversity in directing those activities. This can be accomplished through increased emphasis on conservation curricula in education projects and increased emphasis on natural resources skills in training projects.

### **Option C - Country Program in Natural Resources**

Under the AID Africa Bureau Plan for Supporting Natural Resources Management in Sub-Saharan Africa, USAID/Botswana has the option of developing a country natural resources action program. This program can be developed without regard to current staffing or budget levels, and can therefore include new activities which are beyond the Mission's present resources.

Should the Mission exercise its option to develop a country natural resources action program, it could be based almost entirely on the recommendations of the National Conservation Strategy and this assessment. New activities under the provisional action program could be suggested in tourism and protected areas planning or conservation education. Such activities would complement the National Conservation Strategy and the Mission's rural employment program focus, and at the same time contribute tangibly to improved natural resource management and the maintenance of biological diversity in Botswana.

## CHAPTER 1.

### INTRODUCTION

#### 1. Background and Objectives

The world's natural areas are the origin of the resources necessary for human development. Maintaining these resources in natural areas and wisely managing them in human use is fundamental to maximizing future development and human happiness. Foremost among the resources available for human development are biological resources. Maintaining a full spectrum of available biological resources is important aesthetically, culturally and developmentally. The concept of a full spectrum of biological resources has been given the technical name of 'biological diversity'. Maintaining a full spectrum of biological resources for aesthetic, cultural, and economic development is the conservation of biological diversity.

In the 1986 amendments to the Foreign Assistance Act, the United States Congress recognized the importance of biological diversity and required all overseas missions of the U.S. Agency for International Development to prepare an official statement of:

- the actions necessary to conserve biological diversity and tropical forests in the host country; and
- the extent to which existing or proposed AID activities meet those needs.

The objectives of this assessment are to provide AID/Botswana with:

- Sufficient analysis to satisfy the congressional mandate on biological diversity and tropical forests; and
- A set of program options which could maximize AID contributions to conserving biological diversity in Botswana.

#### 2. Definition of Biological Diversity and Tropical Forests

Biological diversity refers to the variety and variability among living organisms and the ecological complexes in which they occur. A full definition of biological diversity comprises the following three components:

- Ecosystem Diversity: At its highest level, biological diversity is measured by variation and variability among ecosystems. Variations in geography and climate lead to unique assemblages of plant and animal species known as ecosystems. The different types of ecosystems in the world constitute the earth's ecosystem diversity.

-- Species Diversity: Within any particular ecosystem, diversity is measured by the total number and relative importance of species present. The total number of species present in the world represent the earth's species diversity.

-- Genetic Diversity: Within species, genetic variation exists which constitutes the finest level of biological diversity. Subspecies and races are important sources of biological diversity. Within any species, biological diversity is measured by the total number of types of genes present.

Tropical forests, broadly defined, are any forest or woodland lying within the tropics or in adjoining frost-free regions. Because moist tropical forests harbor greater biological diversity than any other type of ecosystem, Congress has instructed AID to specifically address tropical forests in concert with assessments of biological diversity.

Botswana does not have the tropical rainforests which are typically high in biological diversity. Nonetheless, Botswana does have dry tropical forests and woodlands, types of ecosystems which have rapidly disappeared in many parts of the world. Tropical forest issues will be given special emphasis within the context of overall biological diversity and resource management in this report.

Biological diversity and tropical forests may be conserved in two ways - through preservation in protected areas and living collections (zoos, botanic gardens, etc.), and through sustainable use involving sound development and management of biological resources. Together, preservation and sustainable use constitute conservation - the wise use of natural resources.

The goal of preservation is to maintain a representative sample of the earth's ecosystems, species, and genetic resources. In the context of preservation, biological diversity is a socially desirable end in itself. The goal of sustainable use is to manage all natural resources for maximum present and future human benefit. In the context of sustainable use, biological diversity is a desirable quality that should be balanced with the other goals of sustainable development. This report will address both preservation and sustainable use as important aspects of maintaining biological diversity.

### 3. The Value of Botswana's Biological Diversity

Biological diversity is important culturally, aesthetically, and economically. Botswana's development has been, and will be, dependent on biological resources. Integrity of range resources is fundamental to the livelihood of most Botswana. Wildlife tourism is one of the five most important economic sectors in Botswana. Open space and free-ranging game are among the aesthetic values that make Botswana special, both to its own people and to visitors.

The Government of Botswana has demonstrated exceptional foresight in recognizing and caring for these values - Botswana boasts one of the world's exemplary protected areas systems and one of the best land use planning systems in Africa. It is the goal of this report to assist and reinforce the fine efforts which have already contributed to maintaining Botswana's natural heritage.

#### 4. National Conservation Strategy

The Government of Botswana, in cooperation with IUCN and local communities, is currently in the final stages of developing a National Conservation Strategy (NCS). Approval and implementation of this strategy, properly carried out, has the potential to make a greater contribution to maintaining biological diversity in Botswana than any other single activity since independence. This report draws heavily on available draft chapters of the NCS and is intended to assist AID Botswana in meeting its congressional requirements related to the NCS and to facilitate a fuller understanding and support of the NCS by AID personnel.

#### 5. Assessment Methodology

This assessment was conducted by a three-person assessment team in close consultation with mission and local sources. The assessment spanned four weeks, with just under half of the assessment period devoted to field work and the remainder invested in interviews with key institutions and individuals, literature review, and writing. This report would not have been possible without the kind cooperation of the people of Botswana, both public and private, and the assistance of the staff of international donors.

The authors are heavily indebted to the generous cooperation of the drafters of the National Conservation Strategy Technical Chapters, advance copies of which provided much of the technical background for this assessment. However, the views expressed in this assessment are those of the team alone, and do not reflect the views of the National Conservation Strategy, the USAID mission, Government of Botswana officials, or any non-governmental organization.

## CHAPTER 2.

### STATUS AND MANAGEMENT OF PRESERVATION SYSTEMS

Preservation of biological diversity entails ensuring that minimum representative samples of the ecosystems, species, and genetic resources of a country are maintained for the future. The backbone of any preservation system is a good protected areas system. Other fundamental components are endangered species protection, living collections such as zoos and botanic gardens, and ex-situ preservation systems such as germplasm and seed banks.

#### 1. Ecosystem Protection

Design of an adequate preservation system for Botswana's ecosystems involves following general principles of preservation system design, as well as following principles specific to Botswana. In general, the development of Botswana's ecosystem preservation system (National Parks and Game Reserves) has been quite excellent. Changing pressures and some shortcomings in coverage require adjustments to the system.

General principles of preservation design dictate that a complete preservation system should: 1) preserve representative samples of all major ecosystem types within a country; 2) preserve adequate areas of each ecosystem to accommodate generally natural ecosystem function; and 3) interface well with other reserves in the country and in neighboring countries. Botswana's preservation system will be assessed on these criteria below.

Botswana is an arid-semi-arid country which undergoes periodic droughts and has ecosystems which are low in biomass but extensive in area. These Botswana-specific factors must also be taken into consideration in preservation system design for adequate preservation of biological diversity to be ensured. These considerations are particularly acute in considering the necessary protected area design for large mammals. Large numbers of water-dependent herbivores have historically roamed the arid and semi-arid regions of Botswana. This is only possible if perennial sources of water are available, particularly in times of drought, and if movement is possible to areas of relatively higher rainfall in a highly variable mosaic of local and temporal rainfall patterns. Water-dependent herbivores in this setting go through significant population reductions in drought, but reestablish from remnant populations which have survived on perennial water or on locally higher rainfall. If water resources do not exist to tide remnant populations through times of drought, these herbivores will become regionally extinct - a serious blow to biological diversity. Therefore, in Botswana, reserves that are interconnected, allowing wildlife to move in response to sub-regional water availability, are crucial. Until recently, undeveloped areas have provided this connection in Botswana. As undeveloped areas become more rare, it is necessary to establish a formal system of reserve connections. This will be elaborated below.

Assessing the adequacy of Botswana's preservation system for conservation of ecosystem diversity is then a three step process involving: identifying the major ecosystem types in Botswana; comparing the size and coverage of protected areas with respect to major ecosystems; and assessing the adequacy of reserve interconnections to permit intra- and international movements of large herbivores and their predators.

### Ecosystems and Biogeographic Divisions of Botswana

Botswana's ecosystems may be divided into two broad biogeographic zones. The vegetation of northern Botswana falls into a zone shared with Zambia, Zimbabwe, Mozambique and southern Angola and Zaire. The vegetation of the southern two-thirds of Botswana is more closely related to the vegetation of Namibia and South Africa. These botanical divisions are illustrated in relation to all of Africa in Figure 1.

Endemism is the property of being found nowhere else in the world. A species is said to be endemic to an area when it is found only in that area and nowhere else in the world. From the perspective of biological diversity, endemism is important because it indicates which species are found only in one region. Endemism is high in the Zambebian zone of which northern Botswana is a part, and relatively low in the Kalahari-Highveld zone which includes central and southern Botswana.

Species richness refers to the total number of species found in a particular area. An area with more species is said to have higher species richness. Relative to other African biogeographic zones, species richness is high in the Zambebian zone and low in the Kalahari-Highveld zone. Endemism and species richness in these two zones is presented along with the Africa-wide average for comparison in Table 1.

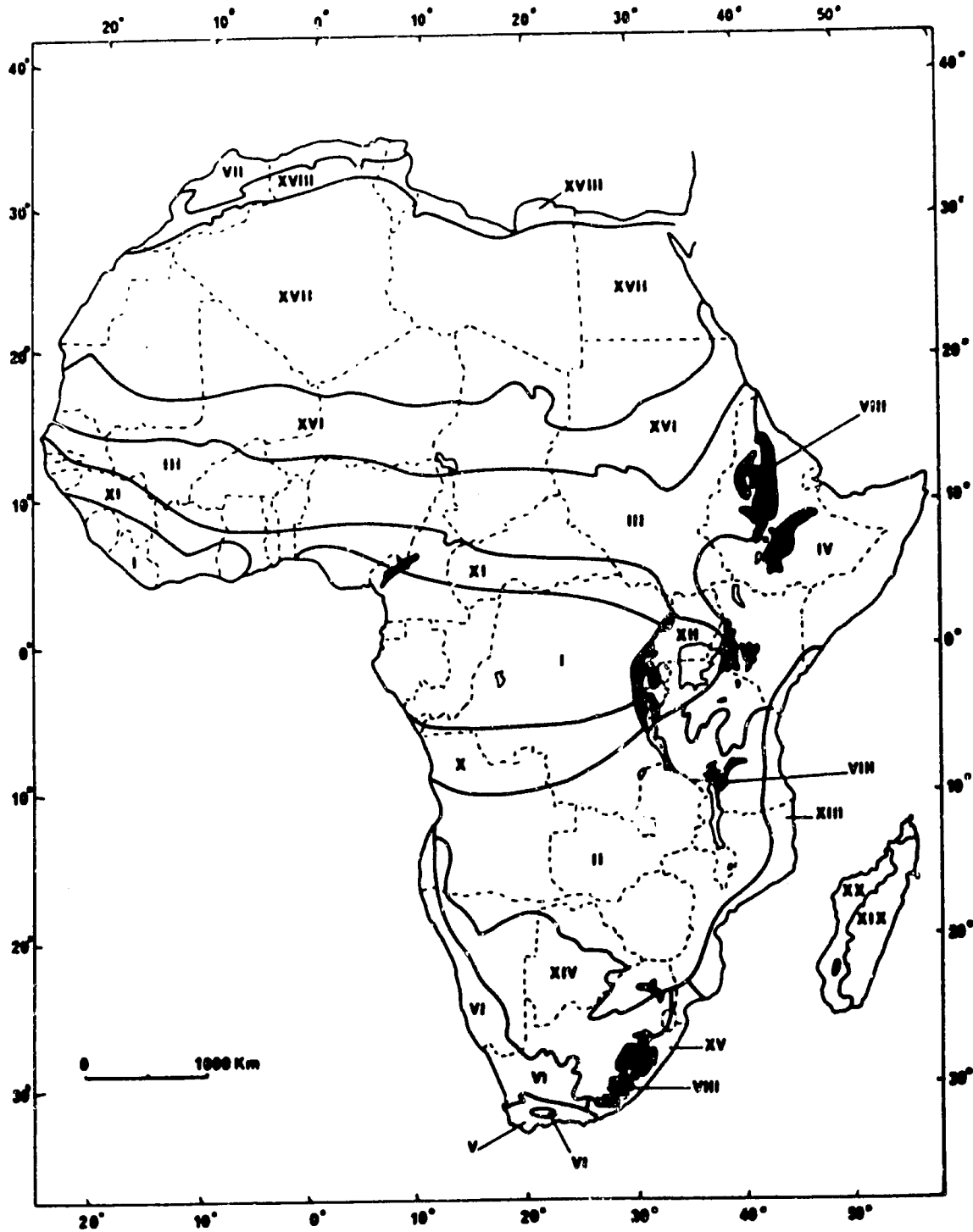
**Table 1.** Percent of species endemic and number of species for biogeographic regions encompassing Botswana

Center of Endemism	Mammals		Birds		Plants	
	species	endemism	species	endemism	species	endemism
Zambebian	55	4%	650	15%	8,500	54%
Kalahari- Highveld	32	0	172	5%	2,000	5%
Average for African zones	37	5%	343	15%	3,700	34%

Botswana then falls within one biogeographic zone which is among the highest in species richness and endemism in Africa and one which is among the lowest in number of



COVERAGE BY BIOGEOGRAPHIC UNITS



**Map 2.5 Main Phytochoria of Africa and Madagascar.**

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

(Source: White 1983) Reproduced from IUCN, 1987.

**Figure 1. Biogeographic Zones of Africa**

species and endemism. Northern Botswana is therefore more biologically diverse and rich than southern Botswana and deserves equal or greater preservation consideration.

Major ecosystem types within these biogeographic zones are identified in Figure 2. Major ecosystem types in southern Botswana are arid shrub savanna, Kalahari bush savanna, and Northern Kalahari tree and bush savanna. Within these major ecosystem divisions there is an abundance of micro-variation, especially around pans, hills, and fossil rivers. Northern Botswana harbors more diversity of major ecosystems, including tree savanna, swamp grassland, mopane bushveld, Chobe forest and fringing pan grassland. Even higher micro-variation exists in the north, the Okavango alone being an uncharted complex mosaic of local variation. Sand ridges, pans, and hills also contribute to micro-variation in the north.

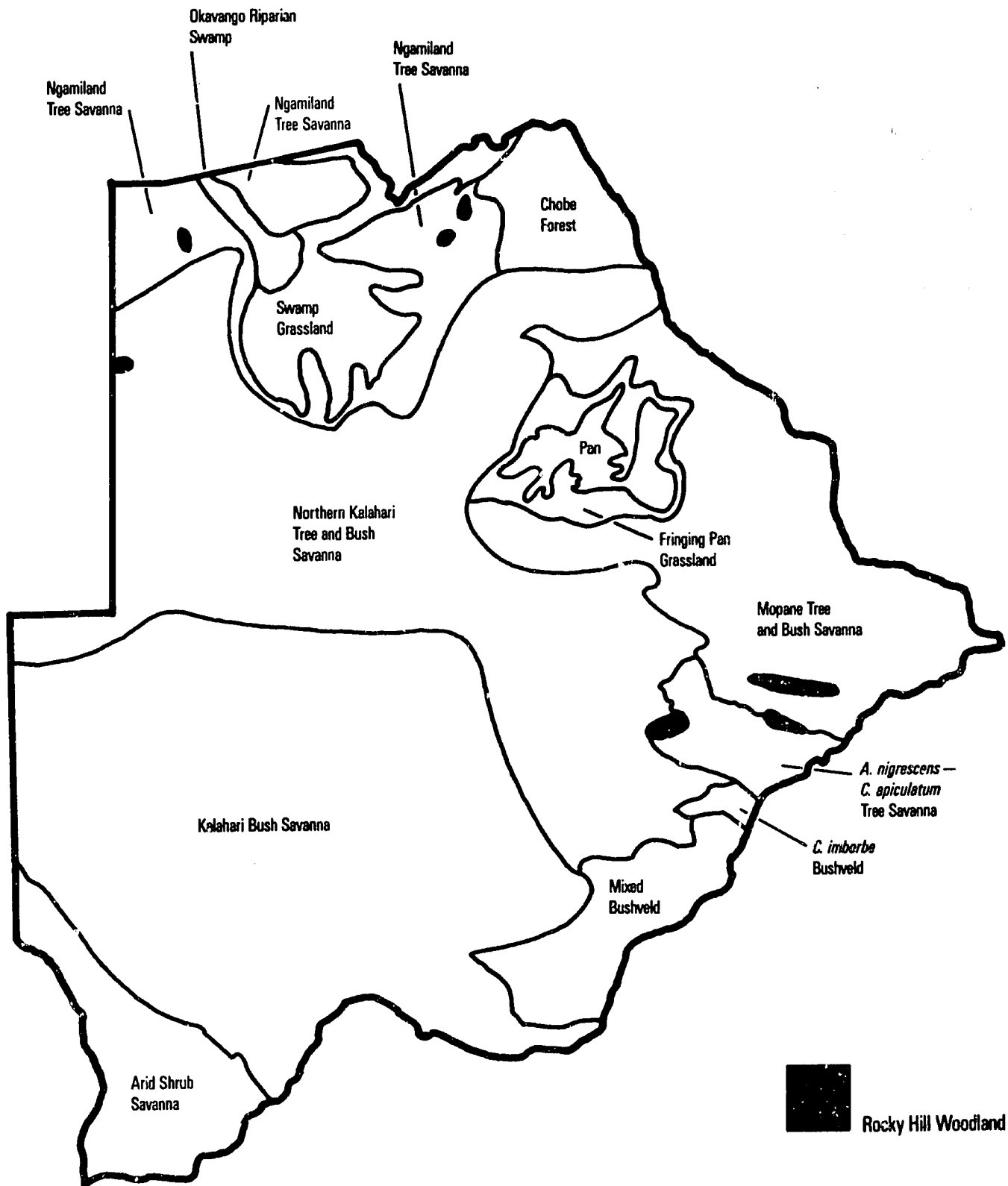
One major disjunct ecosystem - Rocky Hill Woodland - exists in Botswana. This ecosystem is represented in black in Figure 2. Major representatives of the Rocky Hill Woodland ecosystem exist at Tswapong, Shoshong, and Mokgware near Palapye, at Gubatsaa and Gcoha in Chobe District, and at Tsodilo and Aha west of the Okavango. There is substantial variation among these close tree savanna communities, but they are sufficiently similar to be classified as a major, but disjunct, ecosystem type.

### Protected Areas System

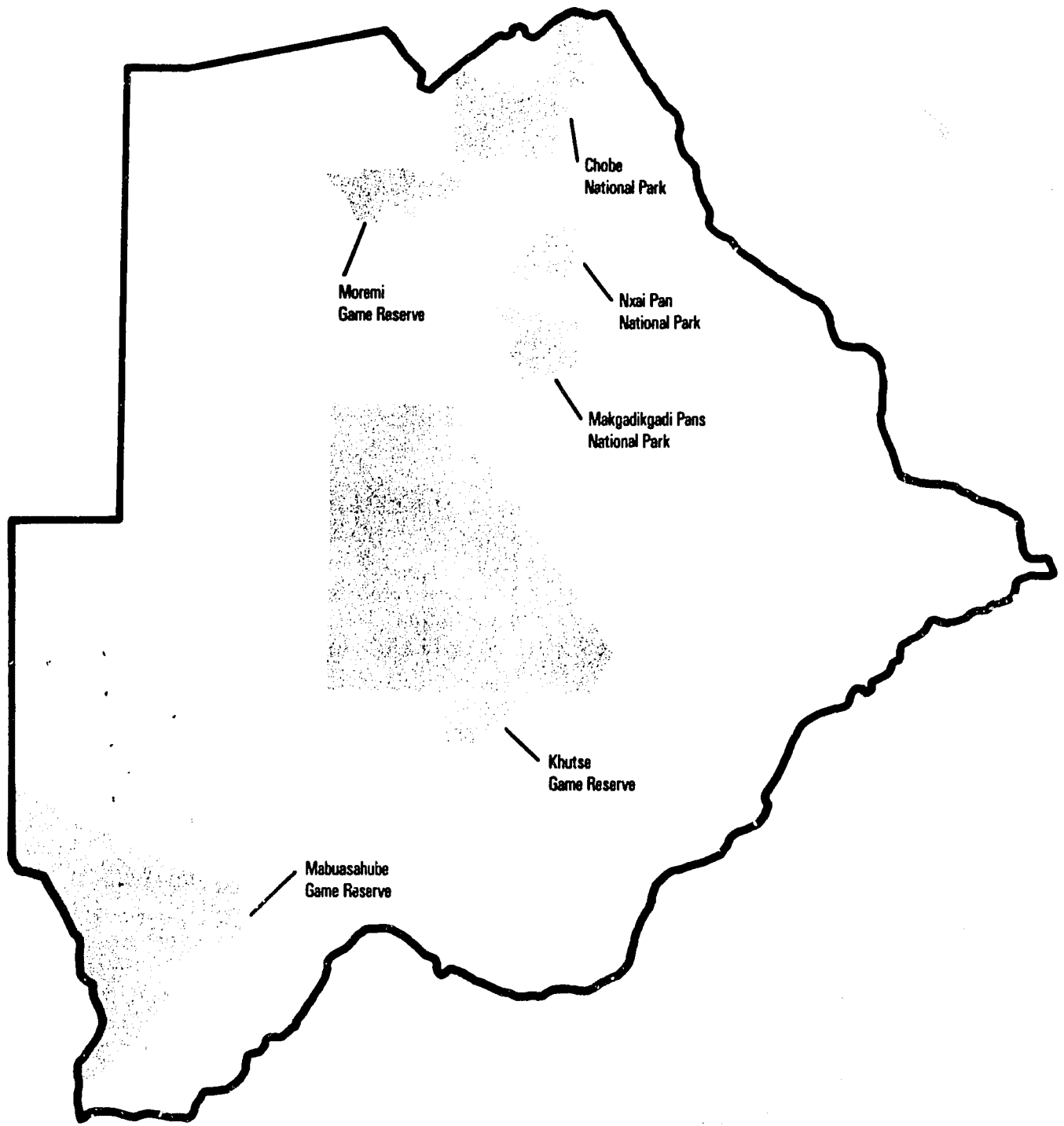
Botswana, with nearly 18% of its national territory set aside as protected natural areas, far surpasses most other countries worldwide in such designations (e.g. the USA has about 5%). If the proposed Wildlife Management Areas are gazetted, the figures will go even higher (about 36%). Already, for all African countries over 20,000 sq. km., Botswana ranks first whether comparison is based on percentage of national area or population density. On the basis of protected area per citizen, Botswana leads all major tropical countries. Some illustrative comparisons include:

<b>Botswana</b>	<b>18% of Territory (14.4 ha./person)</b>
<b>Central African Rep.</b>	<b>12% of Territory (02.8 ha./person)</b>
<b>Malaysia</b>	<b>11% of Territory (00.3 ha./person)</b>
<b>Tanzania</b>	<b>12% of Territory (00.7 ha./person)</b>
<b>Bhutan</b>	<b>20% of Territory (00.8 ha./person)</b>

Figure 3 illustrates the game reserves and National Parks of Botswana. These protected areas comprise the preservation portion of Botswana's protected areas system. Administration of the two types of preservation areas (Game Reserve, National Park) is virtually identical.



**Figure 2. Major Ecosystem Types of Botswana**  
 After Weare and Yalala, 1971; and IUCN, 1987.



**Figure 3. National Parks and Game Reserves of Botswana**

Figure 4 illustrates the coverage of Botswana's preservation system relative to major types of ecosystems. Most ecosystems are well represented even in this most strict of protection status. Okavango Riparian, eastern veld and savanna ecosystems, and hill habitats stand out as unrepresented in this system.

### Completing Botswana's Protected Area System Coverage

For maximizing coverage of major ecosystem types, two candidate regions are the best prospects for major protected areas in the east. These are the Shashe-Limpopo triangle east of Selebi-Phikwe, and the Notwane-Limpopo area centered of Buffel's Drift. These areas are illustrated in Figure 4. The Shashe-Limpopo triangle is an excellent candidate area because it is the largest low-population block of the eastern mopane woodland. The Notwane-Limpopo area offers the prospect of conferring protection to three major ecosystem types simultaneously.

In its best configuration, the Shashe-Limpopo area should include the Lepokole Hills, and the Notwane-Limpopo area should be sited to span the Mixed Bushveld, C. Imberbe Bushveld and A. Nigrescens-C. Apiculatum Tree Savanna ecosystems. The Shashe-Limpopo triangle is already partly protected under private reserve (Mashatu-BDC). A park on the South African side of the Limpopo is under consideration. There should be consideration of location of a public protected area selected to build on the established tourism development in the area.

Establishment of a protected area in this region would also complement international efforts by abutting Zimbabwe's Tuli Conservation Area and the proposed South African park across the Limpopo.

There is some population in both the Shashe-Limpopo triangle and in the Notwane-Limpopo area. Settlement inclusions or some other accommodation would have to be made, but this should not preclude consideration of the establishment of protected areas in these locations.

For full ecosystem coverage, additional protected area is also needed in the Okavango Riparian Ecosystem and the rocky hill habitats. The Okavango protected area could be in a single block, possibly connected to the Moremi reserve, but protection for hill habitats would have to come as several distinct areas or one disjunct reserve. Again, population is a significant concern in these areas, but effective protection can still be afforded without major conflict if timely action is taken.

Needed minor alignments are desirable to extend Chobe National Park to include some of the grassland to the west of the park, an area which is important to the endangered Red Lechwe and Wattled Crane. Also a small addition to Makgadikgadi Pans Game Reserve to encompass permanent water adjacent to the southeast corner of the reserve is desirable, as is joining Nxai Pan National Park and Makgadikgadi Pans Game Reserve with an extension of the park.

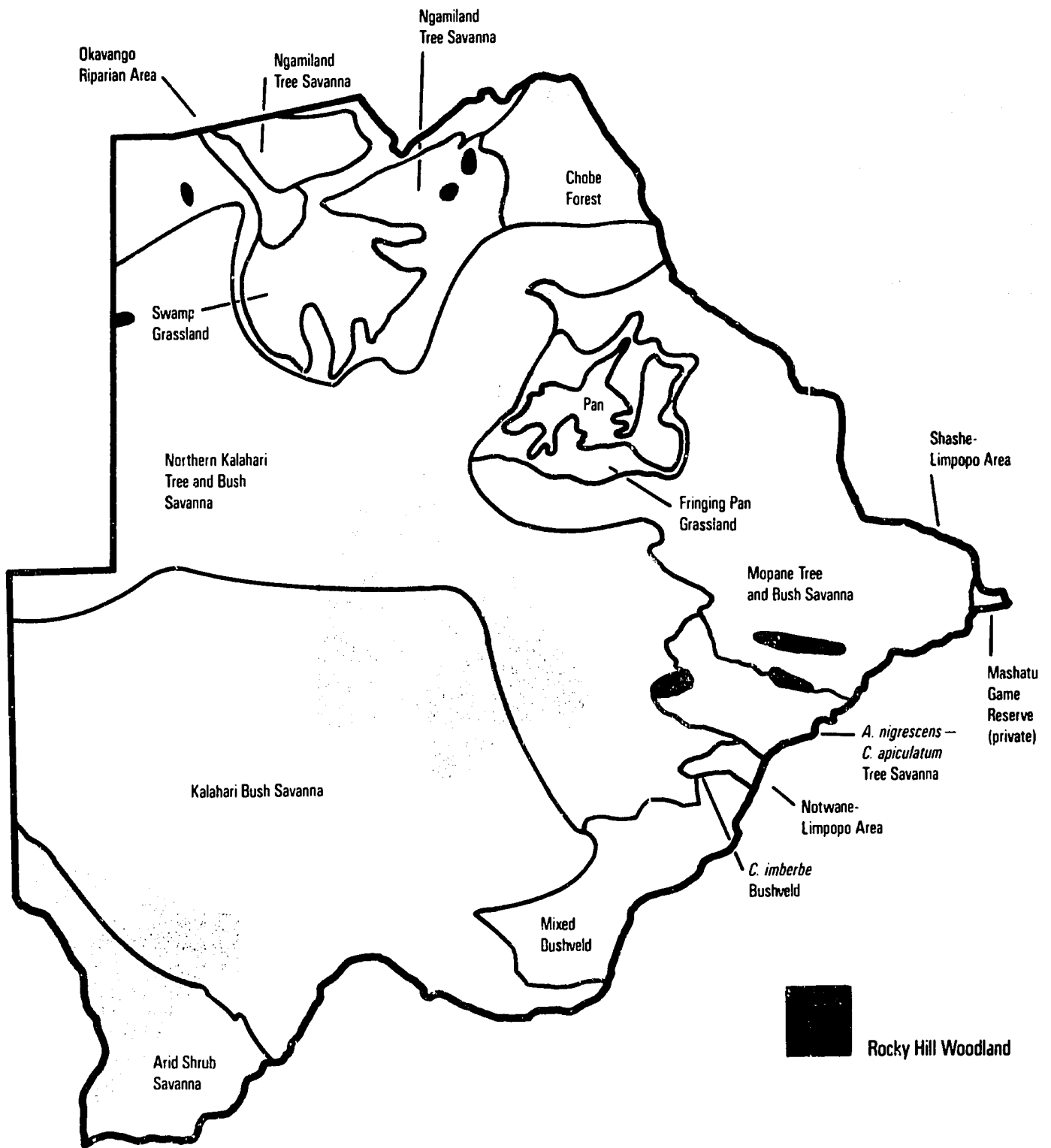
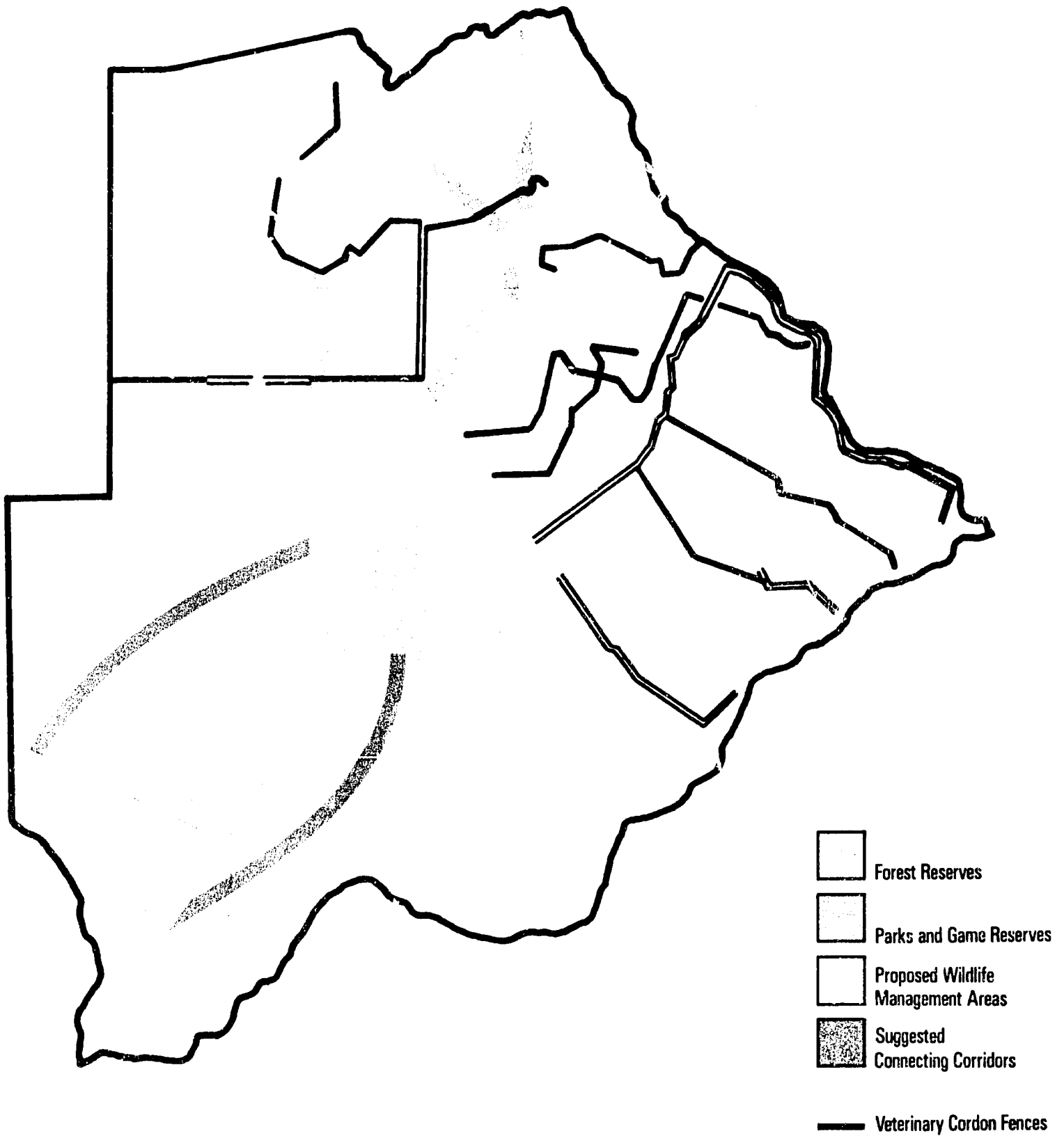


Figure 4. Preservation System Coverage of Major Ecosystem Types



**Figure 5. Protected Areas Connecting Corridors**

Finally, a major amendment to the system is desirable to facilitate interconnections between reserves. These interconnections should be in the form of corridors 10-20 kilometers wide, extending between the major components of the protected areas system. Figure 5 illustrates the suggested corridors, most of which would be provided by the proposed Wildlife Management Areas, should they be approved. The proposed WMAs would afford connection between the Gemsbok Park and Kalahari, and between the various parks north of the Kalahari. What is not provided even in the WMA proposals is a connection between the Kalahari and the Okavango and Pans protected areas. These connections are crucial because they provide routes to water sources and avenues of genetic exchange and dispersal during climate fluctuations. The Kalahari-Okavango connection can include part of Lake Ngami, and both corridors can accommodate human presence if properly fenced and managed.

In order for these corridors to be effective, cordon and reserve fencing must be carefully managed. Existing cordon fences (Figure 5) will limit the effectiveness of corridors provided by WMAs in the north. A review of cordon fencing alignment for disease control and wildlife management should be conducted. Formal Wildlife Department input into cordon fencing decisions is a critical need in this respect.

With additional coverage in the Okavango panhandle, the Shashe-Limpopo triangle, the Notwane-Limpopo area and hilly habitats, and a gated system of connecting corridors, Botswana's protected areas system would cover all of the major ecosystem types of the country and provide for the ecological movement of large animals. This coverage, coupled with the exceptional area covered by the system would make Botswana's protected area system one of the very finest in the world. Extending coverage to these areas has been recommended by the FAO, IUCN, UNEP and the World Wildlife Fund, as well as informally by local conservationists. These internationally recognized resources should be given formal consideration for protected status. Botswana's protected areas system has always aimed for excellence. Protection for these areas should form part of that quest.

### Management of Protected Areas in Botswana

Management of parks and protected areas is as essential to maintaining biological diversity as is protected areas coverage and interconnections. Well managed protected areas permit full realization of the potential provided by good coverage and carefully designed interconnections. Poor management can drastically reduce the effectiveness of even a well designed protected areas system. Management of protected areas involves both the degree of legal protection offered in a protected area and the effectiveness of implementing that protection.

Botswana's protected areas system is comprised of several types of protected area, each of which accord favorably with internationally recognized standards of protection established by the International Union for the Conservation of Nature and Natural Resources (IUCN). The IUCN, in its 1987 "Directory of Afrotropical Protected Areas" recognizes a total of 15 protected natural areas in Botswana in five management categories.



The categories are generally defined below, listed by increasing order of the amount of human intervention permitted in the environments they protect. The IUCN recognized areas for Botswana are named, and the international category equivalent is noted in parenthesis.

National Park (IUCN Category II, National Park) - The definition used in Botswana is that of the African Convention on Conservation of Nature and Natural Resources. Natural areas are designated by the Head of State, and confirmed by a resolution of the legislature. Hunting and collection of plants or animals are prohibited by law. (Tribal lands are administered by local authorities and it is not possible to create national parks in these areas). Chobe, Gemsbok, Nxai Pan.

Game Reserve (IUCN Category IV, Managed Nature Reserve) - Areas where hunting is forbidden without special permit, although regulations may cover only certain species, depending on the act constituting the area. Central Kalahari, Khutse, Mabuasehube, Makgadikgadi Pan.

Section 8 of the Fauna Conservation Act provides for establishment of private game reserves through written application to the President, who can then declare such reserves through the official Gazette. Once declared, the owner can hunt and capture animals within it. The most important private game reserve in Botswana is the Mashatu Game Reserve (40,500 ha.). This private reserve was established in 1987 by agreement between the Botswana Development Corporation and Safmarine Rennies Holdings, but has not been gazetted under section 8.

Wildlife Reserve (IUCN Category IV, Managed Nature Reserve) - Same as Game Reserve. Moremi.

The IUCN Afrotropical Directory also includes the 300 hectare Maun Educational Park, associated with the adjacent Wildlife Training Center. It includes former agricultural lands now reverting to a more natural state. Although designated by a different name, the Gaborone Wildlife Reserve is relatively small (239 hectares) and similar to the Maun Educational Park. IUCN has classified the Gaborone W.R. as belonging to Category V (Protected Landscape).

Wildlife Management Area (IUCN Category VIII) - Multiple use natural areas which often serve as a buffer between other, more preservation oriented designations, and areas of intensive land use. Wildlife utilization is the primary activity, with a variety of other, compatible uses permitted. The proposed network of areas has not yet been gazetted.

Forest Reserve (IUCN Category VIII) - Natural areas established under a 1948 proclamation, in which timber utilization concessions may be granted. Livestock grazing,

agriculture, and dwellings are prohibited in these areas without a permit. Chobe, Kasane, Kasane Extension, Kazuma, Maikaelelo, Sibuyu.

Management of Botswana's protected area system is good but minimal, and much opportunity exists for expanding and improving management. Government authorities interviewed, field observations, and numerous publications in the country all point out that Botswana faces difficulties similar to those confronting most countries in Africa: insufficient trained personnel, funding levels which do not permit adequate infrastructure or sufficient equipment (including vehicles and radios), poaching, lack of uniform regulations for the parks and protected areas, nascent environmental education efforts, and no overall assessment of the country's protected area system and the thoroughness of biological coverage it represents (Protected Area System Plan).

The country's low population density, and the remoteness of its protected areas have helped to maintain their integrity in the past, although isolation can also be a disadvantage for patrolling against poaching.

The lack of trained personnel is especially relevant and is the fundamental basis for management effectiveness. The EDF Technical Assistance Project in the Department of Wildlife and National Parks (DWNP) has analyzed countrywide staffing and infrastructural developments required to bring the DWNP to a level at which it can effectively execute its functions. The Project's "Consolidated Development Program" Report (Vol.1, Nov. 1987, Table 1.1) compares staffing levels in African national parks. Some examples are:

Tanzania	50 km <sup>2</sup> /staff person
Kenya	51 km <sup>2</sup> /staff person
Zaire	106 km <sup>2</sup> /staff person
Mozambique	388 km <sup>2</sup> /staff person
Angola	1242 km <sup>2</sup> /staff person
Botswana	2095 km <sup>2</sup> /staff person

In this respect, Botswana ranks last of all African countries, even though per capita income ranges from about 2-8 times higher than the other countries mentioned. The EDF Project recommends a staff increase for the DWNP from current levels of about 500 to about 1500 individuals. Even if such a significant increase were adopted, the ratio for Botswana would only rise to 252 km<sup>2</sup>/person.

A particularly timely management issue is that of San (known also as Basarwa, Bushmen, or Remote Area Dwellers) use of the Central Kalahari Game Reserve. This area was initially gazetted as a cultural reserve, but is currently classified and administered as a Game Reserve. Cultural and wildlife uses of the Central Kalahari Game Reserve were compatible until government water and health services were provided to the San within the reserve during the 1981-87 drought. These services encouraged sedentarization and undermined traditional nomadic culture. Livestock and firearms became features of San life, and traditional cultural use of the reserve deteriorated. The government has now decided to move water and health services out of the reserve. Most non-traditionally living San are expected to follow. This will restore wildlife and compatible cultural use as the two purposes of the reserve.

It should also be noted that extensive mineral and petroleum exploration is taking place within the reserves. This activity has involved vegetation removal in long, road-like 'cuts' for seismic surveying, and the erection of worker housing and a drilling superstructure for diamond exploration. Given the importance of mining income to Botswana, it is unrealistic to expect that mining or petroleum exploitation would not be admitted in the reserves. If a major resource is located, the prospect of a semi-industrial enclave within the reserves will have to be faced.

## 2. Species Protection

Protection of ecosystems, species and genetic resources requires action on all three levels. While a good protected areas system forms the foundation for protection at all three levels, preservation of a representative sample of ecosystem types is not sufficient to ensure survival of all species. Some species are very wide-ranging and are unlikely to have sufficient populations represented in protected areas to ensure perpetual survival. Other species may suffer from poaching or other pressures which require special action or depend on specialized habitat not represented in major ecosystems.

To ensure the survival of individual species, a number of actions are necessary. Rare species should be protected, special reserves should be established for species with specialized habitat requirements, and especially endangered species may have to be preserved in zoos or through captive breeding. Botswana has undertaken most of these steps, and while there is opportunity for improvement of enforcement, a sound foundation exists for the preservation of the nation's species-level biological diversity.

### Protected Species

All vertebrates in Botswana have been declared game animals, so that no one can take them without having a license or permit (subsistence hunters can have special permits at no cost). In addition, at least fifty species or categories of animals have been declared as conserved. Conserved animals may not be hunted legally. Species or groups listed as conserved include:

Aardwolf ( <u>Proteles cristatus</u> )	Kgori Bustard ( <u>Ardeotis kori</u> )
Antbear ( <u>Orycteropus afer</u> )	Stanley Bustard ( <u>Neotis denhari</u> )
Blackfooted Cat ( <u>Felis nigripes</u> )	All Buzzards ( <u>Family accipitridae</u> )
Brown Hyena ( <u>Hyaena brunnea</u> )	All Cranes ( <u>Balearica spp</u> )
Cheetah ( <u>Acinonyx jubatus</u> )	All Eagles ( <u>Family accipitridae</u> )
Civet ( <u>Viverra civetta</u> )	All Egrets ( <u>Egretta spp</u> )
Giraffe ( <u>Giraffa camelopardalis</u> )	All Falcons ( <u>Family falconidae</u> )
Hippopotamus ( <u>Hippopotamus amphibius</u> )	All Flamingos ( <u>Phoenicopterus spp</u> )
Honey Badger ( <u>Mellivora capensis</u> )	Fish Owl ( <u>Scotopelia peli</u> )

Klipspringer ( <u>Oreotragus oreotragus</u> )	All Goshawks ( <u>Melierax spp</u> )
Mountain Reedbuck( <u>Redunca fulvorufula</u> )	Hammerkop ( <u>Scopus umbretta</u> )
Night-ape ( <u>Galago senegalensis</u> )	All Harriers ( <u>Circus spp</u> )
Oribi ( <u>Ourebia ourebi</u> )	All Herons ( <u>Family ardeidae</u> )
Otter ( <u>Aonyx capensis</u> )	All Ibises ( <u>Family thresiornithidae</u> )
Pangolin ( <u>Manis temmincki</u> )	All Jacanas ( <u>Family jacanidae</u> )
Puku-Puku ( <u>Kobus vardoni</u> )	All Kites ( <u>Family accipitridae</u> )
Roan Antelope ( <u>Hippotragus equinus</u> )	All Pelicans ( <u>Pelecanus spp</u> )
Rock Dassie ( <u>Procavia capensis</u> )	All Sparrowhawks ( <u>Accipiter spp</u> )
Black Rhinoceros ( <u>Diceros bicornis</u> )	All Storks ( <u>Family ciconiidae</u> )
Square-lipped Rhinoceros ( <u>Ceratotherium simum</u> )	Secretary Bird ( <u>Sagittarius serpentarius</u> )
Serval ( <u>Felis serval</u> )	Spoonbill ( <u>Platalea alba</u> )
Sharpe's Steenbok ( <u>Raphicerus sharpe</u> )	All Vultures ( <u>Family accipitridae</u> )
Vaal Rhebuck ( <u>Pelea capreolus</u> )	Python ( <u>Python sebae</u> )
Waterbuck ( <u>Kobus ellipsiprymnus brucei</u> )	Yellow spotted Dassie ( <u>Heterohyrax</u> )

Conserved animals may not be hunted legally. The following animals, indigenous to Botswana, are considered by the IUCN to be globally threatened:

Wild Dog ( <u>Lycaon Pictus [Temminck]</u> )	Leopard ( <u>Panthera pardus</u> )
African Elephant ( <u>Loxodonta africana</u> )	Lechwe ( <u>Kobus leche</u> )
Slaty Egret ( <u>Egretta vinaceigula</u> )	Cape Vulture ( <u>Gyps coprotheres</u> )
Peregrine Falcon ( <u>Falco peregrinus</u> )	Wattled Crane ( <u>Grus carunculata</u> )
Black-cheeked Lovebird ( <u>Agapornis nigrigenis</u> )	Nile Crocodile ( <u>Crocodylus niloticus</u> )
Cheetah ( <u>Acinonyx jubatus</u> )	Brown Hyena ( <u>Hyaena brunnea</u> )
	Black Rhinoceros ( <u>Diceros bicornis</u> )

The African Elephant, although in peril globally, is abundant in Botswana. Elephant populations are concentrated in northern Botswana, particularly in Chobe national park. Elephant population has increased rapidly, from 5,000-10,000 in the mid-1970s, to 40,000-50,000 presently. This population increase exceeds the maximum theoretical biological increase, and almost certainly includes an influx of elephants driven into Botswana by poaching. Elephants cause damage to commercially valuable tree species, and a culling program is probably justified.

There are probably no more than 60 white (or square-lipped) rhinoceros and 20 black rhinoceros remaining in Botswana. Previously extirpated, the white rhinoceros was reintroduced at considerable expense. Research is currently underway to try and determine the viability of the 'present population.

There are also discussions currently underway between Botswana and Zimbabwe concerning a proposal to temporarily import black rhinoceros from Zimbabwe into Botswana, to protect the animals from poaching pressures in Zimbabwe. These animals would eventually be returned to Zimbabwe when it had been determined that the poaching problems in Zimbabwe had been reduced to a manageable level.

The Slaty Egret, *Egretta vinaceigula*, is rare and endemic to Botswana's wetlands and the Wattled Crane, *Grus carunculata*, is recognized internationally as an endangered species whose range is being significantly diminished. Cape Vulture populations are seriously declining, and more intense efforts to preserve the species may soon be called for.

Certain globally threatened species are relatively abundant in Botswana. In addition to elephant, the Red Lechwe and Nile Crocodile are locally common. Leopard, Cheetah, and Brown Hyena are not under immediate threat in Botswana, but the Wild Dog is seriously diminished.

Some species which are not globally threatened are disappearing from Botswana. Notably, the red-necked falcon is rare and the Oribi only occurs in an area northwest of Mpandamatenga and is threatened by commercial farming ventures there.

Botswana's Forest Act (Forest Chap. 38:04, 1968) specifies the following species as protected trees on State Lands:

Timber trees:

Azelia quanzensis (Mwande, Pod Mahogany)

Baikia plurijuga (Mkusi, Rhodesian Teak)

Guibourtia coleosperma (Tsaodi)

Pterocarpus angolensis (Mukwa)

Entandophragma caudatum (Mopomena, Brown Mahogany)

Fruit trees:

Adansonia digitata (Moana, Baobab)

Berchemia discolor (Mozinzila)

Diospyros mespiliformis (Mokochong, African Ebony)

B. Plurijuga has been identified by the Forest Gene Resources panel of the FAO as in urgent need of conservation attention.

Effectiveness of enforcement of Botswana's species protection laws is limited by the large size of the country relative to the staffing of enforcement agencies. As discussed below, forestry staffing is particularly low, and any sort of comprehensive enforcement of prescriptions against taking protected trees is impossible. Persistent or flagrant violations are probably detected and controlled. Wildlife quotas are set by the Department of Wildlife and Parks annually. Record keeping is not currently of high quality. Overselling occurs, and most licences are not returned within 30 days of taking an animal as required by law. A donor-supported effort is currently underway to computerize the hunting license system, and if this effort is successful, the system should be vastly more efficient by 1990. Poaching is

substantial but largely unquantified. The Wildlife Department has begun setting up special anti-poaching units which will be specially equipped units and will have special training, including instruction in the use of automatic weapons. Overall level of enforcement is not bad by African standards but shows considerable room for improvement. The government has taken some initiative in this area, and clearly takes enforcement seriously. Continued donor involvement holds the promise of marked improvement in this area.

### Species-Specific Reserves

A small reserve, the Mannyelanong Game Reserve, was gazetted in 1985 to protect the breeding habitat of the Cape Vulture. The reserve consists of a hill near the village of Otse, between Gabarone and Lobatse. There are also small wildlife sanctuaries at Mogobane Dam and Bathoeng Dam which have been set aside as refuges for waterfowl.

### Zoos, Herbaria, and Arboreta

There is a private zoo in Francistown - Botswana Birds and Game. There are no other local or national zoos. While southern African wildlife is generally well represented in other zoos around the world, information is unavailable as to the actual species represented and their distribution.

There are no arboreta in Botswana. The National Museum has 4.5 ha of land set aside for use as a botanical garden. However, because of funding problems the garden has not yet been started.

There is a herbarium at the National Museum in Gabarone, one at the University of Botswana, and one at the College of Agriculture. The collection at the National Museum, begun in 1951 by De Beer, was originally within the Ministry of Agriculture. Part of the original collection was left with the Agricultural College for use as a "Teaching Herbarium", when the bulk of the collection (3000 specimens) was transferred to the National Museum. The present collection at the Museum has grown to over 8000 specimens.

There has been some plant collecting done by personnel from the Kew Gardens, and by several other international botanical gardens. The actual extent of species represented in foreign collections, and the locations are unknown. The National Museum has had sporadic informal agreements to receive duplicate specimens from international collecting expeditions.

### 3. Protection of Genetic Resources

The final level of biological diversity protection is that necessary to conserve genetic resources. Genetic resources are the variation within species, the sum of all gene types existent in a group of individuals. Genetic resources are important in providing special qualities to commercially used species and as the basic stock for genetic engineering. For example, a primitive ancestor of corn

recently rediscovered in Mexico carries the genes for resistance to diseases which cause billions of dollars of commercial damage each year. The preservation of this genetic resource, in this case purely by chance, resulted in a major economic gain. Similarly, the preservation of Tswana cattle may preserve important genetic tolerance to drought which may be economically important in Botswana. Genetic resources are conserved through protection of ecosystems and species, but also more specifically through programs such as seed banks and cattle breeding programs which are targeted specifically at genetic resources.

### Conservation of Rare Livestock Strains

Local cattle types, which are Bos indicus breeds, have been extensively interbred with European types and pure breeds are becoming rare. The major local breed is the Tswana, typically reddish brown with medium length upturned horns. The Tswana genetic stock still makes up the majority of the national herd, but pure Tswana cattle are becoming increasingly rare, particularly in eastern Botswana.

The Africander, a regional breed originating in South Africa is common in many parts of the country. The Africander was used extensively in crossbreeding programs from 1930 until recently. Although the breed has been extensively cross-bred, pure types are still found in Botswana.

Experience in the 1981-87 drought has shown that the Tswana breed is more drought tolerant than other breeds. Because demand for purebred Tswana bulls is very low in breeding programs, actions have been taken to preserve the Tswana breed.

The Agricultural Production Research Unit of the Ministry of Agriculture has assembled 300 Tswana cows at its Morapedi Ranch near Pitsane-Molopo. 400 cows and 10 bulls will eventually be acquired for the purpose of preserving the Tswana breed. For a more complete discussion of cattle breeds in Botswana, see the consultant's report in appendix III.

### Seed Banks and Conservation of Wild Relatives of Agricultural Crops

There are presently two functioning seed banks in Botswana. One is for the major agricultural crops in Botswana, run by the Germplasm Unit, Department of Agricultural Resources, within the Ministry of Agriculture. The Germplasm Unit has been involved in collecting seeds and preparing descriptions for the various varieties of major food crops. These descriptions are then sent out to the various agricultural officers in the field, who can request seed if so desired. The seed is stored in a cold room, however the Unit is lacking other basic equipment, such as seed cleaners, dryers, etc. The head of the Unit is to undertake a one year MS program in plant genetics in England in the future.

The Forestry Association of Botswana (FAB) has set up a seed bank for indigenous trees of Botswana. These seeds are meant for their program with indigenous species.

Plans are underway for a regional seed bank in Lusaka, Zambia, for the SADCC countries. This is a proposed 20 year project, to be funded by the NORDIC Group. The facility will focus on agricultural crops and tree seeds. As a preparatory step, a National Committee for Plant Genetic Resources for Botswana has been initiated, with participants from the various government agencies that have administrative or research interests in germplasm and genetic resources.

There are no current plans for in situ conservation efforts for wild relatives of agricultural crops. The presence or distribution of any such species is as of yet unknown.

Key References for this Chapter: 11, 25, 39



## CHAPTER 3.

### CONSERVATION THROUGH SUSTAINABLE USE

In addition to preservation systems directed at the three levels of biological diversity (ecosystem, species, and genetic resources), sound resource management is also necessary if a nation's biological diversity is to be maintained. Preservation systems alone are limited and will not maintain diversity if destruction of biological resources outside of the preservation system is widespread.

Sustainable use of resources and sound development planning are key to maintaining biological diversity outside of the preservation system. The management of natural systems such as range, forests, and wetlands is of particular importance. Maintaining diversity in these areas will reduce pressure on the preservation system and offer a source of natural regeneration if the preservation system is damaged. For particularly wide ranging species, protected areas will not be large enough to maintain a viable population, and multiple-use management consistent with their survival outside of protected areas is essential. Development and conservation strategies play a vital role in this respect. Sound development planning will include biological diversity as one of the objectives of multiple-use planning. Together, development planning and natural system management for sustainable use are as important or more important than a good preservation system in maintaining a countries biological diversity.

#### 1. Managed Natural Systems

##### Range Resources

Botswana's range resource covers most of the country, with the exception of the wetlands and forests of the north. A major portion of the range is managed for wildlife, as discussed above. The remaining range, the majority of the country's land area, is managed for livestock.

The Botswana livestock sector directly affects over 50% of the country's population, is the country's second largest foreign exchange earner, and in terms of earnings, slaughtered animals, and standing herd, has almost doubled since Botswana's independence in 1966. Government subsidies to the sector are substantial, and include subsidized inputs (bonemeal, mineral salts), low taxes, and a supported EEC export purchase price.

The sector also faces serious problems. Slaughterhouse (abattoir) capacity is insufficient to handle needed increases in offtake, and poor management practices result in overgrazing. As a result, the cattle death rate (from starvation, disease, dehydration) exceeds offtake to market. Social factors strongly contribute to these problems. Cattle ownership is widely practiced as a means of holding wealth in Botswana, independent of income potential from offtake. This leads to increases in herd size regardless of abattoir sufficiency or range capacity.

Land ownership is communal, but control of grazing lands falls to those with the resources to develop water supplies. This results in a strong dichotomy in the sector between tribal smallholders and commercial ranchers who have the resources to drill wells. The advent of increased well drilling has also alleviated water supply constraints to herd size and contributed to overstocking.

In 1975 the Government of Botswana moved to correct these problems by instituting the Tribal Grazing Land Program (TGLP). This (reverse) land reform policy established a system to segregate commercial ranchers to private holdings and restore communal areas to true communal use. Unfortunately, this policy was based on the assumptions of land surplus and adequate abattoir capacity, neither of which existed. As a result, excess land on which to establish commercial private holdings did not exist, and increases in productivity generated by the system could not be taken off the range to market. In addition, ranchers granted private holdings were still permitted access to communal areas, and mechanisms for controlling herd size in communal areas were never effectively established. Carving commercial holdings out of communal areas met with stiff public resistance, abuse of rangeland continued, and save for the addition of a layer of land use law and a deterioration of tribal authority, livestock sector problems remained largely unchanged.

Superimposed on this scenario were the effects of the 1981-87 drought. During this period herd size fell dramatically and grass cover over large areas was completely removed. Return of rains in 1988 has restored grass cover remarkably rapidly, and herd size may be expected to rebound accordingly.

From a biological diversity perspective, range use in Botswana is an important issue. Much of the nation's biological diversity resides in its extensive rangelands, and range degradation leading to simplification of vegetative cover directly reduces biological diversity. Some areas of severe overgrazing have virtually no vegetative cover, and encroachment of highly simplified bush thicket vegetation is common in others. These problems are currently localized, but will have major impact on biological diversity in Botswana if allowed to spread. In the aftermath of the drought, 1-2% of the country was virtually devoid of vegetation, and 20-25% was suffering from range degradation. If range degradation is a linear response to herd size and past trends in herd size continue, range degradation will affect over half of Botswana early in the next century. If range degradation reaches this magnitude, local extinctions of grass types and vegetation associations will be common. Native areas serving as centers for natural regeneration will be reduced, and undesirable vegetation will become permanently established over large areas. Most importantly, the productive capacity of Botswana's range will be permanently impaired and future income from range use greatly reduced.

Current guidelines for management of borehole development are poorly enforced and inadequate. Current practice often permits no native vegetation zone to survive between boreholes in times of low rainfall and eliminates the ability of native grasses to recolonize overgrazed areas. This will ultimately undermine Botswana's cattle producing capability. With bush encroachment common within 4 kilometers of boreholes during normal rainfall, range damage within 8-10 kilometers can be expected during drought, and observations in the recent drought indicate this figure may reach as high as 20 kilometers. Since waterpoint development

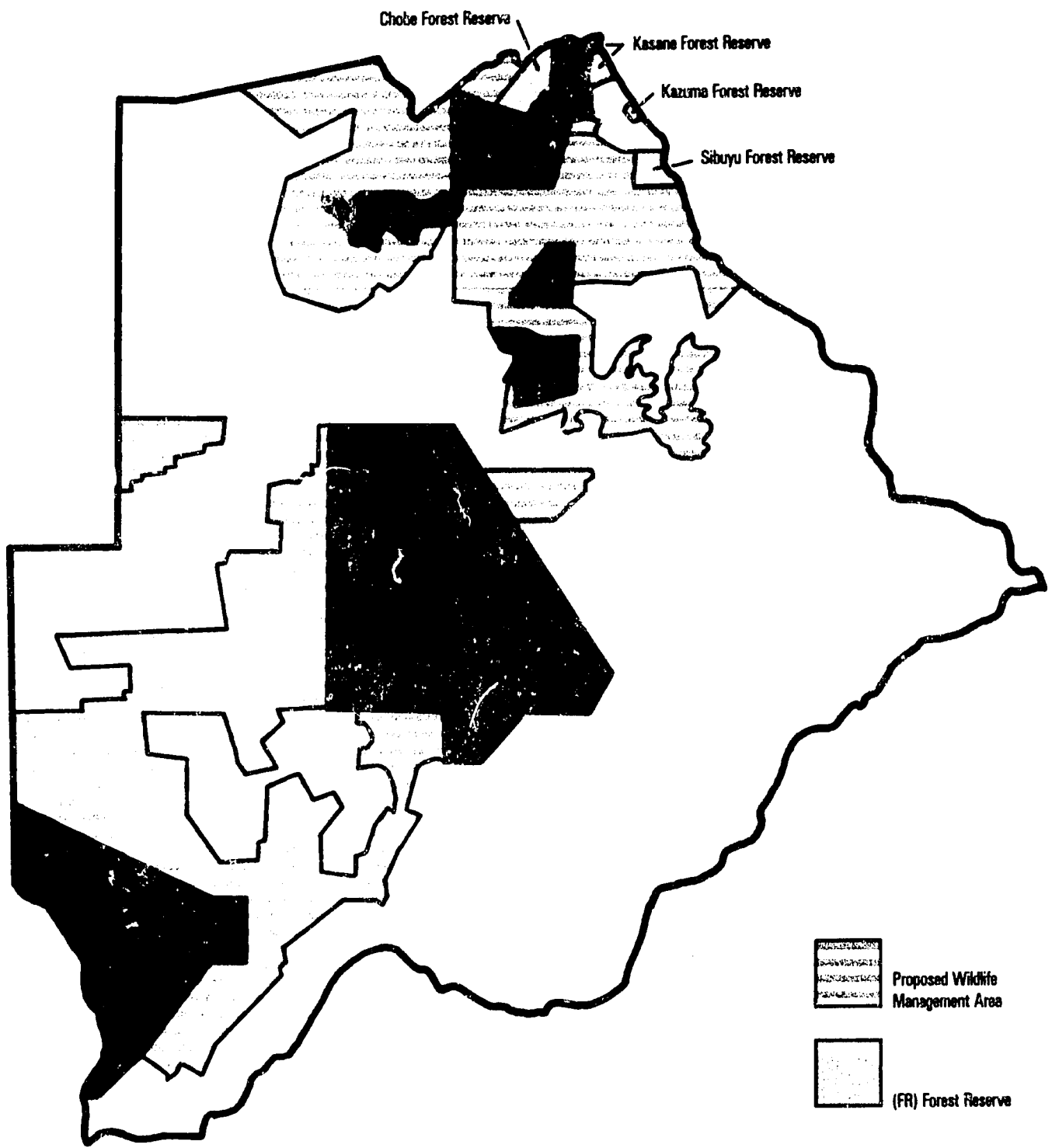
is currently the only effective limit to stocking rates, a waterpoint monitoring and management system to document and control waterpoint development would be very beneficial for Botswana's range.

Another range management practice with major implications for biological diversity is the use of veterinary cordon fences. These fences were first established in the 1950s and are intended to control outbreaks of veterinary diseases, particularly foot and mouth disease. The cordon fencing network has been expanding steadily since its inception, and are important in meeting EEC standards for disease-free beef exports.

The fences also result in large scale wildlife death in times of low rainfall. The fences block former wildlife migration paths and channel broad-scale migrations into small areas which cannot support large numbers of animals. Up to 50,000 Wildebeest were estimated to have died along the Kuke cordon fence in one drought year alone. The combination of drought and restricted access to water - in which cordon fencing plays a major role - has resulted in dramatic reductions in large water-dependent wildlife populations. The Botswana Wildebeest population, once estimated at over one quarter of a million animals, now numbers less than 50,000. Cordon fencing has also limited seasonal movement of certain species into drier areas. Zebra, which once regularly occurred in the Central Kalahari Game Reserve, are no longer recorded there. For a more complete discussion of the cordon fencing issue, see the consultant's report in Appendix III.

Large-scale wildlife deaths reduce gene pool size and are therefore directly detrimental to biological diversity at the genetic resource level. Overgrazing leads to floristic simplification which also reduces genetic diversity. Since the diversity which is lost is concentrated in the most palatable species, potential for loss of commercially valuable genetic material is maximized. Equally important, loss of floristic diversity is accompanied by loss of productivity which directly reduces the economic potential of Botswana's range. Range management is an issue of national importance in Botswana and should be addressed with deliberate action before it reaches the point of seriously affecting the biological diversity, productivity, and economic potential of the nation.

Positive use of Botswana's range can be made which will result in both significant economic returns and maintenance of biological diversity. Management of wildlife for subsistence protein, commercial meat, tourism, and hunting holds considerable untapped potential for maximizing the sustainable output of Botswana's range. The land use category consistent with this multiple use concept is the Wildlife Management Area. Wildlife Management Areas (WMAs) are currently proposed in many areas of Botswana. Proposed WMAs as of June, 1988 are illustrated in Figure 6. If approved, these Wildlife Management Areas would represent an important multiple-use management designation. Sustainable output of wildlife and veld products would be emphasized in these areas, but other ventures, such as cattle raising, might be permitted to the extent compatible with multiple use wildlife



**Figure 6. Forest Reserves and Proposed Wildlife Management Areas of Botswana**

management. Simple establishment of WMAs will not be sufficient to realize the potential economic benefits of wildlife-related land use. Firm, well-financed management implementation will also have to be undertaken to realize the productive potential of wildlife and veld product outputs of the range.

Institution and implementation of the Wildlife Management Areas currently proposed is very important to the future maintenance of biological diversity in Botswana. Multiple product production based largely on natural ecosystems implies a much greater biological diversity than system which produces a single product in a significantly modified ecosystem. The multiple product, diverse system has important dividends to pay in terms of maintaining future options for use of biological resources and in terms of sustainability. Preliminary indications are that the economics, particularly the long-term economics, of the Wildlife Management Areas may be quite positive. Approval of the proposed WMAs, followed by implementation backed by significant resources will be necessary to determine whether this potential can be realized.

### Wetland resources

The wetlands of Botswana are composed of two major systems: the Okavango Delta and adjacent waters, and the Chobe River system. Both systems are important habitat for both wildlife and fisheries, and are important as sites for tourism.

The Okavango Delta is fed by the Okavango River, from Angola. The area has three different ecotypes: 1) the permanent swamp areas, with perennial surface water; 2) the seasonally inundated areas, where the total area affected depends on the annual floods from Angola; and 3) the higher elevation areas that are normally dry throughout the year. The annual flood of the delta is normally at its high point during July. Lake Ngami, the Boteti River and Lake Xau all depend on water from the annual flooding. Because of the recent drought, both Lake Ngami and Lake Xau are dry. The Boteti River is only a series of pools at present.

The Chobe River system lies along the northern border on the Caprivi Strip. It includes the Chobe River, Lake Liambezi, and the Linyanti Swamps. This system, like the Okavango, fluctuates depending on flood waters from Angola. Lake Liambezi is presently dry as well.

Throughout Botswana there are numerous pans, or shallow depressions, which normally seasonally fill with water during the rainy season, and dry up before the beginning of the subsequent rainy season. These pans are important both for livestock and even more importantly for wildlife. The pans are the only sources of surface water throughout much of the country.

Both the Okavango and Chobe systems are potential sources of large quantities of fresh water that are until now largely unutilized. The first proposal for using the waters of the Okavango may have been put forth in 1859, to irrigate north of Lake Ngami. There have been numerous subsequent proposals, usually for irrigation schemes. Bunding and dredging in the

Okavango to increase flow in the Boteti occurred in the early 1970s. The Boteti was dammed at Mopipi in the same period to supply water for the diamond works at Orapa.

Pressures for utilizing water from either or both systems can be expected to increase: water demand in southeast Botswana can be expected to exceed local availability in the not too distant future. A major threat would be major diversions of water from either the Okavango or Chobe systems. The proposed construction of a national water project in Namibia would represent the first major diversion from the Okavango system. Botswana's Sixth National Development Plan calls for a consultancy to determine the technical and economic feasibility of a "major transfer from the Okavango/Chobe", and the terms of reference for this consultancy were nearing completion in mid-1988. The Botswana Water Master Plan will be prepared under this consultancy.

An issue which has attracted much discussion is the attempted eradication of tsetse fly (the vector of trypanosomiasis for both humans and cattle) from the Okavango delta. Eradication is a concern both because it involves potentially biologically damaging chemicals and because it opens previously inhospitable fly-infested lands to cattle grazing. The goal of eradication may be difficult or impossible to achieve, but eradication has been the goal of a government program since the early 1970s. The discovery in 1980 that a 'cocktail' of endosulphan and pyrethroids was far more effective than previous aerial spraying trials led to a large scale spraying effort. All areas of the Okavango have been sprayed at least once since 1980, and the fly population reduced to isolated small pockets.

It is questionable whether such pockets can ever be fully eliminated, and re-invasion from neighboring countries is always a possibility. There is little evidence of serious ecological harm from spraying to date, but cumulative effects cannot be ruled out.

No cases of human or animal trypanosomiasis have been recorded in Ngamiland for three years, and no major aerial spraying is planned in 1988. It seems probable that eradication will never be achieved, but that periodic aerial spraying combined with selective ground spraying can control fly densities within levels that pose little risk to man or animal.

The virtual removal of the fly from the Okavango opens the area to grazing free from the threat of trypanosomiasis, but cordon fencing has thus far prevented violation of current land use prescriptions which exclude grazing from most of the delta. For a more complete discussion of the Tsetse eradication issue, see the consultant's report in Appendix III.

Current use of wetlands in Botswana poses no major threat to biological diversity, locally or nationally. Potential threats from ill-conceived water development or salvinia spread have been anticipated by the government and are the subject of government action. Current land use provisions and cordon fencing has replaced the tsetse fly as the primary constraint to opening the Okavango to cattle. A reduction in the level of insulation from grazing offered the Okavango would seriously jeopardize the biology of the region.

## Forest Resources

Botswana has extensive shrub and woodland areas (covering over 60% of the country), but they are relatively unproductive. The natural vegetation is predominantly wooded savanna, which towards the north and east changes to woodlands. The higher value forests and woodlands, of potentially commercial value, occur mainly in the Chobe District and in the region of the Okavango Delta. True closed forests are restricted to narrow bands along water courses and other favorable sites.

No nationwide inventories of Botswana's forest/wood resources exist. The inventories that do exist are for specific regions or areas, and in many cases are outdated. Estimates of the total volume of the nation's wood resources vary from 1.5 to 2.7 billion cubic meters. The mean annual increment is estimated to vary from less than .2 cubic meters/ha/year up to 1 or 2 cubic meters/ha/year, depending on the species and location.

The importance of the woodlands and forest resources of Botswana should not be underestimated, in spite of its generally limited productivity. The bulk of domestic wood consumption comes from the existing natural vegetation. Approximately 87% of the total rural energy supply is fuelwood collected from natural vegetation. Recent estimates of total wood consumption for all uses are 675,000 cubic meters per year, with 15,000 cubic meters coming from commercial concessions. Consumption is broken down into:

- 45.5 % for energy needs
- 27.3 % for fencing
- 22.8 % for kraal construction
- 4.5 % for other construction.

Because of the relatively low population densities, deforestation is a relatively recent, localized, phenomenon linked to the rapid population growth (estimated at 3.3 to 3.6% per year), growth in the number and size of settlements, and the associated increases in land use pressures. Deforestation is especially evident in the southeast (where 85% of the nation's population is concentrated) and for the major towns and villages in central and northeast Botswana.

Six forest reserves, all in Chobe District, have been gazetted (Figure 6). These are areas of open woodlands and some closed forest that have been declared as forest reserves because of their potential commercial value for exploitation purposes.

<u>RESERVE</u>	<u>AREA</u>	<u>ESTIMATED EXPLOITABLE VOLUME</u>
<u>ha.</u>		<u>(cubic meters)</u>
Chobe	188,000	200,000
Kasane	16,250	*
Kasane Extension	47,500	*
Kazuma	23,750	no estimates
Maikaelelo	62,500	" "
Sibuyu	117,500	100,000
Total	455,400 ha.	

\* combined volume 36,000 m<sup>3</sup> in 1978  
[source Millar 1987]

The primary species harvested in these areas are *Baikia plurijuga* (Mkusi, Rhodesian Teak) and *Pterocarpus angolensis* (Mukwa). The products of the harvest are primarily for export, either to Zimbabwe or South Africa for veneers or worked as railway sleepers for mines to South Africa.

Current management of harvest in the Forest Reserves is minimal. Firebreaks exist and are sporadically maintained. Levels of both professional and semi-skilled personnel are low, leading to low management capability. Current exploitation is almost certainly not sustainable. Little or no regeneration is taking place for the two primary species of harvest, a situation which has led Zimbabwe to cease letting concessions.

Another forested area of possible commercial value is in the northern part of the Ngamiland District. However, this area does not have an adequate roads system, and the government reportedly does not presently have plans to inventory and assess the potential of the forest resources in this region.

The Forest Act of 1968 places restrictions on certain activities within the Forest Reserves. Possession of tree cutting implements, cutting or removal of trees or other forest produce, burning of grass or other vegetation, hunting, livestock grazing, cultivating, and construction of any living space, livestock enclosure, sawpit or road are prohibited within a reserve without a license. Local inhabitants may collect wood and other tree products for their own use, but not for resale. On other State Lands (Figure 7), the Forest Act prohibits cutting of any tree growing within 10 meters of a river or gathering any forest produce for other than subsistence or household needs, without first having a license.

The Forest Act also permits protecting specific trees in any part of Botswana. Protection of trees on Tribal Lands however, requires the agreement of the Land Boards. The Town and Country Planning Act allows for specific trees or woodlands to be protected within planning areas, and some Districts have regulations or bye-laws which regulate or prohibit the export of wood outside of the District.



The ability of the Ministry of Agriculture Forestry Unit to enforce these restrictions is very low. With only 8 degressed foresters and a total staff of under 50 for a national area of 576,000 km<sup>2</sup>, Forestry Unit presence in the field is minimal. No evidence of major misuse of forest reserves exists, but effective implementation of fire control within the nation's forests is beyond the capacity of the current forestry cadre. This has serious implications for the preservation of biological diversity. Inability to implement fire control legislation and unsustainable timber harvest pose a long-term challenge to diversity of forest species. Better forest management is needed to ensure that loss of forest resources to fire is minimized and that use of timber resources is sustainable.

Biological diversity may also be significantly impacted locally by firewood use. Certain species, particularly Acacias, Mopane, and Cobretum species are preferred for firewood, and in areas experiencing firewood shortage these species will be greatly reduced or eliminated. Monitoring to ensure that local variants are not permanently lost would be beneficial.

## 2. Development Strategies

### National Development Plan

Botswana's Sixth National Development Plan (NDP6) which covers the period 1985-1991 provides a strong basis for the conservation of biological diversity and tropical forests. All the Government of Botswana (GOB) policies are founded on the national principals of democracy, development, self-reliance, and unity. The GOB has four main planning objectives: rapid economic growth, social justice, economic independence, and sustained development.

One of the major policies for NDP6 is "To initiate further planning of the management of natural resources". The strategies to achieve this are: (1) by "implementing recommendations of the June 1984 national workshop on management of Botswana's environment"(organized through the nation's oldest NGO, the Botswana Society), and (2) by an educational effort "to set in motion a natural understanding and acceptance of the need to conserve natural resources". In the discussion on policies and strategies for NDP6, a section is devoted specifically to discussing the National Conservation Strategy and how it is expected to "enunciate the long term methods of achieving sustainable development".

The NDP6 is divided into several major chapters including Housing, Agriculture, Water Resources, Health, Mineral Development, and Energy. An entire Chapter (11) is devoted to "Wildlife, National Parks, and Tourism", while "forestry" is listed under "Other Activities" within the Chapter (7) on Agriculture, and does not even appear in the list of contents.

Chapter 11 provides a strong basis for the conservation of biological diversity and tropical forests. It directly links the national planning objectives of economic growth and sustained development, with nature conservation, by opening with the statement: "...the

country's large wildlife populations and unique habitats are the main foundations of its tourist potential. This is by no means their only importance, however, since wildlife exploitation is an important source of income for many rural Botswana".

The policy objective of wildlife development in NDP6 is to "assist rural development through employment creation and income generation. This objective will be pursued through utilization of the wildlife resources on a sustained yield basis and efforts to conserve these resources and to plan their management will be stepped up." The policy envisions "private sector investment in and development of wildlife utilization with maximum citizenship participation."

Unlike many countries which take little note of their biological resources within the context of their national development plans, Botswana's NDP6 clearly provides the basis for sustained development of these resources. The implication is clear that the preservation of the diverse biota, whether through ecosystem protection, species protection, or germplasm conservation, is considered fundamental to national development.

The forestry section of NDP6 anticipates strengthening the Forestry Unit within the Ministry of Agriculture, closer cooperation between the Forestry Unit and the NGO Forestry Association of Botswana, controlled exploitation of forest resources in the Chobe district, and a study to formulate recommendations in fuel use and afforestation.

The emphasis on the role of the private sector, further reflected in the GOB FY 88-89 budget presentation, highlights the intent to strengthen the private sector and employment generation activities. This is in keeping with the AID Mission's own strategy assessment and follow-on private sector studies undertaken in 1987.

### National Conservation Strategy

After a Southern African Development Coordination Conference (SADCC) Environment Workshop held in Gabarone in 1983, sponsored by UNEP and UNDP, Botswana established an Inter-Ministerial Environment Subgroup (ICES) to consider problems relating to overgrazing, desertification, drought, deforestation, and others. Recognizing the GOB's actions in this regard, UNEP subsequently identified Botswana as the first and only African country to receive a team of experts to articulate environmental problems from a national perspective. This UNEP "Clearinghouse" team recommended elaboration of a National Conservation Strategy (NCS) for Botswana. This recommendation was adopted by the GOB as a priority, and the Botswana NCS is entering its final stages at the time of this assessment. Conservation of biological diversity and tropical forests is inherently an integral part of the deliberations on the NCS, and AID has been a strong supporter and partner of the GOB in this process.

The Director of the Department of Town and Regional Planning (DTRP) in the Ministry of Local Government and Lands (MLGL) has overall responsibility for the planning and production of the NCS. The GOB has requested technical assistance from the IUCN in preparation of the NCS, and for two years, former AID Mission Director (Tanzania, Nepal,

and Deputy in Sudan) Sam Butterfield served as the IUCN Advisor. Numerous individuals have contributed to the NCS, and continuity has been provided in the current final stages by provision of an IUCN advisor from the United Kingdom, Ralph Cobham.

In keeping with the Tswana custom of people's participation in policy formulation and decision making, various drafts of the Strategy have undergone close public scrutiny during a series of workshops and public meetings at the District Council and village level, all associated with its preparation. At the request of the DTRP Director, the NGO Botswana Society organized a national level Seminar on the NCS in mid 1987 to "ensure a review of the proposed solutions to environmental problems by a cross section of professional and influential persons from the private and public sectors". The resultant publication Developing Our Environmental Strategy summarizes discussions on the major environmental problems in Botswana, most of which have direct bearing on the conservation of biological diversity and tropical forests.

USAID/Botswana supported local participation in the NCS development through provision of a six month consultancy in which rural villages and local governments were systematically canvassed to identify conservation problems and solutions. The July 1987 report of Charles Bussing helped give rise to a USAID and UNDP co-sponsored workshop in February 1988 where nearly 100 village representatives, District Officers, and representatives from NGOs and donors discussed the NCS implementation problems and strategies.

The Botswana NCS will consist of some 26 Technical Reports on a variety of topics. A Synthesis Document of some 80-100 pages is being developed and will be presented to the National Parliament, probably in November 1988. An Action Plan for implementing the NCS also is being drafted, which will include environmental solutions recommended during District consultations, and proposed opportunities for participation by Government Departments and all other interest groups. The latter already has been subject of one meeting by the donor community, in cooperation with GOB authorities.

Some of the Technical Reports of greatest specific concern regarding biological diversity and tropical forests will deal with: veld products, forestry, tourism, fisheries, wildlife, livestock, social values and traditions, law and economics and the environment. A 30 page draft Technical Report on Biological Diversity has been prepared and is undergoing revision based on a review by Robert Prescott-Allen, principal author of the World Conservation Strategy. The NCS chapter on biological diversity will be a "cross-cutting" chapter recognizing the relevance of the topic to most of the other chapters of the NCS.

Major issues of concern identified in the various workshops and seminars all have potential relevance to the conservation of biological diversity and tropical forests. These include:

- Overgrazing
- Depletion of veld products and wildlife for consumption and tourism
- Use and conservation of woodland resources
- Devegetation and attendant desertification

AID Regional Forestry Advisor David Gibson's report on the February 1988 Gaborone Local Participation Workshop (funded by AID and UNDP) indicated that participants identified the following major constraints to effective action to implement the NCS:

- Lack of a lead institution in natural resources.
- Inadequate enforcement of existing legislation.
- Insufficient numbers of qualified technical and extension field staff.
- Lack of a coherent and comprehensive conservation education curriculum in primary and secondary schools.
- Inadequate action after five years of interviews by consultants.

### USAID Country Development Strategy Statement and Portfolio

The currently approved Country Development Strategy Statement (CDSS) of the U.S. Agency for International Development in Botswana (USAID/B) was initially drafted in 1983, and covers the period starting Fiscal Year 1985 (October 1, 1984) and extending through Fiscal Year (September 30) 1989. It describes three principal objectives:

1. To improve the quality and efficiency of the primary and post-primary educational systems to better meet projected workforce requirements.
2. To provide advanced training for administrators and technical personnel to help increase and diversify employment opportunities.
3. To strengthen selected institutions which are directly responsible for increasing agricultural and off-farm productivity and incomes in rural areas.

These objectives closely supported the GOB's Fifth National Development Plan and its policy initiatives in education, work-force training, and employment creation. At the same time, the CDSS envisioned reduction of the USAID/B portfolio from 21 active projects in FY 1982 to 7 high impact projects. The project focus would continue to concentrate on education/manpower development, and rural development/ agriculture. The planned level of obligations of funds is expected, over the life of the CDSS, to shift slightly down from 80-75% for education and up from 20-25% for rural development. The current CDSS does not anticipate new natural resources management projects that would result directly in the conservation of biological diversity and tropical forests. However, as shown below, the AID Mission has initiated several important activities in this regard through existing resources.

Specific preparations have not yet been undertaken to update the CDSS for several reasons. The current CDSS does not expire for more than a year. USAID/B is now classified as a "Class A, Programmatic Category II" Mission, which requires neither a CDSS nor the normal 2-year Country Action Plan which outlines its implementation.

In the March 1988 Assessment of General Condition of The USAID/Botswana Project Portfolio, the following six bilateral projects were identified as currently active:

633-0077	Rural Sector Grant
633-0221	Agricultural Technology Improvement Project (ATIP)
633-0229	Junior Secondary Education Improvement Project (JSEIP)
633-0231	Botswana Workforce and Skills Training Project (BWAST)
633-0240	Primary Education Improvement Project Phase II (PEIP)
633-0241	Botswana Workforce and Skills Training Project Phase II

The list also includes two housing projects and one Southern Africa Regional Program (SARP) project. Total planned life-of-project funding, excluding the housing investment loans, is about U.S. \$87.6 million with \$57.1 million obligated. All projects are in their final phases, so preliminary considerations are being given to 1990 and beyond.

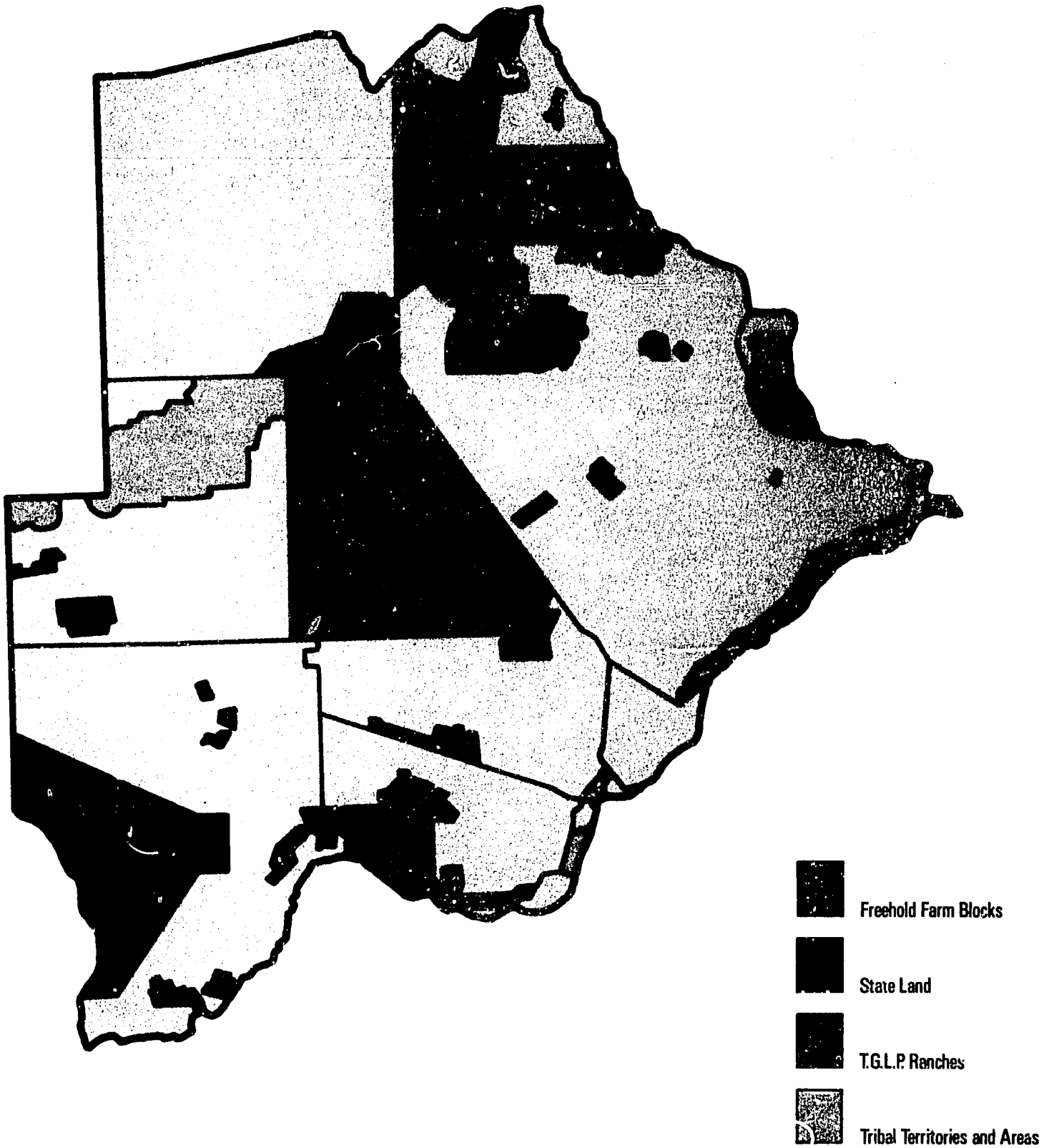
The core of USAID/Botswana's overall strategy is to assist in job creation through a strengthening of market forces. This includes a private sector strategy seeking to help entrepreneurs in expanding or starting enterprises, skills development to meet manpower shortages, curriculum development, agriculture, and limited but important attention to conservation matters. An emphasis in all these areas and especially in the private sector/employment generation area is on policy dialogue to bring about change.

Through existing projects, or other available funds, the AID Mission has initiated numerous activities, all broadly supportive of biological diversity and tropical forest conservation. In support of conservation efforts in Botswana. These actions are described in Chapter 7.

### 3. Development Planning

#### Land Use Planning

The Lands Division of the Ministry of Local Government and Lands (MLGL) is the primary focal point for land policy and land management issues in Botswana. Together with the Rural Division of the same Ministry, and in close coordination with local authorities, District Development Plans are produced. Development Plans are developed under separate but similar procedures for statelands and tribal lands (Figure 7). These plans are increasingly integrated land use plans, and are expected to become more so, as the national planning process evolves.



**Figure 7. Land Tenure in Botswana**

Source: NDPB

The Tribal Grazing Land Policy of 1975 gave rise to systematic land use planning in the country. The Policy itself followed from the Tribal Lands Act of 1970 which had enacted Land Boards at the District level (DLBs). The Boards have the responsibility of approving and implementing land use plans. At the national level, the MLGL has established a Land Development Committee to review plans approved by the Boards, and to advise the Minister on their suitability. The Minister has the right to overrule the DLB decisions. In practice, this is made less likely by the fact that DLB Secretaries meet yearly with the Ministerial Committee to report on progress and to jointly discuss any potentially controversial issues.

Land use planning is considered by MLGL officials to consist of two phases in Botswana. The first has been the "Zoning Phase" during which principles of land use were sorted out on a national basis. To a certain extent, this represented a practical rationalization of existing land uses. One result was the May 1987 publication of a National Land Use Map (1:1,500,000) showing Freehold/Leasehold Farms; Tribal Grazing Land Policy Ranches; proposed (not gazetted yet) Wildlife Management Areas; and existing National Parks, Game Reserves and Forest Reserves.

This Phase is expected to be complete by the end of 1989, at which time all the District Land Use Plans should have been approved by the Minister, and officially gazetted. None of the Districts' Plans has reached this stage although the Southern District will likely have its Plan gazetted by the end of July.

The second phase will be the "Area Management Phase". During this Phase, a more detailed look will be made at the resource base, including inherent land use capabilities. Land management decisions will be put into practice, with adjustments made as realities dictate. Again, this will be closely coordinated and monitored by the MLGL and District authorities. The greater technical detail required in this second phase offers excellent opportunities for donor support of the planning process.

### Population Planning

Botswana's population was estimated to be 1.2 million in 1987 with an annual growth rate of 3.7% (second or third fastest growing in the world). The death rate is rapidly declining and with the current birth rate, the population is expected to double approximately every twenty years.

Several facts stand out concerning the population. Nearly half (48%) of the people are under 15 years old. A high proportion (about 24%) of the men aged 20-40 are employed abroad, mainly in South African mines, and consequently women predominate among young adults, and as heads of households. Population density is low by world standards, and is expected to increase from only 1.6 persons/km<sup>2</sup> in the early 1980s to 3.2 persons/km<sup>2</sup> at the turn of the century. The population is heavily concentrated in the eastern quarter of the country where land and water resources provide the best opportunities for livelihood. Botswana has a predominately rural population, but with rapidly growing urban centers. Gaborone, though still under 100,000 people, is frequently touted as the fastest growing capital city in Africa.

The Government provides family planning services in its family health activities, but does not yet have a major family planning effort underway. However, the government is in the process of developing a national population policy. USAID has assisted in this regard through regional funds and has provided contraceptive support and assistance to the National Population Conference. A new family planning project has also been proposed.

### Environmental Review of Development Projects

Legal requirements do not exist for development projects to be formally accompanied by an environmental impact assessment. However, in the past, proponents of some large scale projects, especially when in environmentally sensitive areas (such as the Sua Pan Soda Ash Project, and the 1983 proposed Trans-Kalahari Railway) have been asked to prepare such analyses. The Ministry of Local Government and Lands now regularly requests that proposed development projects have an environmental impact analysis prior to approval. However, formal legal requirements currently remain ad hoc. Many local observers suggest that legislation in this regard be introduced, and that, in addition to biological impacts, it also anticipate social and economic impacts.

### 4. Impacts of Internationally-Financed Development

The most celebrated of Botswana's internationally financed development projects are the World Bank livestock sector loans. The first two of these loans were well-intentioned efforts to improve range management that suffered serious flaws. These loans also had serious equity problems, preferentially benefiting wealthy livestock owners over smallholders. The latest World Bank livestock sector assistance has learned from the errors of the previous two projects. About half of this effort is now well channeled to sound land-use planning efforts. The remaining half goes to a still-controversial ranch credit scheme. Few, if any, new ranches have been established under the latest tranche of this credit, repayment rates have been very low, and the program still preferentially benefits powerful livestock owners. Lending under this program is currently frozen and intense international scrutiny seems destined to ensure that environmental effects of this program will be well monitored and controlled.

Future projects with potential negative environmental impact are limited. Most donors are now voluntarily preparing environmental impact statements, and past difficulties have sensitized government to the need for careful review. The Sowa soda ash development will have limited local environmental impact, but nothing of a magnitude to warrant interrupting development. Water development needs of this project should be carefully considered and explicitly stated prior to project implementation. Similarly, water issues will be one of the primary concerns of most major development initiatives in Botswana, and donors and the government should be particularly cognizant of the need for careful water resources planning in all projects.



Perhaps the largest international development assistance package to Botswana is EEC subsidized beef prices. The environmental impact of this indirect aid may be considerable, both in contributing to overstocking and in requiring largely unnecessary cordon fencing. Because this aid is not explicit, no environmental impact analysis has ever been conducted. A successful range management program and review of cordon fencing procedures can overcome most of the negative environmental consequences of this policy, but the economic distortion it causes is unavoidable, and will eventually result in a difficult adjustment period when the aid is no longer available.

Other internationally financed development activities are generally having neutral or beneficial effect on the environment. As described elsewhere, many donors have active natural resources portfolios in Botswana, and donor awareness is contributing greatly to environmental protection in Botswana.

Key References for this Chapter: 2, 3, 27

## CHAPTER 4.

### LEGISLATIVE AND INSTITUTIONAL STRUCTURES

#### 1. Botswana Legislation and Treaties

Internationally, Botswana has signed the 1933 African Convention on the Conservation of Nature and Natural Resources, as well as the Convention on International Trade in Endangered Species (CITES). It is not yet a member of the World Heritage Convention or of the Ramsar Convention on Wetlands of International Significance. Sites which may qualify for World Heritage status include the Moremi Wildlife Reserve in the Okavango Delta, the Central Kalahari Game Reserve, and perhaps the Chobe National Park. IUCN's 1986 Review of the Protected Area System in the Afrotropical Realm identified Lake Ngami and parts of the Okavango Delta as areas of potential designation as Wetlands under the Ramsar Convention.

Various domestic proclamations, acts, and policies govern environment and natural resources topics in Botswana, and consequent conservation of biological diversity and tropical forests. The full text of each is contained in the multi-volume publication Laws of Botswana. An analysis of Botswana legislation will be made in one of the Technical Reports for the National Conservation Strategy. A consultancy is planned which would examine the adequacy and overlap in the country's natural resource conservation legislation and prepare a comprehensive piece of natural resources legislation.

Although other laws may affect the conservation of biological diversity and tropical forests, some of the most directly applicable ones enacted since Independence in 1966 are briefly summarized below, in chronological order. Chapter references to the Laws of Botswana are noted in parenthesis following the name of each act. A few of the relevant regulations and policy declarations also as noted.

#### 1968 National Parks Act (38.03)

-Amended in 1976 and 1979.

-Covers establishment, control and management of national parks.

-Section 3 empowers the President to establish national parks "...for the propagation, protection and preservation therein of wild animal life, vegetation, as well as objects of geological, ethnological, historical and other scientific interest".

-Subsidiary Orders constitute various national parks and provide for their specific regulations.

-Provides legal protection for national parks by prohibiting the killing, or capturing of any animal and the cutting and destruction of any vegetation in the parks.

-The Department of Wildlife and National Parks, both in Gaborone and in the Kgalagadi District, indicated that a high priority is to draft "unified" regulations for the reserves and parks.

#### 1968 Forest Act (Chapter 38:04)

- Provides for declaration of Forest Reserves on State Land, by the President, as well as subsequent boundary alterations.
- Section 11 provides for declaration of any tree or class of trees as protected, in any part of Botswana. Identifies five species of timber trees and two species of fruit trees as protected.
- Prohibits felling, cutting, burning or removing of any protected tree, or any unlicensed such activities in Forest Reserves and along waterways.
- Declares the Kasane Forest Reserve.
- Section 17 provides for exemptions from the Act to allow, under certain circumstances, cutting and burning in the Forest Reserves.

#### 1968 Statutory Instrument No. 22

- Declared "Controlled Hunting Areas".

#### 1969 Waterworks Act (34:03)

- Prohibits polluting or fouling public water by discharge of any matter or substance likely to cause injury to public health, livestock, orchards, or gardens.
- Water Authority acquired rights to water and to construct and manage works for supplying water.

#### 1970 Monuments and Relics Act (59:03)

- Provides for declaration of caves, rock shelters, shell mounds, and other "ancient monuments" as National Monuments.

#### 1970 Tribal Lands Act

- Enacted District level Land Boards and vested Tribal Lands in them. In practice, they approve and implement land use plans.
- Provided legal basis under which Wildlife Management Areas will be gazetted.

#### 1974 Agricultural Resources Conservation Act (35:06)

- Provides for conservation and improvement of agricultural resources.
- Establishes an Agricultural Resources Board to "...issue conservation orders, stock control orders, and make conservation regulations".
- Section 19 authorizes the Board to indicate the number of stock animals may be kept or pastured in particular areas, if the Board determines it necessary for the conservation of resources in that area.
- Section 20 provides for establishment of Conservation Committees to "constantly review the conservation of agricultural resources under their jurisdiction".

#### 1975 Fish Protection Act (38:05)

- Section 3 authorizes Ministerial regulations concerning fishing, including seasons and species to be caught.
- Section 4 prohibits use of explosives, poisonous or noxious substances.

### 1975 Tribal Grazing Land Policy (TGLP)

- Intent is to increase herd productivity through grazing control and improved range management.
- Categorized tribal grazing lands into commercial, communal, and reserved zones, with specific policies for each.
- Provided conceptual basis for Wildlife Management Areas.

### 1976 Herbage Preservation Act (38:02)

- Purpose is to prevent burning of trees, bushes, grass and other understory plants.
- Establishes Herbage Preservation Committees which may prohibit burning in areas under their authority.
- Section 4 prohibits any person from burning on land not his or under his lawful occupation. (Such fires, in practice, may easily spread elsewhere.)

### 1979 Unified Hunting Regulations

- Gives all citizens equal rights to hunt in any of the "Controlled Hunting Areas" for which quotas are set, subject to other conditions of the Fauna Conservation Act. Other activities are not controlled in these areas.

### 1979 Fauna Conservation Act (38:01)

- Gives effect to the International Convention of 1933, as amended, for the protection of fauna and flora of Africa.
- Provides the legal framework for wildlife management and enforcement throughout the country.
- Declares certain animals to be either conserved animals or protected game.
- Sections 5 & 6 provide for the establishment of game reserves and sanctuaries.
- Section 8 provides for establishment of private game reserves, requested by the owner in writing to the President. These are declared through notice in the gazette. Once declared, the owner may hunt or capture animals within the reserve.
- Section 10 empowers the President to declare controlled hunting areas.
- Includes various subsidiary regulations concerning hunting seasons, the declaration of Moremi Wildlife Reserve, declaration of controlled hunting areas, and others.
- In 1977 FAO noted that only vertebrate species are mentioned, although, in practice, protection is provided for the whole ecosystem.
- IUCN has noted an inadequacy of the nation's two major wildlife laws (1961 and 1972) in that they permit transfer of hunting licenses, and allow unlicensed people to "assist" hunters.
- The 1985-91 National Development Plan proposes to "amend existing legislation to remove provisions which inhibit new forms of wildlife utilization" (game cropping, culling, wildlife ranching, trophy industries), and to "remove loopholes for poaching".
- In 1985-87, American Fulbright Scholar, Steve Mishkin, conducted a thorough legal analysis of the wildlife laws of Botswana and suggested revisions for legal clarity and consistency. This suggested revision rests with the government.

### 1981 Forest Order (Statute Law Vol.LX5)

- Declares 10 species of protected trees under provisions of the 1968 Forest Act.

### 1986 Wildlife Conservation Policy

- Objective is to insure management of the wildlife resources on a sustained basis.
- States that wildlife resources must be seen in terms of their potential contribution to the economic well-being of the nation, as well as in terms of its heritage and aesthetic value.
- Proposes staff increase of 100 positions in the DWNP.

## 2. Institutional Structures

Although the conservation of biological diversity and tropical forests may involve aspects of many institutions in Botswana, it is primarily concerned with ones in the Ministries of Agriculture, Commerce and Industry, Local Government and Lands, Education, Finance and Development Planning, and the Ministry of Mineral Resources and Water Affairs. Local institutions and their capacities were addressed by Eleanor Warr in the April 1987 Botswana Natural Resources Expertise Profile, which included organizational diagrams and descriptions of the major Ministries and Departments. The structure of these Ministries is briefly described below with highlights of some of the land use management institutions and functions they include. A national "Organizations and Methods Program" is critically reviewing the structure and functions of all the Ministries at the present time.

### Ministry of Agriculture (MOA)

The MOA is divided into four Departments. The Department of Agricultural Field Services, within its Division of Land Utilization, includes the Forestry Unit and the Range Ecology Unit. These units are administratively parallel to a Beekeeping Unit, and a Land Development Unit.

The Forestry Unit has nationwide responsibility for woody vegetation. It operates through a system of District Forest Officers, although only 6 of the 12 are currently in place. It presently oversees 9 government nurseries with Forest Guards at each, and about 600 hectares in government plantations along railroad lines. The Forestry Unit supplies the seedlings for National Tree Planting Day. Two of the MOA foresters are presently in the UK for training, and the U.S. Peace Corps has been requested to supply two Volunteers, one in harvesting and marketing, and the other in plantations.

The Range Ecology Unit has two professional positions to implement national range monitoring. The unit is expected to be significantly strengthened under the World Bank National Land Management and Livestock Project.

The other major MOA Departments are Agricultural Research, Veterinary Services, Cooperative Development, and at the equivalent level, the Botswana Agricultural College.

### Ministry of Commerce and Industry (MCI)

The MCI has numerous responsibilities, including wildlife, national parks and tourism. The Department of Wildlife and National Parks is the largest and most relevant government body dealing with conservation of biological diversity and tropical forests. With some 500 employees nationwide, the DWNP is responsible for administering park and wildlife matters, and implementing the pertinent laws, regulations, and policies. In protected natural areas alone, it currently has some 18% of the national territory under its jurisdiction, which would rise to about 36% if the planned Wildlife Management Areas are gazetted. Already, an inhouse study financed by the European Development Fund has recommended that the staff be increased by some 1000 individuals. DWNP has requested U.S. Peace Corps Volunteers as managers of both Chobe National Park, and the Moremi Wildlife Reserve.

The Wildlife Education Unit of the DWNP has coordinated with the Department of Curriculum Development and Evaluation of the Ministry of Education, in providing suggested teaching topics for children in different age groups.

The DWNP also is responsible for the Wildlife Training Center, established in Maun in 1980 to train game scouts.

An Organization and Methods Report prepared in 1986 for the MCI identified the DWNP as an "odd one" for that Ministry. Two alternative institutional structures being currently discussed are either changing the MCI name to include Natural Resources, or, establishing a new, separate Ministry of Renewable Natural Resources (MRNR). Either might include forestry, fisheries, water, and soils, in addition to wildlife and parks.

The Tourism Development Unit within MCI, with a staff of less than 10, is charged with oversight of a fast growing industry which accounts for one of the nation's largest sources of foreign exchange. Tourism has developed rapidly, and it has had little control by the government. The Unit participates in international tourism trade shows, and is developing a tourist policy.

### Ministry of Local Government and Lands (MLGL)

The MLGL is the focus within the GOB for overall land use planning and policy. As the name suggests, the MLGL coordinates closely with local authorities to produce the District Development Plans (described above under "Land Use Planning").

The Department of Town and Regional Planning (DTRP) within MLGL provides a link between the central government and local authorities. It also presently serves as the secretariat for the National Conservation Strategy, and as chair for the Interministerial Coordinating Environmental Subgroup (ICES). DTRP is responsible for the preparation of settlement and regional plans under the Town and Country Planning Act (1977).

The National Conservation Strategy is expected to suggest the formation, through Act of Parliament, of a National Environmental Board or Council, located outside the formal government structure. Such a Board would promote sustainable development, and coordinate with all Ministries, local government authorities, parastatals, and private entities on environmental/development matters.

### Ministry of Education (MOE)

Although not directly responsible for land management decisions which affect the conservation of biological diversity and tropical forests, the MOE has a very important, long term role, primarily through its Department of Curriculum Development and Evaluation (DCDE). The Department initiated a new 9-year program in 1987 intended to sensitize school children to the environmental conditions prevalent in Botswana. It is also developing an environmental education program in cooperation with Kalahari Conservation Society with UNDP funding.

### Ministry of Finance and Development Planning (MFDP)

The important MFDP is responsible for preparing and implementing National Development Plans, and all negotiations concerning international aid. Reporting to its Rural Development Unit is the Natural Resources Technical Committee (NRTC) which receives and reviews proposals for the utilization of natural resources. NRTC has established an Interministerial Coordinating Environmental Subgroup (ICES) coordinated by the Department of Town and Regional Planning.

### Ministry of Mineral Resources and Water Affairs (MMRWA)

The MMRWA includes the Departments responsible for geological surveys, protection of water sources, and allocation of water rights. In 1984 it commissioned a national "Study of Energy Utilization and Requirements in the Rural Sector of Botswana", which made particular emphasis on use of native plant species for fuelwood. MMRA is also the lead agency on the extremely important Water Master Plan development effort, and lead agency on the unified water and sanitation

### 3. National Non-Governmental Organizations

Non-governmental organizations (NGOs) are generally new in Botswana, and only a few of them exist. The oldest, the Botswana Society, was formed in 1969. Most have gained national and international recognition for the high quality of the various projects and activities they have carried out. This has resulted in modest but regular funding by the international donor community.

Most of the NGOs have prominent Botswana in key positions such as Committee Members, Honorary Presidents, and Patrons, although active general membership tends frequently towards expatriots. The principal NGOs are all Gaborone based. Discussions are currently surfacing in several fora related to the NCS, about establishment of rural based "People's NGO", in which more villagers would be actively involved than in the present NGOs.

The NGO profiles below are derived from observations and discussions, Eleanor Warr's Botswana Natural Resources Expertise Profile, and the UNDP Inventory of Environment Related Projects in Botswana.

#### Botswana Society

Botswana's oldest NGO, the Botswana Society has its headquarters in the National Museum. The Society encourages research on cultural and natural history, and has been important in promoting environmental understanding through conferences and symposia, including UNDP-funded 1986/7 national seminars to review the National Conservation Strategy. The society has assumed a role as a major convenor of conferences on national issues (drought, education, conservation), and publishes a newsletter, The Zebra's Voice.

#### Botswana Bird Club

A section of the Botswana Society, the Bird Club assists the Society's efforts in conservation and organizes ornithological activities.

#### Forestry Association of Botswana (FAB)

The Forestry Association of Botswana carries out extension work in rural areas, promotes tree planting, natural resource conservation, forest industries and scientific research. The Royal Norwegian Ministry of Development Cooperation (NORAD) is supporting a 2 year Botswana Tree Seed Program through FAB to provide selected seed of known origin for research, plantations, woodland enrichment, village planting, and international exchange. FAB assisted with UNEP funded seminars on desertification control (1987), IDRC-funded tree species trials and research nursery at Kumakwane (1985-88) and organized of National Tree Planting Day (1985-89). FAB has the highest membership of Botswana (about 1/2 of the total 300 members) of any NGO, and publishes a semi-annual Journal.

#### Kalahari Conservation Society (KCS)

Kalahari Conservation Society is perhaps Botswana's best-known NGO. KCS coordinates the NGO environmental liaison group, promotes conservation of wildlife and environment through education and publicity, and encourages and finances research. In cooperation with MLGL, KCS prepared the Proposed Land Use Plan for Ngamiland Statelands. KCS is Partially supported by EEC/EDF, WWF/UK, and USAID. Among the active conservation activities at KCS are a UNDP funded FAO activity to provide GOB with computerized system for hunter licensing and administration; a UN Volunteer working on environmental education for primary school children; and a second UN Volunteer slated to begin a similar assignment attached to the Ministry of Education. KCS has also developed a Management Plan for the Central Kalahari Game Reserve under WWF-International support. The Society publishes a monthly newsletter.



**Thusano Lefatsheng (Helping Each Other on Earth)**

This NGO provides assistance to small scale agricultural operations, to help rural people attain an improved standard of living and promotes cultivation of indigenous and exotic dryland crops for medicinal, aromatic, food, fodder, and industrial purposes. A major activity from 1985-89 is Grapple processing in Kumakwane supported (personnel) by Netherlands Development Organization (SNV).

**Foundation of Education with Production**

Botswana's premier grassroots NGO organized by Patrick von Rensberg.

**Collective for Resource Development and Education (CORDE)**

Associated with Foundation of Education with Production, CORDE is headed by Gavin Anderson and receives support from the government of the Netherlands.

**4. International Organizations**

In developing its policies and programs, the Government of Botswana has requested assistance from various international organizations and bilateral agencies. U.S. Ambassador Natale Bellocchi pointed out that the United Nations Development Program (UNDP) plays an important donor coordination role by hosting bi-monthly meetings for key representatives of the various donor organizations, at which current activities are discussed and respective areas of concentration are mutually defined. Subject-specific coordination meetings also are held as appropriate, with "environment" being one of the 3 specific topics.

Some of the major international organizations are described in a UNDP Report on Development Cooperation Botswana 1986. The UNDP also has prepared a December 1987 Inventory of Environment-Related Projects in Botswana. The 1987 Botswana Natural Resources Expertise Profile, prepared for IUCN's Conservation Development Center, identifies environmentally related initiatives taken by such organizations. Brief summaries of the activities of major international organizations are given below:

**World Bank (IBRD)**

The IBRD is funding the National Land Management and Livestock Project (1986-88), executed by GOB. The objectives of this project are: development/improvement of range management; improvement of communal grazing management; development of land use planning and management; and development of group ranching. Land use planning specialist seconded to DWNP under this project to quantify manpower and fiscal needs for Wildlife Management Areas.

**Swedish International Development Authority (SIDA)**

SIDA supported development of the National Conservation Strategy and a workshop for use of microcomputer models for environmental planning and has provided a 1987-89 consultancy for comprehensive planning for utilization of the Okavango area. Other

SIDA-supported efforts include the Physical Development Plan for the greater Gaborone area, the National Water Master Plan, environmental sanitation, water hygiene education, and a village sanitation costs and tariff study.

#### United States Agency for International Development USAID

USAID/Botswana emphasizes external and in-country training, including placement of operational experts (OPEXers) to fill personnel gaps and provide on the job training for Botswana counterparts. USAID funded KCS to assist District Land Use Planning Units to carry out an integrated land use plan for the Makgikgadi (Ngamiland) area. Current USAID portfolio and natural resources activities are described in Section C2.

#### US Peace Corps

The United States Peace Corps effort in Botswana is heavily education oriented. Most US Volunteers in Botswana serve as teachers in primary or secondary schools. The second largest block of PC Volunteers is in small enterprise development. Recently, the Peace Corps has been requested by the GOB to provide four natural resources Volunteers by the end of 1988: Directors for Moremi Wildlife Reserve and Chobe National Park, with the DWNP, and two foresters with the Forestry Unit. The Peace Corps has increased emphasis on natural resources and coordinated, in cooperation with the Forestry Association of Botswana, a May 1987 forestry workshop for some 30 secondary school teachers and PCVs (funded by AID/S&T/FENR). By October 1988 Peace Corps expects to have about 200 Volunteers with most working in secondary education. This could provide a significant opportunity for AID/PC cooperation on environmental education in support of biological diversity and tropical forest conservation.

#### Netherlands Government (SNV)

SNV has funded a groundwater resources monitoring and recharge study 1987-1990, in eastern Botswana; the Environment development linkages project (1985-86), and National Institute of Research strengthening activity (1985-87). These activities have produced a number of high quality publications on Botswana's environment and development. In addition, the Netherlands has had up to six rural planning volunteers in various Districts at a time (1979-1990) and has supported Molopo farming near Gomare and Thaoge River (1985-89) and Grapple processing promotion through Thusano Lefatsheng.

#### United Kingdom

The UK program has supported training, the 1976-89 Tsetse Control Program, a Rural energy utilization (fuelwood demand) study, a study on water administration, and is co-financing the National land management and livestock project (1987-1992) with the IBRD. Other UK activities include the Pandamatenga economic development study and the 1987-91 SADCC land and water research program.

#### Canadian International Development Agency (CIDA)

CIDA funded a regional study of environmentally benign and cost-effective means of tsetse eradication in Zimbabwe and Botswana.

### European Community (EEC) and European Development Fund (EDF)

The EEC has a major natural resources oriented program in Botswana. The EEC has a 5 year, \$70 million program underway, with focus on wildlife and forestry. Included in past or present EEC efforts are:

- The first systematic large-scale study of Kalahari grazing resources and the wildlife resource base
- Funded the country-wide 1980 animal range assessment
- Assessed the construction impact of Metsemotlhaba and Kolobeng Dams.
- Provided core funding to Kalahari Conservation Society.
- Funded extension to Maun Wildlife Training Center.
- Funded consultancies to determine staffing needs for strengthening of Department of Wildlife and National Parks, and Tourism Development Unit.
- Assisted development of the National Conservation Strategy by providing IUCN technical advisor for 18 months.
- Provided technical assistance and infrastructure development, including borehole drilling and equipping in the Central Kalahari Game Reserve.(1987-1990).
- Supported 1986 workshop on use of microcomputer models for environmental planning.

### Norwegian Agency for International Development (NORAD)

NORAD has supported development of the National Conservation Strategy and is involved in settlement of Remote Area Dwellers (San, Basarwa). NORADs natural resource emphasis is in forestry.

### United Nations Development Program (UNDP)

The UNDP assumes the lead in donor coordination in Botswana, a critical area. UNDP funding has provided logistical support to development of the National Conservation Strategy, helped fund a Botswana Society sponsored national seminar on the NCS in 1987, provided equipment and Training Officer for Maun Wildlife Training Center 1975-85, and UN Volunteers at KCS to work on Environmental education of primary school children. UNDP has also cofinanced with Netherlands a Soil Mapping and Advisory Service (1982-90).

### United Nations Environment Program (UNEP)

It was the UNEP 1983 Clearing House Mission which identified numerous environmental priorities, including development of a National Conservation Strategy for Botswana. UNEP is also promoting an Action Plan for the Zambezi River System to involve riparian states in coordinated management of the riverbasin system. In 1987, UNEP helped fund three MOA seminars on desertification control, in cooperation with the FAB and University of Botswana.

**UN Food and Agriculture Organization (FAO)**

FAO conducted a survey of "Training for the Development of the Water Resources and Agricultural Production in Botswana" in 1972, and an investigation of the Okavango Delta as a primary water resource for Botswana in 1978.

FAO also sponsored a 1982-85 range management project dealing with process of range restoration and forage crops in association with arable farming and is funding a 1985-87 computerized hunting licensing control system, executed by KCS in Maun.

**Key References for this Chapter: as noted in text**

## CHAPTER 5.

### ECONOMICS OF CONSERVING BOTSWANA'S BIOLOGICAL DIVERSITY AND TROPICAL FORESTS

Maintaining biological diversity is a legitimate social goal in its own right but in addition often pays handsome economic benefits as well. While many of the benefits of conserving biological diversity will occur in the future - in the form of new uses for plants or animals, or in options for ecosystem uses not presently envisioned - many of the benefits accrue immediately. In Botswana, some of the most important near-term benefits of maintaining biological diversity involve range resources, timber and veld products, and tourism.

#### 1. The Range

Maximizing productivity of natural range and conserving biological diversity are complementary activities in Botswana. Many areas of the country are affected by overgrazing which reduces both range productivity and biological diversity. The long-term economics of conserving rangeland biological diversity are therefore very positive.

Maximal productivity of rangeland is achieved at stocking rates just below those which cause serious range degradation. Stocking rates as little as half again as great as the optimum rate can cause complete range deterioration and render the range completely non-productive. Figure 8 illustrates this phenomenon, showing that overstocking above the optimal level results in rapid loss of productivity.

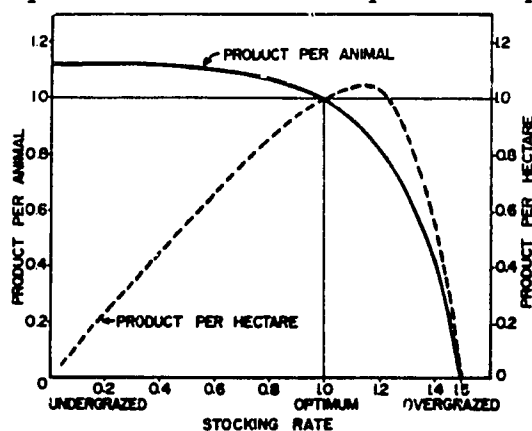


Figure 8. Product per animal and per hectare in relation to stocking rate. Units on all axes are ratios of actual to optimum values; therefore the value 1 indicates the situation in which actual stocking and product are optimum. Ratios permit plotting both curves on the same scale. (Adapted from Mott, 1980.)

A promising economically productive alternative to overgrazing is wildlife utilization. Wildlife viewing and safari hunting are primary contributors to the estimated 20-25 million Pula currently contributed to Botswana's GDP by wildlife

utilization. Subsistence use is also economically important. The capacity for increase in wildlife utilization's contribution to GDP is substantial. It has been estimated that wildlife utilization could contribute up to 50 million Pula to GDP within the decade, and nearly 100 million Pula within 20 years. Wildlife utilization therefore has the potential to make a significant economic contribution very consistent with maintaining range quality and biological diversity. Combining improved range management under cattle with increased economic return from wildlife utilization holds the promise of maximizing the economic output of Botswana's range in a fashion which maintains biological diversity and which can be sustained into the future.

The same range deterioration which is devastating for economic productivity also has serious consequences for biological diversity. Completely unproductive range is also generally completely barren of vegetation. This situation, which is not uncommon in Botswana, represents a severe local reduction in biological diversity. This diversity may be restored, either from soil seed source or recolonization from neighboring areas, just as range productivity may be restored. However, successive and continuous overgrazing will eventually lead to complete biological degradation, from which it will be difficult to restore either biological diversity or economic productivity.

Overgrazing is widespread in Botswana, and even with the recent herds size reduction due to drought, the national herd is expected to exceed 4 million head by the turn of the century. Land around boreholes may have reduced productivity for up to a 20 kilometer radius.

Although overgrazing is harmful to economic productivity, national revenues have not yet been damaged by overstocking practices for several reasons. One major reason is that offtake has not been sufficient to maximize productivity, and this has masked the lost revenue due to overgrazing. Another key reason is that grazing is continually expanding to new areas. The increased productivity coming from the newly developed areas also masks the loss in productivity in the older, degraded areas.

If the long-term economic return of range resources in Botswana is to be maximized, both these trends need to be reversed. Offtake must be increased to an economically maximal level, and new grazing areas should not be developed until means are established to adequately manage existing areas. Much of the productivity of Botswana's rangeland over the past ten years has been capitalized into an expanded national herd. Unless this herd can be managed sustainably, that productivity will have been wasted. If destruction of grazing areas followed by expansion into new areas continues, eventually the point will be reached at which there are no new areas for expansion, and the system will collapse. There will be insufficient range productivity to support the national herd and die-off will result.

If the situation is allowed to reach this point, recovery will be very difficult. Seed stores in soils will be largely depleted, and productive areas capable of

supplying recolonizing vegetation to degraded areas will be few. Herd size will be permanently reduced, and a long time stream of potential economic benefits will be lost. Conversely, managing range to maximize productivity coupled with increased offtake, can maximize economic returns to Botswana's rangeland.

Because overstocking of as little as 1.2-1.4 times the optimal rate can cause up to a 50% loss of productivity, the economic consequences of overstocking can be severe. As discussed above, Botswana is not maximizing economic productivity of its range for several reasons which mask the damaging effects of overstocking and range degradation. If other range productivity factors were optimal, the economic consequences of even the current level of overgrazing would be substantial. Remote sensing analysis suggests that over one fifth of Botswana suffered from range degradation at the end of the 1981-87 drought. Degradation sufficient to be detected by remote sensing is likely to result in productivity losses of up to 50%. Thus, Botswana may have lost 10-15% of the productive potential of its rangeland (in addition to the loss of productivity caused by the drought itself) due to overgrazing in the drought years. Since even the sub-optimal earnings from beef production were exceeding 100 million Pula/year in these years, this loss is substantial, perhaps on the order of 10 million Pula/year or more. This estimate is probably in fact low, since the percentage of degraded land in grazing areas is likely to be higher than the national average.

Therefore, while range use and environmental values are sometimes perceived as conflicting, this analysis shows that they are in fact consonant. Avoiding overgrazing is crucial to both economic productivity and to biological diversity. A more diverse range is a more productive range, and in the extreme, diversity and economic return both approach zero in severely degraded range. Range managed for cattle will have a lower diversity than that managed for wildlife, but both will have much higher diversity (and economic productivity) than land severely degraded by overgrazing.

Both diversity and economic productivity have escaped irreversible harm due to the sheer size of Botswana's range resource. Localized overgrazing has not severely impacted either national biological diversity or national range income. However, local range income and local diversity have suffered, sometimes seriously. As the national herd expands, unless better management is instituted, there will come a time when the sum of local damage will be significant on a national scale. That time is rapidly approaching, and remedies will be exceedingly difficult if it is allowed to arrive unrestrained. For the benefit of both biological diversity and economic productivity, better management of Botswana's range is essential.

## **2. Conservation of Economically Important Ecosystems, Species and Germplasm**

### **Value of Veld Products, Bushmeat and Fisheries**

Veld products, bushmeat, and fisheries all depend on intact natural ecosystems for productivity. These products are therefore both economically important and important to the conservation of biological diversity at the ecosystem level.

The indigenous biological resources in Botswana are important not only in terms of environmental quality and biological diversity, they also play a significant role in the economic and physical well being of the citizens of Botswana. Indigenous plant and animal species are important sources of food or as raw materials used either for individual or household needs, or for artisanal uses and income generation. Poorer people may rely on veld products as supplemental food sources, or for income generation, either through manufacture or sale of diverse items. In the case of Remote Area Dwellers not reliant on government support programs, veld products are the main source for food and other subsistence needs.

For the sake of this report, veld products are considered to include all wild or naturally occurring biological products that have potential human uses. This includes wildlife, insects, and plants or plant materials used in traditional building or other artisanal uses.

The identification of useful species, and the quantification of their utilization and relative economic value is a difficult undertaking at best. The uses for some species may be guarded or secret information; an example being medicinal plant or animal species that may be known only by traditional healers, who may not be willing to disclose their specialized knowledge.

Even where species utilization information is not a guarded secret, quantification of individual or household use is not a simple matter. Hunting is the only example of the controlling and monitoring of non-commercial individual or household use of a veld product (wildlife). Even though hunters are required to report their eventual success, fewer than 30% of the licenses are actually returned, resulting in very limited information being available. Monitoring the use of other products that may only be used periodically as needed or that are only rarely available or periodically of exceptional abundance is virtually nonexistent.

The availability of individual veld products fluctuates according to environmental conditions, utilization intensity and other factors, many of which may be unknown. With increased human population, increased grazing pressure and farming intensity, and other developmental pressures, and because of inadequate conservation efforts, the productivity of the veld has been decreased, with a



concurrent reduction in the variety and abundance of some veld products. Reportedly the traditional concerns for careful utilization of veld products and their conservation are changing, and people are becoming increasingly careless in their exploitation or harvesting techniques.

There are over 50 species of wild animals that are hunted in Botswana, providing over 90 kg per person per year of protein in some areas, and contributing approximately 40% of the total diet. The estimated value of the game meat obtained for subsistence purposes in 1983/84 was 11 million Pula. This value fell to about 6 million Pula at the end of the 1981-87 drought, but is expected to climb to over 20 million Pula by 1991. The value of skins and trophies generated by hunting was on the order of .5 million Pula in 1986, and is expected to approach 1 million Pula by 1991.

There are at least 150 wild food plants, and numerous edible insects as well. The mokula palm is used for both basketry and wine making. A wide variety of plant species, and some insects, are reported to have medicinal uses. The NGO Thusano Lefatsheng has initiated a study which has reportedly identified approximately 100 indigenous plant species that may have uses in traditional medicine.

The value of veld products may approach 10 million Pula per year. Crafts such as wood carving are estimated to employ between 400 and 500 people per year. Basket production in Ngamiland has been reported to have generated 193,000 Pula in income for approximately 2000 women in 1985. In 1981 600 people harvested approximately 20 tons of grapple (Harpagophytum procumbens) in the Kgalahadi District, earning 50,000 Pula. The phane worm (Gonimbrasea belina) is sold for between 7.50 and 30 Pula per 32 kg bag, depending on abundance; the value of phane exported to South Africa in 1979 was estimated to be in excess of 1.4 million Pula. BGI bought 96 tons of silk cocoons in 1986, total value 280,000 Pula, and 400 tons in 1987 with a value of 600,000 Pula.

The grapple plant, phane worm, and cocoons of Gonameta spp. are the three veld products with established commercial markets. Other products with potential commercial value may be identified from the panoply of locally utilized veld products.

While hitherto an underutilized resource, the fisheries sector in Botswana has the potential of becoming a significant income and protein source for the rural inhabitants in the northern part of the country. There are two major aquatic systems: 1) the Okavango Delta, with a surface area of up to 10,000 km<sup>2</sup> and 80 species of fish; and 2) the Chobe River system, an extensive system of potentially productive fishing waters, with 45 species. The Chobe River system still has to be developed as part of the national fishery. There are also 250 artificial reservoirs that potentially could be developed for fisheries.

Not a traditional food source for several cultural groups, fish is being accepted more and more as a food, as a result of the Government of Botswana's promotional

efforts. The sector is receiving increased development emphasis, with the goal of increasing the total harvest and consumption level. Current harvest estimates are 1,700 tons/year for the Okovango. The sustainable harvest for the two systems, once developed, is estimated at 10,000 tons/year. In addition to being a good protein source for local needs, it is believed that the potential exists to develop export markets as well.

An estimated 1000 - 2000 people are involved in fishing for informal trade or commercial purposes and up to 12,000 people are thought to have some involvement in fishing activities in the Okavango Delta. Further development of the sector has the potential of creating employment for several thousand additional people, with additional annual receipts approaching 10 million Pula for the sector. Further development of the sector, including export of aquaria fish, aquaculture, commercial fishing in reservoirs, etc., could increase the total value for the sector to 20 million Pula per year.

Combined, fisheries, veld products, and bushmeat may generate added value in excess of 50 million Pula per year. This value is represented very poorly or not at all in estimates of gross national product (GNP). The value of these systems is also largely discounted in the traditional values of the people that rely on them, although disappearance of veld product species is a concern expressed in many NCS local meetings. Botswana attitudes towards veld products and wildlife tend to take these resources for granted as inexhaustible, even in the face of recognized limitations and shortfalls. These attitudes may lead subsistence users to overexploit and destroy these very valuable subsistence resources. Both for the preservation of biological diversity and for the future well-being of subsistence users, increasing education and awareness of the value of natural systems is vital in Botswana.

#### Value and cost of protecting timber species and Natural Woodland

The only commercial timber areas in Botswana are all located in the Chobe District. The commercial harvesting of timber is licensed, with the concessionaire paying between 7.75 and 30 Pula per m<sup>3</sup>, depending on the species. While there are five "principal" and nine "minor" species with commercial value, the two main species harvested are *Pterocarpus angolensis* and *Baikiea plurijuga*. The maximum annual cut permitted for each timber concession is 500,000 ft<sup>3</sup>/year (about 5000 m<sup>3</sup>), but actual harvest is much less. The royalties are 450,000 Pula per year, which is split between the government (40%) and the Land Boards (60%). Utilization and conversion is reported to be very wasteful. Much of the wood that is extracted is exported as unmilled materials, with minimal benefits returning to Botswana, either as finished materials, employment, or income. The lumber that is actually milled in country (maybe 12,000 m<sup>3</sup>/year between four operational mills) is processed using inefficient and wasteful equipment and techniques. There are only two forestry technicians and four forest guards assigned to the District. These people are responsible for all Forestry Unit activities within the District. No regular government

supervision at concession sites is practiced, nor is tree marking, and neither maximum or minimum cut requirements are enforced.

The return to the government from royalties and the level of employment resulting from harvesting and manufacturing are significant locally, but it is highly unlikely, given the low stocking rates of the preferred species and their slow growth, that sustained yield commercial forestry is possible over the long-term. In addition, economic viability of exporting raw logs ("peelers") for veneer is probably higher than for the small-scale inefficient processing possible in Botswana, and it is precisely raw log export which minimizes returns from the activity to Botswana.

Even using present practices, continued logging will almost certainly lead to depletion of commercial species and consequent local reduction in biological diversity. The present level of development seems to exceed long-term sustainable potential, raising questions of unemployment impacts or severe biological damage in the long-term.

Present practices are probably permanently altering forest structure, reducing biological diversity, and contributing little to value-added industry in Botswana. It would be advisable both economically and biologically to reduce present harvest until: 1) the resource is fully inventoried; 2) regeneration is better understood; and 3) processing and end-use industries are better developed in Botswana. Botswana's timber harvest is currently fueling industry in South Africa and Zimbabwe, neither of which will have timber to export to Botswana should wood-based industry develop in the future. Botswana would be well-advised to conserve its timber resources to supply high value-added processing in-country. Exporting raw timber to Zimbabwe and South Africa will deplete the resource, compromise biological diversity, and reduce the long-term base for economic diversification in Botswana.

Non-commercial uses of wood include fuel, construction, fencing, crafts, and other domestic uses. The domestic household wood supply comes almost entirely from natural vegetation. However, demand for some products, such as posts and construction wood exceeds local supply; 1984 imports of these products were valued at 11 million Pula.

While there are no accurate figures for annual wood consumption in Botswana, 1985 estimates were 34,000 tons/year for construction wood, 170,000 tons/year for kraal construction, and 204,000 tons/year for fencing. Another (local) study indicated that 35 kg of fresh wood was used for each meter of fence constructed. The annual per capita wood used for fencing was 780 kg dry weight, or 1.5 times the average annual per capita consumption of fuelwood.

Wood shortages, for fuel, construction, and other uses, are a relatively recent, localized phenomenon. Two possible solutions have been proposed and tried, with very limited success; woodlots and natural woodland management. A total of 635 ha of exotic species woodlots had been planted by 1985; 233 ha by the Forestry Unit,

220 ha by the Kweneng Rural Development Association; the remainder by various small efforts. For the most part survival and growth have reportedly been much poorer than anticipated.

There have been at least two attempts at initiating natural woodland management. The first effort was part of the Matsheng Land Use Planning Project (30 ha of woodlot were planted). In 1986 the University of Botswana's National Institute for Research and Documentation initiated some natural woodlands management trials at Morwa Forestry (as well as an indigenous species woodlot trial). While initial results are promising, the trials are only 2-3 years old and are not far enough along for more thorough evaluation.

### 3. Tourism

Most tourism revenue in Botswana is generated from activities which rely on wildlife and are complementary or beneficial to conserving biological diversity. This revenue is vital in providing an economic incentive for preserving biological diversity and in contributing to the nation's economy.

Tourism is one of the five most important economic sectors in Botswana. In foreign exchange generation, tourism ranks fourth behind diamonds, beef and copper, and just ahead of textiles. The 40,000 tourists visiting Botswana in 1984 generated almost 10% of the country's formal sector employment. Underscoring the economic importance of this sector is the phenomenal growth which the industry has experienced in the past decade, more than doubling in the only four-year period (1981-1985) for which reliable figures exist.

Foreign exchange earnings from tourism were at least 16.9 million Pula in 1984. Because of limitations in the methods of study, an estimate of 20-25 million Pula is more realistic. Official government estimates of gross tourism revenues for 1983 ranged as high as 28 million Pula. This compares with the other four major foreign exchange earning sectors for that year listed in Table 3.

Table 3. Foreign Exchange Earnings - 1983  
(P million)

Diamonds	462
Beef	98
Nickel-Copper	68
Textiles	18
Tourism	20 (estimate)

Tourism generated approximately one fifth as much foreign exchange as livestock and almost one third as much as Copper in 1983. If tourism continued to grow at its 1981-85 rate of 32% per year, its contribution to Botswana's economy would be as high as that of beef by the turn of the century.

At the same time, tourism has grown with little help or guidance from government. This underscores the dynamic nature of the sector, but also raises questions about the means to manage tourism to maximum benefit. Detailed statistics on Botswana's tourists, their origins and spending patterns have not been routinely kept. The EEC has provided a consultancy to the Tourism Development Unit to begin to plan for a more comprehensive government management program, but presently the Unit is vastly understaffed and unable to maintain effective oversight, much less control, of an extremely important industry with clear potential for expansion.

Potential for expanding tourism exists at Gemsbok National Park, Chobe National Park, and in the Limpopo River-Tuli Block region. Limited but real potential also exists for near term expansion in the Central Kalahari Game Reserve (particularly the Khutse extension) and, with proper planning, the Moremi Game Reserve.

Gemsbok National Park has the potential to attract both South African and international tourists to the Botswana side of a park that is now visited exclusively from the South African side. This will require development of visitor facilities, a process which is already underway. It will also require the construction of roads on the Botswana side to attract visitors from the South African park. The joint border road should remain accessible to visitors from either side, but Botswana entry fees should be required for access to roads extending to the east toward Mabuasehube Game Reserve. International tourism can be accommodated if charter air service is available to the existing airstrip and private enterprise zone for vehicle rental is provided at the site.

Additional development in Chobe National Park can be facilitated by the improvement of the Nata-Maun road and improvement of park roads to accommodate two wheel drive vehicles of local tourists. Expansion of activities in the Limpopo-Tuli Block region should be based on existing private enterprises and on consideration of establishing an official protected area in the region.

Air tourism of the Central Kalahari can be developed, and improving tracks into the Khutse Game Reserve holds excellent potential for Gaborone-based vehicle tourism. Tourists come to Botswana to see the Kalahari, and with improvement of the Khutse road, the Kalahari is only four hours from Gaborone. Developments in the Central Kalahari or Khutse should be predicated on an increase in Wildlife department staff adequate to deal with the challenges presented by additional access.

Further development of Moremi and the greater Okavango region is extremely possible, but here, more than any other region, careful government planning is essential. Both intensive and further extensive development is possible within the delta. Currently, most lodges are in the Moremi area and have a capacity of 16-20 guests. Larger developments could be established outside the reserve, but may require special leasehold arrangements. Moremi proper is probably near saturation, and any further tourism development should be carefully evaluated for impact on the reserve. Government control of expanding tourism in this area is vital if the wilderness values on which the industry is based are to be preserved. Over 50% of the private sector jobs in Ngamiland derive from tourism, and deterioration in the industry would have serious local impacts. The proposed Okavango Wildlife Management area is essential to realizing increased development in this region and should be gazetted as soon as possible.

To ensure that Botswana realizes maximum economic benefit from tourism with minimum social and environmental costs, a more intensive tourism monitoring and managing effort is needed. Botswana has been largely fortunate to have benefited from rapid tourism growth with relatively few negative consequences, but this cannot be expected to continue indefinitely without a more active government role in planning and development. Villages springing up within protected areas in response to staffing demands of lodges is one example of problems which will require careful government management if the industry is to develop constructively in the future. At the same time, the vigor of the industry with the present minimal government involvement argues for keeping government intervention modest.

Tourism has a major role to play in the economic future of Botswana. Tourism development has proceeded to date largely outside of government influence. The time has come to begin government oversight. Expansion of tourism in all the areas discussed above is contingent on positive government action, whether in road construction, management, or protected area establishment. Tourism in Botswana will grow in the absence of government involvement, but it will grow in an uncontrolled way and will not realize its full potential. Careful government action can ensure an orderly growth of the tourism industry which will provide a major input to the nation's economy and contribute significantly to conservation of biological diversity.

Key References for this Chapter: 2, 11, 13, 33, 37

## Chapter 6.

### ACTIONS TO BE CONSIDERED FOR THE CONSERVATION OF BIOLOGICAL DIVERSITY AND TROPICAL FORESTS IN BOTSWANA

One objective of this assessment is to assist USAID/Botswana in developing a statement of the actions necessary to preserve biological diversity in Botswana, as required by the United States Congress. While it is not possible to list all actions necessary to maintain biological diversity in a country, the most prominent necessary actions can be identified, and the most important of those highlighted as major issues in biological diversity. For Botswana, three major issues emerge: establishment of Wildlife Management Areas, extending protected areas coverage and interconnections, and management of water resources. In addition, two issues of long-term importance, 'issues of sustainability', stand out as critical to maintaining biological diversity once the more pressing 'major issues' are addressed. These 'issues of sustainability' are conservation education, and economic benefit derived from tourism. The long-term foundation for biological diversity maintenance lies in citizen awareness of the value of biological diversity and in direct economic returns from activities which depend on biological diversity. Together, the major issues and issues in sustainability will determine the greater part of Botswana's success in maintaining its biological heritage. Coupled with the other actions identified, the outline of a program to conserve biological diversity can be discerned.

#### 1. Major Issues

The major issues in biological diversity in Botswana revolve around immediate land-use decisions. Decisions made in the next decade will profoundly affect the future of biological diversity in Botswana. These decisions involve Wildlife Management Areas, protected areas interconnections, and water, particularly borehole, management.

#### Wildlife Management Areas

The proposed Wildlife Management Areas (WMAs) are crucial to preserving biological diversity in Botswana. The establishment of these areas is far from assured. Both local approval and official gazetting have yet to be achieved. Management of WMAs is expected to be compatible with maintaining relatively intact ecosystems. Because Botswana's ecosystems are diffuse and extensive, large areas are required to permit adequate preservation of functional examples. Botswana's large protected areas system responds to that need, but the areas required by Botswana's ecosystems dictates that no preservation system would likely be large enough to preserve representative samples. Therefore, sustainable productive uses compatible with ecosystem conservation are essential if representative samples of functioning Botswana ecosystems are to be preserved.

Wildlife management areas present just such an opportunity. These areas are also important in augmenting ecosystem coverage and in providing migratory corridors for water-dependent herbivores (see below). Because WMA's are compatible with Bushmen use, wildlife conservation, and tourism, they are Botswana's most important multiple use areas. Without WMAs, protected area coverage of Botswana's ecosystems is less complete (see below) and populations of migratory game face a high likelihood of disappearance. The establishment of the proposed WMAs should be supported at every level of government.

### Protected Areas Coverage and Interconnections

Botswana's spatially extensive ecosystems require, and have received, an extensive protected areas system. Figure 3 shows the protection coverage provided to Botswana's ecosystems by National Parks and Game Reserves. Figure 5 shows the coverage provided by parks, reserves, and proposed Wildlife Management Areas. Even including WMA coverage, 4 habitat types remain unrepresented. Extending protected area coverage to the Shashe-Limpopo triangle, the Notwane-Limpopo area, Hill Woodland areas, and the permanent Okavango swamp would bring permanent Okavango swamp, eastern Mopane bush and savanna ecosystems, and Hill Woodland into the protection system. Biogeographic coverage of large habitat divisions would then be complete in the Botswana system.

An expansion of Botswana's protected area system is therefore desirable if preserving a representative sample of the nation's ecosystems is a national goal. Figure 8 shows potential areas where protected area establishment would complete biogeographical coverage of Botswana's protected areas system.

In addition to biogeographic coverage, which is based primarily on vegetation type, Botswana's protected area system could appropriately be augmented to make allowance for migratory and water-seeking movements of animals. The ability of large animals to move to water is especially critical in drought periods. Wildebeest and other water-dependent herbivore populations go through population "bottlenecks" in times of drought, when species numbers are greatly reduced. If the number of animals surviving a drought is very low, populations will be slow to recover. If access to water and ability to move are too restricted, species may die out altogether. Successive droughts may also lead to local extinctions if a remnant population that has survived one drought is too small to retain a viable breeding population through another dry period.

Keeping movement corridors open is then extremely important if Botswana's large water-dependant herbivore populations are to be preserved for the future. Major corridors could be established between the major protected areas of the country. Connection between the Gemsbok National Park and the Central Kalahari Game Reserve and between the Central Kalahari and water points in the north are particularly important. Map 4 shows the major corridors of importance. Map 5 shows the contribution of the proposed Wildlife Management Areas to the needed corridor system. Corridors between Gemsbok and the Kalahari and between the Chobe and pans areas would exist if the WMAs are gazetted. Still absent is a connection between the Kalahari and the pans or between the Kalahari and



the Moremi-Chobe system. These corridors do not have to accommodate large numbers of animals. They are intended instead to permit the survival of core populations of animals which can recolonize or temporarily occupy the more extensive protected areas in times of better rainfall. For instance, Zebra once occurred in the Central Kalahari Game Reserve, but are now locally extinct. A corridor between the Central Kalahari and Makgadikgadi Pans Game Reserves would permit this population to re-establish. Corridors are also important in maintaining exchange of genetic information between the populations of the individual protected areas.

To establish wildlife corridors, the Government of Botswana would need to gazette protected areas in the corridor zones, and to provide fencing where the zones traverse areas of high human habitation or livestock use. The most appropriate protection status for corridors is probably Wildlife Management Area, since only minimal free passage of wildlife needs to be provided by these areas. Human habitation is consistent with the corridors if hunting is controlled (prevented in times of drought) and livestock are excluded by fencing.

A further impediment to functioning corridors is the existence of Veterinary Cordon Fences. These fences are as important for the protection of wildlife from competition with livestock as they are to containment of livestock disease. Accordingly, Veterinary Fences should be managed jointly by the Department of Veterinary Services and the Department of Wildlife and National Parks. A joint panel between wildlife and veterinary services might appropriately be established to review all new proposals for fences and to review the existing fence system for effectiveness in both disease control and wildlife conservation. In particular, an effective corridor system will require realigning fences in the Chobe-Okavango-Kalahari region. This realignment need have no negative effect on veterinary disease control.

Protected area extension to the Shashe-Limpopo triangle, the Notwane-Limpopo area, Hill Woodland areas, and the permanent Okavango swamp is important for a theoretically sound preservation system. Establishment of corridors is important to ensuring continued populations of large water-dependant herbivores (Wildebeest, Wartebeest) in Botswana. Botswana already has an excellent international reputation for protected areas which contributes significantly to its tourism attraction. With extension of coverage to all habitat types, Botswana could well boast one of the worlds most comprehensive protection systems. Botswana's famous Wildebeest populations also have a major contribution to its tourism reputation, and wildlife corridors are vitally important to preserving these populations through drought.

### Water Management

Botswana's greatest biological diversity lies in the water-rich areas of the Okavango and Chobe. The arid nature of the rest of the country makes water the controlling factor in land use in the country. These two factors dictate that water management is of primary importance in safeguarding biological diversity in Botswana.

Proposed developments for the Okavango and Chobe vary dramatically in technical and

environmental soundness. Poorly planned, wasteful development of these resources may severely damage biological diversity in Botswana. The tourism industry of northern Botswana may also be severely impacted if water development is not carefully planned and executed.

The Government of Botswana has demonstrated admirable foresight, restraint, and attention in these respects. No major development has been permitted in the Chobe or Okavango to date, and government plans call for developing a Water Master Plan to guide development.

Conversely, in spite of considerable government attention, water management in the open range is an immediate concern. Borehole restrictions and 'freezes' have gone largely unheeded, and the level of range degradation and the rate of spread of range degradation is a matter of legitimate national concern. Control of range is largely through control of water, and ultimately, control of range degradation is most likely to be achieved through control of water sources.

Limiting number, spacing, and output of boreholes are all options which should be considered. Though a formidable task, counting and monitoring of boreholes can be accomplished where it is likely that similar exercises with highly mobile livestock would be impossible. Enforcing water point controls is much more tractable than enforcing stocking limitations. The exact program of water point management best for Botswana should be the subject of careful study, but at the same time, important actions can be taken immediately. Building of a staff and program for water point inventory and monitoring is a major first step. Simple water point limitations can be applied to halt deterioration in the most severely affected areas. Registering and regulating drilling operators is also immediately feasible.

These actions, along with a carefully developed program of water point control based on ecological principles and maximization of economic return can help assure both the maximal economic productivity of Botswana's range resources and the maintenance of biological diversity.

## 2. Issues of Sustainability

Sustainable conservation of biological diversity requires, above all else, an aware public and economic incentives to conserve. In Botswana, public awareness is very low and tourism will be the primary economic return to conservation of biological diversity. Therefore, conservation education in the formal education system and through informal channels and careful and productive development of tourism are vitally important to conserving the nation's biological diversity.

## Tourism

Tourism is one of the mainstays of Botswana's non-mining economy. As mining income is projected to stabilize in the near future, Botswana's economic growth will depend on development of tourism and other non-mining sectors. Botswana's preservation system holds a vast and largely undeveloped tourism potential. If this potential remains unrealized, one of the major economic incentives for maintaining the protected areas system and biological diversity will be lost. Tourism development can play an important economic role in Botswana, and at the same time provide important support for wildlife preservation and the maintenance of biological diversity. The government should be encouraged in its intent to take a more active role in promoting and controlling tourism.

Integral to development of tourism is increased staffing and management of protected areas. Improved access, increased visitation, and enhanced demand for services all require upgrading of the management capability of the wildlife department. Increased tourism cannot be maintained without conserving the wildlife and natural base which is the foundation of virtually all leisure tourism in Botswana. To preserve the tourism resource and the integrity of protected areas, the government of Botswana should consider increasing staffing levels and training opportunities within the wildlife department dramatically.

## Conservation Education

Conservation education is vital in any country in which biological diversity is to be preserved. People ultimately conserve or destroy biological diversity, and it is people's attitudes towards biological resources which will determine the fate of a nation's ecosystems, species, and genetic resources.

This is particularly true in Botswana, where population pressure has been extremely low and abundant wildlife and veld resources have long been taken to be inexhaustable. Even in the face of drought and greatly reduced wildlife availability for subsistence use, concern about conservation of subsistence resources is very low in Botswana. Paradoxically, Botswana tend to deplete wildlife resources on which they depend for meat, and to conserve cattle which often provide a lower percentage of their diet.

Range management is also very poorly appreciated in Botswana. As more and more cattle owners stock more and more cattleposts, the overall productivity of Botswana's range is seriously threatened. This will not have an immediate impact on individuals contributing to overstocking, but it will have serious negative impacts on the national economy and welfare.

Education in these and other conservation issues is vital if Botswana is to maximize productive use of its natural resources and preserve biological diversity. Such education, leading to grassroots understanding and support for conservation, must be the long-term foundation of conservation of biological resources in the nation. Education and awareness should be fostered in the formal primary, secondary and university education system, as well

as in the popular media and through rural conservation activities which yield tangible and timely results.

Botswana is a country approaching a level of affluence where the focus of individuals and families will begin to shift from subsistence to maximizing happiness. Aesthetics of nature and maximizing productivity of natural resources take on new importance in this milieu. Conservation education can thrive under these circumstances, but it will not spring up of its own accord. Careful government and donor programs can establish successful conservation education efforts which will fundamentally affect the attitudes, actions, and resources available to coming generations. These programs may be initiated now with the expectation of excellent results.

### 3. Actions Necessary

A complete preservation system for biological diversity in Botswana would require expansion of the protected areas system and upgrading of management. Sustainable use of biological diversity in the context of overall resource management could be enhanced by a number of resource-related actions.

Specific actions to be considered in preservation include:

Establishment of protected areas in the Shashe-Limpopo triangle, the Notwane-Limpopo area, hill ecosystems, and the upper Okavango.

Full coverage of ecosystem type is one of the goals of an effective preservation system. Extending coverage to the areas identified would help achieve this goal in Botswana.

Establishment of Wildlife Management Areas currently proposed.

Botswana's extensive ecosystems and wide-ranging game require protection that can only be provided by compatible multiple use of lands. Wildlife Management Area is the government's land use classification which permits multiple use consistent with wildlife conservation, and gazettment of these proposed areas is vitally important to conservation of biological diversity in Botswana..

Establishment of wildlife corridors from the Central Kalahari Game Reserve to the Nxai Pans and Okavango areas.

Closely associated with the issue of wildlife management areas, the establishment of wildlife corridors would help protect Botswana's large, water dependent herbivores, particularly Wildebeest, from the threat of local extinction during drought. With the preservation of core populations through corridor connections to water resource areas, these populations can reestablish to levels which brought Botswana international tourism reknown prior to the 1981-87 drought. Borehole development may substitute for some previously available water sources, but corridors are still necessary to provide for genetic exchange between isolated reserve populations and to prevent local overpopulation deaths and wildlife-caused desertification.

**Creation of a joint Department of Veterinary Services-Wildlife Department commission to administer cattle-free zones and govern alignment and realignment veterinary/wildlife fences.**

Cattle-free zones and cordon fences are now as important in wildlife management as in disease control in Botswana. Since livestock income is likely to stabilize in the future and tourism revenue is likely to increase, the role of cordon fencing in wildlife viewing and hunting industries should be formalized in the administration of cordon fences. A joint commission of the two relevant departments will permit effective management of the cordon fence system for both disease control and wildlife management. Such a commission might appropriately review existing fence alignments for effectiveness in both disease control and wildlife management immediately upon its creation.

**Increase in number and training of Wildlife Department personnel.**

Wildlife personnel per hectare of protected area is very low in Botswana. This reflects the remote and undeveloped nature of the country's extensive reserves. As tourism and general economic development grow, more and more sophisticated management will be required. This requirement must be anticipated if damage to protected areas during 'staffing-up' is to be avoided. Action now to upgrade staff numbers and training will ensure that the Wildlife Department will be able to accommodate increased tourism and wildlife utilization in the future without compromising biological diversity.

**Specific actions to be considered in sustainable use include:**

**A major initiative in borehole management.**

A major program of management of borehole drilling, spacing, and drawdown would be extremely beneficial economically and would greatly benefit conservation of biological diversity. There is currently virtually no control of borehole drilling, leading to a land use free-for-all. A permitting and monitoring system is badly needed. An alternative to spacing limitations may be yield restriction. Borehole yield might be controlled by specifying pump type (i.e., wind, diesel) or size (i.e. hp). These restrictions could be readily enforced and graded to range carrying capacity. Borehole spacing can be much less restrictive if yield is restricted on individual bores. Incentives to uncontrolled drilling will also be reduced if borehole yield is regulated and enforced. Such a program of borehole monitoring and management would serve to simultaneously check impairment of biological diversity and prevent loss of cattle production potential.

**Improved implementation of Land Use Plans**

Botswana has an excellent land use planning system which emphasizes local involvement and central coordination. Development of Land Use Plans in Botswana is a model exercise. Implementation of these plans is seriously limited by lack of manpower and equipment. Land Use Plans are frequently well represented on paper but only sketchily implemented on the ground. Improved manpower assigned to land use plan implementation is essential if the carefully constructed land use plans of Botswana are to be effective in the vast countryside. Vehicles and other equipment are also essential if the demarcations of land use maps are to be verified on the ground.

A unified program to strengthen implementation of land use plans would render significant benefits to natural resource use, economic productivity, and the conservation of biological diversity.

**Development of an international agreement guaranteeing water supply to the Okavango.**  
Natural water supply to the Okavango is crucial to fisheries, tourism, and other major economic uses of the Delta. An international agreement could ensure that upstream diversions do not deprive Botswana of this important economic and natural resource. The most likely vehicle for such an agreement would be the RAMSAR convention for the protection of wetlands of international significance. Botswana would clearly benefit from becoming a signatory of this convention and pursuing water supply guarantees for the Okavango in recognition of its status as a wetland of international significance.

**Improvement of Forest Management in the Chobe District.**

The unique timber resources of the Chobe District are being damaged by high elephant populations and unsustainable harvesting practices. Timber harvest in the Chobe should be examined closely with respect to biological and economic sustainability, and compared with other options, particularly the areas burgeoning tourism potential. High elephant population in the Chobe District represents a distinct economic asset which may be sustainably exploited. Culling should be considered in compliance with IUCN ivory control quota procedures and include taking of tuskless and one-tusked animals to avoid generating selective pressure for these recessive genetic traits.

**Development of veld products and wildlife utilization options.**

With tourism, wildlife and veld products utilization hold the greatest potential for generating economic return from Botswana's natural ecosystems. Veld products and wildlife can be harvested in ways which conserve biological diversity. Organized and well-managed wildlife and veld products utilization should be promoted to maximize economic potential and consistency with maintaining biological systems and conserving biological diversity.

**Production of a good, nationwide vegetation map**

Vegetation mapping for much of Botswana is incomplete. Far from being an academic exercise, vegetation mapping is vital to planning sound land use, estimating range capacities and managing timber resources. Vegetation mapping and resource inventories are vital to maximizing sustainable use of biological resources in Botswana. Without an effort to map at least high priority areas, some of the nation's biological diversity may disappear before it is ever identified.

### **3. Opportunities for AID Involvement**

AID/Botswana can contribute to conservation of the nation's biological diversity in a number of ways. This subsection will lay out the broad areas of opportunity for AID, the following report section will elaborate specific AID actions in support of these opportunities.

The following opportunities are suggested for AID/Botswana contribution to biological diversity conservation.

### National Conservation Strategy

No action in the next decade will be more important to biological diversity in Botswana than the implementation of the National Conservation Strategy (NCS). This strategy will aim to make wise use of all of Botswana's natural resources, and in so doing will make maximum room for maintaining biological diversity while realizing the nation's full economic potential. AID has supported the NCS process and can continue to do so. In addition, AID can carefully consider supporting specific implementation actions of the strategy when it is formally released.

### Training

Both degree and specialized short-term training in a broad range of fields can have an important impact on biological diversity conservation in Botswana. In-country and international training in wildlife management, tourism, agricultural germplasm conservation, and education can all have a very beneficial influence on the capacity of Botswana to better manage the nation's natural resources. AID has existing training programs which can contribute to this need immediately.

### Education

Conservation education is a critical component of national environmental awareness. No contribution is more important to long-term conservation than an aware and well-informed citizenry. Conservation education is established in Botswana and can be significantly strengthened with modest inputs. Assistance is needed in both curriculum development and integration and in disseminating existing conservation curricula. AID's education projects have the capacity to contribute to curriculum development in conservation, and AID/Peace Corps collaboration can be used to disseminate conservation education curricula to classrooms throughout the country. Only a modest refocusing of current AID efforts could result in a major contribution in this area.

### Policy Dialogue

The Government of Botswana fully recognizes the importance of the nation's wildlife and natural areas. However, biological diversity is a broad and complex concept, and implementing development consonant with maintaining biological diversity is

a difficult task. Donors have a role to play in maintaining policy dialogue with the government on this issue, to be aware of government needs for technical assistance and in helping to resolve potentially difficult development issues. Continued support for the National Conservation Strategy can be an important part of this dialogue, and USAID dialogue with other donors is important to ensure constructive and organized donor support to the government in this important field.

### Planning

Timely assistance for small planning studies can be of great assistance to the government of Botswana in managing natural resources in specific areas. Local planning needs sometime exceed government regular capabilities, and in these instances timely donor assistance can be very valuable. AID has already contributed in this field with funding of the planning study of the Ngamiland Stateland. Future similar efforts can be equally rewarding and can be made a regular, if not continuous, aspect of AID involvement in natural resources and biological diversity.

### Tourism and Protected Areas Planning

Tourism and protected areas planning is an area of particular importance in Botswana. Donor involvement exists and is continuing in this field. Growth in the field indicates that increased donor involvement in the future can be productive. This is a particular sector in which AID may want to investigate the possibility of further involvement. A need currently exists for timely technical assistance in planning and management of tourism and wildlife. The soon to be established Wildlife Management Areas will require complex multiple use planning, as will existing parks and protected areas if increased tourism is to be accommodated in an orderly fashion. A broadly-based, highly responsive assistance effort addressing everything from stocking rates in Wildlife Management Areas to tourism capacity in national parks would be very beneficial.



## Chapter 7.

### CURRENT AND PROPOSED AID/BOTSWANA ACTIONS TO CONSERVE BIOLOGICAL DIVERSITY AND TROPICAL FORESTS

USAID has existing involvement in education and training, and a program focus in rural employment. These Mission emphases point suggest roles for USAID in conserving biological diversity in Botswana.

Current USAID/Botswana actions to conserve biological diversity are:

- Supported local participation in the NCS development through provision of a six month consultancy in which rural villages and local governments were systematically canvassed to identify conservation problems and solutions.
- Cosponsored with UNDP a February 1988 workshop on the NCS and its implementation.
- Requested and coordinated with GOB and local NGO authorities, the visit of US NGO representatives to gain a first hand impression of environmental problems, and efforts to solve them, in Botswana.
- Supported Botswana participants in the USDA-Forest Service International Forestry Seminar, and the USDA-National Park Service International Parks, in Arid Lands Seminar.
- Funded the Kalahari Conservation Society, in cooperation with the Ministry of Local Government and Lands, to prepare a Proposed Land Use Plan for Ngamiland Statelands.
- Initiated the search for a Senior Training Officer for a two-year AID-funded contract through the Academy for Educational Development to work at the Wildlife Training Center in Maun.
- Funded a National Crop Protection Center in the Ministry of Agriculture to help coordinate efforts to control the quelea bird and brown locusts.
- Initiated a land use plan for the Matsheng Villages area, which included supplementary woodlot plantation species trials, designed to eventually relieve pressures on the primary natural woodlots in an area of degraded tree savanna.
- Supported development of a permaculture (organic Farming) project to encourage soil conservation along with development for low resource farmers.
- Agreed with Peace Corps to a pilot initiative to sponsor a scholarship (under the BWAST Project) for a GOB designated Motswana to study park planning and management. A Peace Corps volunteer will fill the post while the training is taking place, and Peace Corps

will train a counterpart to serve as deputy to the degreed person upon their return. Other such opportunities are being explored.

- Submitted with its FY 89 Congressional Presentation a "shelf item" (633-0249) on natural resources management which would support the National Conservation Strategy, develop and train technicians, further assist in sustained management of forest and range management through District level integrated land use plans, and cooperate closely with Peace Corps and NGOs to develop overall natural resources management prescriptions.

- Supported this Biological Diversity and Tropical Forests Background Assessment, and requested both REDSO/ESA and AID/W assistance to help make any resultant programming compatible with the NCS when released.

For the future, various scenarios for USAID involvement in maintaining biological diversity can be envisioned, three of which are outlined below.

#### Option A - No Change

USAID/Botswana may continue with no change in present programs and still make a number of positive contributions to preserving biological diversity.

#### Option B - Increased Emphasis within Present Activities

A second option for the Mission is to maintain present activities, but increase emphasis on natural resources and biological diversity in directing those activities. This can be accomplished through increased emphasis on conservation curricula in education projects and increased emphasis on natural resources skills in training projects.

#### Option C - Country Program in Natural Resources

Under the AID Africa Bureau Plan for Supporting Natural Resources Management in Sub-Saharan Africa, USAID/Botswana has the option of developing a country natural resources action program. This program can be developed without regard to current staffing or budget levels, and can therefore include new activities which are beyond the Mission's present resources.

Should the Mission exercise its option to develop a country natural resources action program, it could be based almost entirely on the recommendations of the National Conservation Strategy and this assessment. New activities under the provisional action program could be suggested in tourism and protected areas planning or conservation education. Such activities would complement the National Conservation Strategy and the Mission's rural employment program focus, and at the same time contribute tangibly to improved natural resource management and the maintenance of biological diversity in Botswana.

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**APPENDIX I**

**TEAM CONTACTS DURING BOTSWANA VISIT**



## TEAM CONTACTS DURING BOTSWANA VISIT

### U.S. EMBASSY

Natale Bellocchi, Ambassador  
Johnnie Carson, Deputy Chief of Mission

### U.S. AID

John Hummon, Mission Director  
John Roberts, Assistant Director/Programs  
Paul Daly, Agriculture Development Officer  
William Elliott, Project Development Officer  
Ann Domidion, Human Resources Development Officer  
Robert Hill, Research and Extension Officer, Agriculture  
Technology Improvement Project (ATIP)  
D. Norman, Manager, ATIP  
Naraine Persaud, Soils Scientist, ATIP/INTSORMIL

Dave Gibson, Regional Forestry Advisor REDSO/ESA (Nairobi)  
Ed McGowan, Regional Environmental Officer REDSO/ESA (Nairobi)

### U.S. PEACE CORPS

Lloyd Pierson, Director  
Kim Ward, APCD/Programs and Training  
C. Binke, APCD/Natural Resources  
Bruce Burwell, OTAPS, Washington, D.C.

### MINISTRY OF AGRICULTURE

#### Department of Field Services

Sandy Alidi, Chief Forestry Officer, Forestry Unit

#### Department of Veterinary Services and Tsetse Control

M. G. Mosienyane, Director

#### Department of Planning and Statistics

Elizabeth Muggeridge, Agricultural Economist

**Department of Agricultural Research**

Lucas Gakale  
Tabé Tietema, Germplasm Section

**MINISTRY OF LOCAL GOVERNMENT AND LANDS**

**Department of Town and Regional Planning**

Anderson Chibua, District Commissioner, Ghanzi  
Seeletho Tiro, Acting District Commissioner, Maun  
Seiso D. Liphuko, Director of Town and Regional Planning  
Nigel Hunter, Chief Planning Officer (National Coordinator Land  
Use Planning)  
Victor Rantshabeng, Planner

**MINISTRY OF COMMERCE AND INDUSTRY**

**Department of Wildlife and Parks**

K.Ngwamotsoko, Director  
M.L. Nchunga, Principal Wildlife Biologist  
M.P. Simbotwe, Senior Wildlife Biologist  
Joseph Matlhare, Wildlife Biologist  
N. Tlhalerwa, Director, Range Ecology Unit  
Hundred Seitsang, Game Scout, South East District (Gaborone)  
Abram Modo, Senior Game Warden, Kalahare District  
Keith Lindsay, Wildlife Biologist, Water Point Survey  
Piet Rapelana, Principal Training Officer of the Maun Wildlife  
Training Center  
G. Heinz, Training Officer, Maun Wildlife Training Center  
J. Zimmerman, Training Officer, Maun Wildlife Training Center  
Larry Patterson, DVM, (former Department member, Animal Disease  
Control)  
C. Spinage, EDF Technical Assistance Project Manager  
J. Barnes, EDF Consultant

**KALAHARI CONSERVATION SOCIETY**

Eleanor Warr, Executive Director

## FORESTRY ASSOCIATION OF BOTSWANA

Patricia Walker, Extensionist  
Dan Michaelson, Tree Seeds Unit and Research  
Phillip Eskeli, International Service Volunteer (Forester,  
former US PCV)

## THUSANO LEFATSHENG

Abraham Nkhumane  
Brian Monaham

## UNIVERSITY OF BOTSWANA

John Cook, Professor, Former Head of Department of Environmental  
Studies  
Susan Ringrose, Department of Environmental Studies  
Tabe Tietema, National Institute for Development Research and  
Documentation

## EEC DELEGATION

Jeremy Turnacliff

## IUCN

Ralph Cobham, Advisor on National Conservation Strategy  
Sam Butterfield, former Advisor on the National Conservation  
Strategy and currently with the University of Idaho  
Jeremy Harrison, Conservation Monitoring Center, Protected Areas  
Data Unit, Kew Gardens, London

## U.N. DEVELOPMENT PROGRAM

Hans von Sponeck, Resident Representative

## MASHATU GAME RESERVE

Jeff Hoal, Hotel Manager  
Pete Le Roux, Wildlife Biologist

**HOTEL AND TOURISM ASSOCIATION OF BOTSWANA**

Janis Mullan, Chairperson  
John Fowkes, Consultant, University of Capetown Graduate School  
of Business

**NATIONAL DEVELOPMENT BANK**

Ernest Chilisa, Agricultural Credit Officer

**NATIONAL MUSEUM**

Alec Campbell, Director (retired)

**NORAD**

Asbjorn Eidhammer, Deputy Resident Representative

**U.S.D.I. NATIONAL PARK SERVICE**

Rob Milne, Chief of International Affairs

**U.S.D.A. FOREST SERVICE**

Stan Krugman, Staff Director, Forest Management Research

**NATURAL RESOURCES DEFENSE COUNCIL**

David Wirth, Lawyer

**SIERRA CLUB**

Larry Williams, Washington Representative

**BOSTID**

Jeff Gritzner, Research Associate

**APPENDIX II**

**USAID MISSION DIRECTOR OBSERVATIONS  
ON TEAM VISIT TO GHANZI AND MAUN**

## memorandum

DATE: June 6, 1988

REPLY TO  
ATTN OF: John Hummon

SUBJECT: REPORT OF TRIP TO WESTERN AND NORTHERN BOTSWANA WITH BIOLOGICAL  
DIVERSITY TEAM, MAY 3, 1988

TO: The Files

This is a report of a trip around Botswana with a Washington team here to undertake a biological diversity assessment required by Congressional legislation. The team was composed of Lee Hannah from AID/Washington and two employees of the U.S. Department of Agriculture, G. Wetterburg and L. Duvall. Botswana has become a critical area of environmental concern. Representatives of the National Resources Defense Council and the Sierra Club were recently here and reached an understanding with the Ministry of Local Government and Lands on cooperation in the area of environment. Botswana has precious resources in the Okavango Delta and the Chobe to preserve. It also has a cattle industry which has been an important part of development, but also has been the subject of controversy because of its impact upon the natural resource base. There have been many articles in American newspapers and attention given throughout the world's media to Botswana and environmental matters. USAID does not have a project per se in the area of environment/natural resources and management, but we have been heavily involved in assisting in the development of a National Conservation Strategy through dialogue, provision of a medium-term consultant to assist in the development of the strategy and the funding of a workshop to bring together leaders throughout the country to comment on the development strategy. This is an area that we should continue to be involved in.

USAID and the natural resources team decided that it would be useful for the team to have an aerial reconnaissance of key parts of Botswana to secure an immediate understanding of some of the ecological and basic biological diversity problems that are in evidence here. The trip included the principal of the wildlife management college in Maun and a senior wildlife official from the Ministry of Local Government and Lands. The aerial reconnaissance began on May 3 left early in the morning. We left at daybreak flying over the Molepole road. Molepole has 40-50,000 inhabitants spread out over a wide area. The team the day before had visited the Gemsbok National Park and said that there was considerable tourist potential in the southwestern portion of Botswana. About 100,000 people come in annually from the South African side of the Gemsbok Park. Botswana gets about 30% of the revenue.

The area around Molepole is largely range land but there is also much under cultivation. As we were closer to the Central Kalahari Game Reserve, a large area in the center of the country, there was much more cattle grazing. In this reserve there are hartebeest and gemsbok. According to the government officials with us some people would like to move cattle into the area but there are probably no plans to do this. Later the District Commissioner in Ghanzi said that this is not a particular problem. We saw a large herd of gemsbok and one giraffe, a large number of ostrich, but no human habitation in flying over the Central Kalahari Game Reserve. We flew over a DeBeers mine exploration area in the game reserve. We saw one so called village but it was basically a wildlife camp with an airstrip adjacent to it. This is all part of the Ghanzi District. The DeBeers camp is a Falconbridge diamond mine where diamond exploration is being undertaken. There could be an impact in terms of environmental concerns with the development of a diamond mine.

Basically big cattle owners have never argued that they should get into the Central Kalahari Game Reserve. It has been the Bushmen with their little herds of cattle who have wanted to come in here and use the reserve. We looked for a Bushman settlement along the river and there we could see evidence of overgrazing adjacent to it. The reserve is a large game area, with no sand dunes; basically it is flat terrain with scrubby type vegetation. There is very little in the way of forest. We came across a couple areas where there were trees but essentially they were scrub-type vegetation. The government has plans to put 15 boreholes in this Central Kalahari Game Reserve -- for wildlife. As we moved out of the reserve we came into a number of private ranches which are fenced. This is big cattle country -- right outside of Ghanzi. As we came close to Ghanzi, there were predominantly white Batswana cattle ranches, many of whose owners came from South Africa a long time ago. Some of these ranchers would have hundreds of cattle.

The population of Ghanzi District is around 21,000 and about 50% are RADS; this means that there are 8,000 to 10,000 Bushmen. Commercial farms are supposed to have a maximum of about 400 cattle but many have much more than that. There is considerable overgrazing. There is a limitation in terms of grazing land that should be available for each head of cattle. We met with the District Commissioner and his staff and we had an intensive briefing by a Dutch volunteer on land utilization. The District Commissioner was in New Haven and went to Yale graduate school. He asked that my daughter send him a picture from Yale. We also promised to send him pictures taken in Ghanzi that day. I also promised that I would come back to Ghanzi, perhaps in July to get a fuller briefing on all the activities and development within the district. The district commissioner pointed out that they are having problems in establishing certain areas as wildlife managed areas where cattle will not be permitted to come in. That is a basic

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environmental problem. The idea is to have remote area dwellers living on the edge of these areas and to use the wildlife management areas for hunting. They are attempting to establish three such areas in the Ghanzi district. The wildlife management areas are to help maintain an area which assists in migration from the north to the southwest of the herds of game, and back again. Basically however, they are trying to encourage game to move into the Central Kalahari Game District and to stay within that area. The majority of the RADs do not have much cattle but might have one to two to three. Much of the land through the Ghanzi area looked overgrazed but you have to keep in mind that Botswana had just come through six and one-half years of drought. As you fly north from Ghanzi toward Gomare in the Okavango delta and in Ngamiland District you move into a different ecological area where there is much less vegetation and a different type of vegetation. There are much more pan-type areas with salt flats, and much of the land area in Ngamiland has considerable amounts of goats and donkeys and some cattle. But there are less cattle than in other areas because the area here is infested with hoof and mouth disease, hence a large veterinary fence across the area. All the cattle from in the area south of the Okavango go into the Maun abattoir.

We also saw several areas where they have recession farming -- as water recedes, people plant. The fringes of the Okavango Delta were not yet with water since the floods from the Angola highlands had not yet reached Botswana. We crossed over the buffalo fence which restricts the buffalo from coming into the cattle area. Buffalo are to the north and cattle to the south. We were flying over the Okavango Delta and seeing various types of game, a truly remarkable tourist area which begs for protection. The Government has no plans to move cattle into this area. We then landed in Maun.

At Maun we visited the Wildlife Training Center where USAID is are going to provide a training expert. I promised the Principal that I would send him a copy of the book The Kalahari for his library. I told him I would come back and meet with the students. A good deal of construction is being undertaken by the EEC. They have twenty students now and they plan to extend it to increase this to thirty.

There is a need for many more people working in the wildlife management areas. This is critical for the preservation of wildlife and the development of tourism. It is an area in which I want us to play a more active role even if it is a limited one financially. I was asked to go back to a conservation seminar which will be held in August in Maun or also to short courses in July. Their regular course ends in June. The college provide a good deal of in-service training.

Later we followed the Boteti River outside of Maun going over to the Makgadikgadi Pan. We are supporting a land utilization survey by the Kalahari Conservation Society in this important



area. The survey is to determine how to manage wildlife, land, livestock and tourism within the area of the north-central district which is bounded by the Francistown road on the east and by the Boteti River on the west, the Nata road on the south and essentially Orapa and the southern part of the Makgadikgadi Pan area in the south. Basically the area includes two pans of the Makgadikgadi Pan region, the Sua Pan on the eastern side and the Metwetwe Pan on the west. These are part of the Kalahari's great lake which existed thousands of years ago. In it are islands which are plainly visible and with so much water, it looked as though the lake had been reborn. There were shades of green and blue and shorelines with sand banks clearly visible. We flew low, sometimes at 50 feet, most of the time at 300 feet and flew over the Makgadikgadi Game Reserve which is a large area with little vegetation but adjacent to areas now with the heavy rainfall, having considerable amounts of water. These are areas where there are several thousand zebras and wildebeest, hartebeest, ostrich, large numbers of springbok, pelicans, flamingos, black bellied bustards, corey bustards, an endless variety of different kinds of birds, cattle posts, and Batswana. On this particular trip we saw little people or game, however. The Moteti River still has some water in it, but is essentially dried up. The people living on the adjacent banks have planted maize in the river bed and have moved into the river bed and some of the maize is growing pretty well. One objective of a survey of the Pan area which we are supporting through the Kalahari Conservation Society (KCS) is to determine where an additional cattle fence (barrier fence) could be placed across the pan to preserve wildlife, but also make additional areas available for cattle.

Another environmental problem is the question of possible damming of the Boteti River at Maun to divert water which could be available for the Orapa diamond mine. It would have a devastating impact upon the thousands of zebra and wildebeest that still live in the pan area. Their numbers have dwindled from the 120,000 zebra that were estimated seven or eight years ago before the onslaught of drought to roughly 20,000. If the water is diverted away from the area to make it move toward Orapa, it could impinge adversely upon their future existence. Also another cattle fence through the area must be handled with great care or it too could have an adverse impact upon the wildlife that is still in this magnificent area. We saw a dam on the Boteti which currently provides a reservoir of water for Orapa for the sluicing of the diamond mines and which has destroyed the bird sanctuary which was Lake Khosa. One time there were large numbers of flamingos and pelicans who resided in that lake but the lake has dried up and even in the wet season has virtually no water because of the diversion through this dam to Orapa. In the area between the two pans, the Sua Pan and the Metwetwe Pan, there is a large area where cattle roam. Another objective of the study we are supporting through the KCS is to develop a local game reserve here which would basically benefit the people of Nata and would establish a large portion of the northeastern corner of the Pan area as a Nata or local game reserve.

Conclusions from this remarkable aerial reconnaissance:

- O I wish I had taken this short trip when I first came to Botswana. It would have made it much easier to understand the basic environmental questions here and the reason we have had visitors such as Senator Kasten and representatives of the Sierra Club and the National Resources Defense Council and others who continue to focus on the environment in Botswana. The government is doing a great deal in terms of preservation of natural resources, but it is also very clear that cattle is an extremely important part of the economy. With rain the cattle-wildlife problem is much less severe, but in drought there are many critical decisions to be made.
- O In terms of USAID involvement, I think we should consider the possibility of developing a natural resources management project in FY 89 or FY 90, if there is any prospect of funding. I would like to see a natural resources survey carried out as a follow-up to this biological diversity work as a prelude to developing a PID. I think as we phase out of the dryland agricultural project, it would be useful to have a greater participation in the natural resources area -- but not to get involved in the cattle controversy, but to focus on the wildlife management, tourism and forestry areas.
- O In the meantime, I think there are several areas where we can be helpful:

- Continue to provide support to the development of the National Conservation Strategy through short-term consultants, through funding of workshops to develop the strategy, and continue our policy dialogue with government in the conservation area.

- In our policy dialogue we could perhaps help on the question of the NGO implementation of the National Conservation Strategy.

- Provide an expert under OPEX to the Wildlife Management Center and carry out some limited training under BWAST particularly as this relates to the development of tourism potential in this wilderness area of the north which is without parallel in the world.

- In our support of the National Wildlife Management School, purchase a copy of the Okavango films that they could use. This would be a minimal cost contribution.

- Be prepared to provide short-term technical assistance in certain areas, especially if central funding is available, such as carrying out a critical land utilization survey. The land utilization survey that is being undertaken by the Kalahari Conservation Society of the Makgadikgadi Pan and Ngamiland areas will be extremely useful to the government and to wildlife and

environmental preservation. The Kalahari Conservation Society has approached us to undertake a similar type study on the Okavango Delta. It would be excellent if we could be responsive; however, we have no Mission funds and would have to rely upon Washington to come up with money. Perhaps we could also tap into private groups.

--I think also we want to look at the SACCAR Faculties of Education Project and the possibility of its application here at the University of Botswana/Botswana Agricultural College which has the responsibility for natural resources management training at the professional level.

--Consider the possible funding under either the SARP program or AERP of a desert resurrection program which is to be part of the National Conservation Strategy -- assuming this does not get us involved in cattle.

In conclusion, I think there is an important role for the USAID to play and I hope that we will continue to do so. Much of this can be in the form of a dialogue with the government and among the donors, and to pitch in with short-term assistance as appropriate.

cc: The Files  
The Ambassador  
Johnnie Carson  
AFR/SA, Len Pompa  
Biological Diversity Team

Clearance: ADO:PDaly

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### **APPENDIX III**

#### **CONSULTANT'S REPORTS**

- 1. Local Livestock Strains**
- 2. Veterinary Cordon Fences**
- 3. Tsetse Control**

**Note: Dr. Larry Patterson, DVM, was contracted by the assessment team to prepare detailed reports of issues of special interest in biological diversity. The full text of these reports is presented in this appendix.**

## CATTLE BREEDS

In the traditional system, cattle are used for milk, beef production, hides and draught power, particularly for ploughing. The accumulation of large herds for these purposes may seem wasteful to outsiders, but in an adverse environment large herds are better able to stand depletions through drought or disease.

Indigenous cattle are classified as Sanga types, which are Bos indicus breeds originating from Asia many hundreds of years ago. The major local breed is the Tswana, which makes up an estimated 80% of the national herd, though pure types are becoming difficult to find, particularly in the east of the country. Closely related to this is the Tuli, from Zimbabwe, though some authorities suggest that the breed actually originated from Tswana types. The Africander, originating in South Africa is still the dominant beef breed in some parts of the country.

Exotic breeds are usually Bos taurus types, originating from Europe and introduced during the colonial period. They include the Sussex, Hereford, Shorthorn and more recently the Charolais, Simmental, Fresian and Jersey. A conspicuous exception which has found considerable favour recently is the Brahman, a Bos indicus breed introduced via the southern states of the USA.

In the 1930s a system of Livestock Improvement Centres was set up throughout the tribal reserves in the eastern and central parts of the country. The aim was to produce crossbred bulls and heifers for sale to local farmers in order to improve their Tswana cattle with exotic breeds. The choice of exotic breeds was left to the committee of each LIC. All the centres used the Africander, but others such as the Sussex, Hereford and Dairy Shorthorn were tried and usually discarded. No formal evaluation of these breeds and their crosses was carried out. In 1944 the authorities decided that the Africander was to be the main breed used at the LICs. This was because of the favourable performance of a large Africander herd which had been introduced by the Bakatla tribe in the south east of the country at the turn of the century.

The Africander breed was promoted until 1970, when the Botswana Government set up the Animal Production Research Unit. Its responsibilities included the evaluation of the main cattle breeds in the country for beef production. Seventeen beef cattle ranches have been set up, distributed in different ecological zones across the country, to facilitate data collection and serve as experimental stations for related research. A breed evaluation program involving the Tswana, Tuli, Africander, Brahman, Simmental and Bonsmara and their crosses with the Tswana was started. Comparisons of the indigenous breeds led to the conclusion that the Tswana is a suitable breed for Botswana conditions given reasonable management. The Tuli is highly recommended and upgrading of Tswana herds to Tuli would be sound practice, mainly due to the excellent calving percentages obtained with this breed. The Africander cannot be recommended for Botswana as it performs poorly in all measured traits of reproductive performance, growth and mortality.

Advantages of cross breeding exotic breeds with the Tswana are confined largely to weight gains. Simmental, Brahman and Bonsmara crosses all out perform indigenous cattle in this respect, but interestingly, the Tuli shows no hybrid vigour. The advantages in growth rates of the crossbreeds are carried forward to the mothering ability of the crossbred heifers, which produce heavier calves at weaning.

An attempt is being made by the APRU to produce a composite breed of cattle based on the Tswana but incorporating elements of a number of other breeds, principally the Tuli for its high fertility and the Brahman for its higher rates of pre- and post-weaning growth, but also using the Simmental, Hereford, Africander and Shorthorn.

The demand for the Tswana through the Bull Subsidy and AI Schemes has been almost zero. Recently, due partly to the heavier losses due to the drought among crossbreeds and exotics, the Government has recognised the value of the genetic resource of the Tswana breed. Concern has been expressed that with a national herd of less than 3 million head the rate at which exotic bulls and their

crosses are being released into the communal areas may cause a problem in the future. Action to preserve this genetic resource has now been instituted.

A herd of four hundred Tswana cows and ten bulls is being established at the APRU's Morapedi Ranch near PitsaneMolopo in the south of the country. The aim is to further improve the breed through a planned selection program. To date about 300 cows have been acquired, mainly from Kgalakgadi and western Kweneng Districts. Many farmers are reluctant to sell cattle from their herds after losing so many cattle during the drought. This is especially so in the worst affected areas in the west, where the Tswana type still predominates. Veterinary restrictions also make it difficult to move stock from these areas to the south east of the country. At the same time there is no restriction on the import of any breed whatsoever as long as individual animals have the necessary veterinary health certificates. Given this situation, the policy of promoting the Tswana breed through the Bull Subsidy and AI Schemes may be somewhat ineffective.

## CORDON FENCES

Since the late seventies veterinary cordon fences have been at the heart of the most controversial debate on wildlife populations in Botswana. The argument has continued unabated with conservationists here and overseas almost unanimous in their condemnation of the fences, while veterinarians and the Botswana Government in general have defended the fencing and quarantine system both at home and in the international forum.

One of the problems encountered when trying to assess the impact of these fences on wild animals is the lack of accurate information on their population sizes both past and present. Despite this only the most pedantic would deny that severe and in some cases catastrophic declines have occurred in the Kalahari wildlife populations over the last thirty years or so- the same period in which the fences have appeared.

In 1950 a body called the International Foot and Mouth Committee advised that cordon fences should be built to contain outbreaks of foot and mouth disease by preventing the movement of cattle. No thought was given to the possible role of wildlife in the spread of the disease. Three fences were built: Dibete, Central Bamangwato (Makoba) and Makalamabedi which effectively divided the cattle population into four areas. Movement from one area to another was via quarantine camps located on these fences where cattle spent three weeks and were examined before being released.

These fences were sited with little or no thought given to land use planning or environmental effects, but to be fair these considerations were unheard of in those days.

This situation remained largely unchanged until 1977 except for the addition of the Kuke cordon fence in 1958. It was also during this decade that most of the fencing was completed along the Transvaal and Southern Rhodesian borders, although the latter only extended as far north as Maitengwe.

Early experiences with wildlife along these fences indicated that they did interfere with wildlife movements. There are many references to damage caused by wildebeest and eland in particular in the annual reports of the Veterinary Department. The fences were initially patrolled by police (an indication that they were meant to prevent people moving cattle). Most observers were of the opinion that "the game will soon learn" and especially if encouraged by "judicious shooting". Police patrols were issued with shotguns to "frighten away the more picturesque and magnificent animals".

Despite the fences FMD continued throughout the fifties. Perhaps surprisingly after the 1961 outbreak the Veterinary Department's annual report stated "the value of cordon fences and quarantine camps in FMD control cannot be overemphasized" and that beef was still exported "thanks to the cordon fences".



Outbreaks of FMD occurred during the sixties but were relatively quickly controlled by the advent of vaccination programmes. From 1969 until 1977 there were no outbreaks of FMD in Botswana and throughout that period all cattle in the "high risk" areas of Ngamiland, Boteti and North East Central District (Zimbabwe border) were vaccinated annually. No new fences were constructed. Interestingly there were no outbreaks of the disease in neighbouring countries throughout most of that period.

In November 1977, when cattle numbers had built up to approximately three million, catastrophic outbreaks of FMD occurred, starting in Nokaneng and Gweta. These resulted in beef exports to the EEC being halted for 3 years and cost the Botswana economy an estimated P20 million annually. Contacts with the buffalo population were blamed for these outbreaks although the evidence was circumstantial and extremely tenuous. Outbreaks also occurred around the same time in Zambia, Zimbabwe and Mozambique.

As a result of FMD in the late seventies a new phase of fence building began. In Central District new fences were constructed and existing ones doubled. A very controversial fence was constructed around the western, southern and south eastern Okavango Delta to prevent contact between cattle and buffalo. The Delta was gazetted as a cattle free zone due to the presence of FMD virus in buffalo. Fences along the Zimbabwe border were also extended and re-enforced.

Environmental effects of these new fences were not all harmful. Although the Central District fences were again built with little or no consultation and caused large scale die-offs of game in May 1981 (mainly hartebeest and eland), the Okavango fence undoubtedly has prevented large scale invasion of the Delta by cattle and its conservation value cannot be overstated. Ironically too, the Kuke fence, perhaps the most vilified because of its alleged effects on wildlife migrations has prevented incursions of large numbers of cattle into the Central Kalahari Game Reserve from the desperately overgrazed Hainaveld. The Department of Wildlife and National Parks even requested the Veterinary Department to re-build the southeastern tail of the Makalamabedi cordon fence in order to exclude Central District cattle from the Central Kalahari Game Reserve.

Currently the cordon fence and quarantine system is being developed further, mainly within Central District. The emphasis from the livestock industry's point of view has changed from merely containing future outbreaks of FMD to expanding the area acceptable to the EEC for export of beef. The proposed fences, particularly where they might have significant environmental effects, have become the subject of consultation with Government land use planning officers and non-Governmental Organisations such as the Kalahari Conservation Society. Current information

suggests that one of the two major fence projects planned, in the south eastern Makgadikgadi Pans area where it will create a buffer zone between the major cattle producing areas of Central District and the high disease risk cattle and wildlife populations to the north west, will not interfere with any significant wildlife movements. The extension of the Okavango fence north to the Caprivi border has been the subject of intense debate, but the finally agreed route has minimal environmental effects and will provide a barrier to any future expansion of cattle or human encroachment into the proposed Wildlife Management Area immediately to the west of Chobe N.P. and north of the Okavango Delta.

Latest information from surveys in the Kalahari indicates that there has been a disastrous decline in numbers of some species of large animals during this decade. The wildebeest population may have crashed by 90% and hartebeest by nearly as much. There are perhaps half a million fewer herbivores in the Kalahari than existed in the late 1970s. This is as precise a statement as is possible with our present state of knowledge. It is obvious that the Kalahari is not what it was. Reference to documents kept by the Department of Animal Health proves that cordon fences have had a significant effect on wildlife movements and they still do in some cases. The expansion of cattle and people, particularly onto the pan systems of the Kalahari and along the Boteti river has also played a major role in the decline of the Kalahari ungulates as have the last few years of severe drought. There are many other factors too which have been highlighted elsewhere, but the cordon fences have undoubtedly had a crippling effect on the capacity of some highly mobile species to cope with drought and loss of their range.

The effectiveness of the cordon fence system in disease control, particularly when effective vaccinations are routinely practised, must be open to some degree of speculation. Similarly the role of buffalo in the aetiology of FMD outbreaks in cattle has never been adequately established and is still the subject of intensive research. Nevertheless, when outbreaks do occur, the cordon fences provide a useful tool for the speedy and efficient isolation of the affected area. The people of Botswana have come to recognise the need for and respect the fences, right or wrong, thus enhancing their efficiency and providing spin offs for conservation as well as disease control.

Realignment of most of the fences in order to minimise interference with wildlife migrations or movements has long ceased to be an option in most cases. The damage has been done, mostly some time ago, and development of human habitation, fenced farm blocks, roads and reservoirs means that removal or changes of alignment are either impractical or would have little, if any, benefits to the residual wildlife. Should any new fences be planned in sensitive areas, the knowledge that the conservation lobby is alerted will ensure that they are the subject of proper planning and environmental impact assessments.

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## TSETSE CONTROL

In Botswana the tsetse fly has always been limited to the North-West District (Ngamiland) and a small portion of the Chobe District in the far north. Its importance has been magnified because of its infestation of the only significant wetlands in an otherwise arid country. Only one species of tsetse fly occurs, Glossina morsitans, and this carries trypanosomes responsible for sleeping sickness in human beings and nagana in cattle.

Early attempts at tsetse control were based on the creation of barriers between susceptible cattle and human populations and areas of tsetse infestation. These were initially (1944) formed by building parallel fences and attempting to shoot out game animals between them. These methods, combined with some bush clearing and controls of cattle movements remained the major means of tsetse control until 1966 (Independence), when responsibility for tsetse control came under the Department of Animal Health. At this time annual losses of cattle to nagana were estimated at about 500 head but the infection rate was thought to be much higher, between 10 and 20%. The number of reported sleeping sickness cases reached a peak at 127 in 1966.

Trials with insecticide had been carried out in the early sixties, on a small scale mostly around villages or field workers' camps. In 1967 hunting was stopped and the emphasis for control was placed on large scale ground spraying for the first time. A solution of 3.8% dieldrin was sprayed selectively on preferred tsetse breeding sites. Almost 600 square miles were sprayed with 4,268 gallons of dieldrin concentrate. The spray had a residual effect of at least three months and had no noticeable effect on wildlife or people and their livestock. It was judged a very successful operation. Between 1967 and 1970 this method cleared some 13,000 square kilometers at a cost of P50 per square kilometer. In 1969 so few cattle were infected with trypanosomes that it was decided to discontinue the nagana treatment service. Prophylactic drugs were considered to be ineffective under the free range cattle herding system and could only lead to resistant strains developing.

After 1970 ground spraying was mainly a holding operation costing P30 per sq. km. maintained free of tsetse. Seasonal advances of the fly during the rainy season were the norm.

In 1972 limited trials with aerial application of insecticide took place and the possibility of eradication of the fly from Botswana, or at least the Okavango Delta, was entertained, but was considered too expensive. Endrin, dieldrin and endosulfan were all compared. Dieldrin and endosulfan were equally effective but it was considered that the latter affected the environment less adversely. At this time human cases of sleeping sickness averaged around 50 p.a. and nagana in cattle averaged about 150 cases p.a.

Extensive trials continued until 1980 and included investigations into the environmental side effects of endosulfan with particular reference to its effects on the aquatic ecosystem of the Okavango Delta. These were largely carried out by a team from the Centre for Overseas Pest Research, London. The team's conclusions were that endosulfan applied at 6-12 grams per hectare produces deleterious effects in fish. However, these are mainly confined to the year of spraying and should not reduce the population permanently unless the same area is treated annually. The insecticide does not accumulate in food chains, non-target arthropods were not affected and it was concluded that people on a diet of poisoned fish would consume only 0.1% of the lethal dose. The cost of producing a sq. km. free of tsetse using this technique was P100.

Around 1980 it was found that by combining the highly selective endosulfan with the much more potent but non-selective synthetic pyrethroids a synergistic effect was obtained, allowing the application rates to be halved to 6 grams and 0.1 grams per hectare respectively of endosulfan and alphamethrin. The greater susceptibility of pregnant female flies to this "cocktail" also allowed the number of applications per year to be reduced from five to four.

Recent control operations have employed this method in the Okavango Delta. Large blocks of land have been sprayed each successive year, moving from west to east across the Delta. The whole Delta has been sprayed at least once since 1981, followed by the Selinda and last year the Linyanti/Kwando. This has been combined with ground spraying of dieldrin up until 1984 when alphamethrin became the insecticide of choice. It was found that although it is bio-degradable (unlike dieldrin), it nevertheless has a longer residual action when sprayed on tsetse resting and breeding sites.

Although very effective, the aerial spraying of endosulfan/alphamethrin cocktails has not achieved eradication. The rationale for an eradication program was that it would be cheaper to carry out a single large scale operation than to continue with annual local control programs. It was also considered less damaging to the environment than continuous re-spraying. Funds for a full scale eradication attempt have, however, not been made available. Technical staff had hoped that eradication would have been achieved anyway, using the normal allocation, but this has proved not to be the case. Successively larger areas have had to be sprayed annually to give greater depth of protection to populated areas and to reduce re-invasion. It is claimed that this is due to an unprecedented amount of tourist and other traffic by air, boat and vehicle in an unusually dry phase in the Delta. Some observers maintain, however, that the spraying inevitably leaves small pockets of flies behind and these are responsible for the failure to eradicate.

In 1988 no major aerial spraying is planned. The Department is to carry out a comprehensive survey by helicopter to try to ascertain the extent of pockets of surviving flies. It is anticipated that these will then be eliminated by small scale ground spraying operations using alphamethrin. Ground spraying will remain the method of choice in the northern (Linyanti) area. An attempt to use aerial techniques in this international border area last year was unsuccessful due to a lack of co-operation with the neighbouring authorities and conflict with the Department of Water Affairs' biological control program for the water weed Salvinia molesta.

For the future, it may well be possible to eradicate the surviving flies in the Delta by spraying the whole area in one operation if the funds were to be made available. Assuming that this is successful, any further work would concentrate on protecting this area by preventing re-invasion from the Kwando/Linyanti, along the Selinda spillway. Further progress would then only be possible with the co-operation of the Namibian authorities in a joint operation against the Kwando fly belt, which extends across the Caprivi Strip from Angola.

Trials have been carried out recently in Botswana using the much vaunted and environmentally safe Vale odour-baited traps which have reportedly had so much success in Zimbabwe and elsewhere. In comparative studies with electrical screen traps and conventional two-man fly rounds they proved unsuccessful in eliminating flies from an area, although they did reduce fly densities significantly. Their lack of success has been attributed to the fact that Botswana has only one species, G. morsitans, which for unknown reasons is acknowledged to be less susceptible to the traps. It would be impractical to try to use them under Okavango conditions except to mop up surviving pockets of flies if, and when, their attractiveness to G. morsitans is enhanced.

During the last three years there have been no recorded cases of either human or animal trypanosomiasis in Ngamiland. It is postulated that tsetse fly densities are now so low in most areas, especially the Okavango, that contact with infected flies is a rare occurrence. It is possible that un-recorded cases have occurred among the Remote Area Dweller communities in the vicinity of the Kwando River, where there are no cattle on the Botswana side of the border.

It would appear that, subject to confirmation by this year's surveys, the major stronghold of the tsetse fly in Botswana, the Okavango Delta, has been reduced to scattered small pockets which cause insignificant risks to both human and cattle populations, at present levels. Unfortunately, these pockets are unlikely to be eliminated without a further large scale spraying operation. Even with the accepted low degree of toxicity of the chemicals used, environmental risks do occur, mainly due to the possibility of human errors during application, but also possibly because of unknown effects which may have been overlooked during the

somewhat limited monitoring of environmental parameters which has taken place thus far. If eradication using the current techniques is feasible in one or two years, this should be the aim. Any longer term control measures must be subject to exhaustive environmental monitoring procedures to ensure minimum harmful effects.