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DIRECTORATE OF FORESTRY  
NAMIBIA-FINLAND FORESTRY PROGRAM  
P.O. BOX 23930  
WINDHOEK, NAMIBIA  
Tel. +264-61-221 478 Fax +264-61-222 830

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## **FOREST CONSERVATION WITHIN THE PROTECTED AREAS NETWORK SYSTEM OF NAMIBIA**

**Pilot Study to evaluate Forest Cover and Vegetation  
Types as Indicators of Forest Conservation Value**

**Prepared by Dr Antje Burke**  
for  
**Environmental Forestry component**

**Windhoek, March 1999**

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Prepared by Dr Antje Burke

for

Namibia – Finland – Forestry Programme

*EnviroScience*  
P.O. Box 90230  
Klein Windhoek  
TEL/FAX: +264-61-223739  
e-mail: [enviroscience@iafrica.com.na](mailto:enviroscience@iafrica.com.na)

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## Executive Summary

### Project Background

In a first step towards appropriate forest conservation in Namibia, EnviroScience was commissioned to evaluate the existing conservation categories in terms of representation of forest ecosystems. Using vegetation as a parameter, available forest cover and vegetation types were investigated as indicators of forest conservation value in this pilot study.

### Methods

The study area comprised northern Namibia north of 20° S latitude. Conservation categories included in this survey were:

- National parks
- Game parks and Game camps
- State forests
- Conservancies (proclaimed and proposed) and
- Community forests (pending ratification of new Forest Act).

National parks and game parks exclude any utilisation of natural resources, thus provide the highest conservation status, while State forests, conservancies and community forest provide protection in combination with resource utilisation.

Data sources included the vegetation types from Giess' "Preliminary vegetation map of South West Africa" and forest cover types developed during Forestry's vegetation mapping project. To evaluate the status of protected areas, percentage cover of each vegetation and forest cover type per conservation category was obtained using a GIS approach. Apart from an analysis of representation of these vegetation and forest cover types in northern Namibia, information on land forms, habitats and biodiversity aspects was included in general terms to make recommendations for further tasks.

### Implications for Forest Conservation

Although a detailed analysis on biodiversity level was beyond the scope of this study, the combination of GIS based analysis together with review of biodiversity related information resulted in several aspects which could assist in directing future studies towards guidelines for forest conservation. These were:

- Review and amendment of current forest conservation categories
- Protection of habitats with high conservation value
- Representation of habitats and forest cover types
- Representation within regions
- Expansion of state controlled protected area network
- Assessment of conservation value of communal and private reserves
- Priority areas for forest conservation.

More specifically, the table below (Tab. A) summarises the findings of the pilot study and provides recommendations for areas and aspects which should receive attention in further more detailed studies.

Table A. Not sufficiently protected habitats and areas recommended for protection in northern Namibia.

Region	Habitat or vegetation type	Recommendations
Kunene	North-western escarpment and mountains	<ul style="list-style-type: none"> <li>▪ Baynes Mountains with Kunene River</li> <li>▪ van Zyl's Pass to Okamanga Mountains</li> <li>▪ Tonnesen Mountains and upper Hoarusib River</li> </ul>
	Riparian woodland	<ul style="list-style-type: none"> <li>▪ Kunene River</li> </ul>
	Ephemeral rivers and catchments	<ul style="list-style-type: none"> <li>▪ Hoanib River west of Sesfontein</li> <li>▪ Tonnesen Mountains and upper Hoarusib River</li> </ul>
North Central	Eastern woodlands	<ul style="list-style-type: none"> <li>▪ Woodlands in eastern Oshikoto, e.g. area north of Tsintsabis</li> </ul>
	Semi natural woodlands of cultural importance	<ul style="list-style-type: none"> <li>▪ Palm savanna</li> </ul>
Otjozondjupa	Mountain savanna and karstveld	<ul style="list-style-type: none"> <li>▪ Otavi mountains</li> </ul>
Okavango	Riparian woodlands	<ul style="list-style-type: none"> <li>▪ Remnants of riparian woodlands, e.g. Takwasa Mission Station</li> </ul>
	Western woodlands on fossil dunes	<ul style="list-style-type: none"> <li>▪ Woodlands north-east of Tsintsabis</li> </ul>
Caprivi	Impalila islands	<ul style="list-style-type: none"> <li>▪ Implementation of higher protection status</li> </ul>

## Recommendations

### Short-term

- Investigate priority areas identified in this study (Table A) in more detail.
- Phase more detailed analysis of potential future conservation areas in line with availability of data from Environmental Profiles Programme.
- Include habitat diversity, landforms, soils and agro-ecological zoning as parameters for evaluation of forest conservation value in subsequent studies.
- Test the reliability of forest cover data and update boundary discrepancies.

### Medium-term

- Investigate the incorporation of forest inventory data for assessment of conservation value.
- Adapt IUCN recommended conservation categories for PAN in Namibia.
- Develop detailed guidelines for ecologically sound management in conservancies, community forests and state forests.

### Long-term

- Compare biodiversity parameters of forest ecosystems in non state-controlled private and communal reserves to high status state-controlled reserves to evaluate their effectiveness.

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## 1. Introduction

### 1.1 Project Background

Environmental forestry was identified as one of four priority project components within the recently prepared Namibia Forestry Strategic Plan. The main objective of environmental forestry is to establish and co-ordinate forest conservation activities in Namibia. The first step towards appropriate forest conservation in Namibia comprises to evaluate the existing conservation categories in terms of representation of forest ecosystems and their associated biota.

Forest ecosystems are defined as tree dominated communities of organisms and their associated environment. They thus comprise fauna and flora as well as substrate, climate and water status. Apart from providing a variety of forest products, healthy forest ecosystems fulfil a number of vital ecological functions, such as:

- fertilising and stabilising soil
- cleaning the air
- controlling the water balance and
- providing wildlife habitat (Chenje & Johnson 1994).

Ideally, a review of forest ecosystems should investigate numerous ecological variables and their interaction to analyse the conservation value of individual forest ecosystems. However, this requires time consuming and costly in-depth studies over a long period which is often not feasible due to time and financial constraints. Under such constraints, vegetation is often used as an indicator of plant, animal and habitat diversity. This is based on the assumption that a combination of high vegetation cover, high plant diversity and structural diversity provides favourable conditions for diverse animal communities, thereby contributing to diverse ecosystems.

This assumption was underlying the first step towards evaluating forest ecosystems and their conservation status in Namibia. In this pilot study the merit of available forest cover and vegetation types was investigated as an indicator of forest conservation value (see more detailed Terms of Reference in App. F).

Unfortunately the data and descriptions backing the vegetation map and forest cover maps do not provide sufficient information to attempt an assessment of biodiversity value of each of these land cover units. Hence this study does not attempt to make detailed recommendations concerning forest conservation but rather comprises a pilot study with the objective to:

- identify broad areas, vegetation and forest types from the present data sources which need further investigation,
- develop and test a Geographic Information Systems approach,
- develop a methodology consistent across all regions and
- to update present conservation categories in digitised format.

### 1.2 Study Area

Although broad vegetation types are available for entire Namibia, forest cover data are only available north of 20° S latitude. Thus the study area was limited to northern Namibia north of 20° S.

## 2. Methodology

### 2.1 Data Sources

A variety of data sources, comprising map data based on satellite image interpretation, topographic maps and hand-held Global Positioning System readings were used to evaluate conservation areas in northern Namibia (Table 1).

For the purpose of this pilot study, only vegetation and forest data presently available in digitised map format were selected. These are forest cover types (Directorate of Forestry 1994) and vegetation types (Giess 1971).

The only more or less consistently mapped forest data for entire northern Namibia are the forest cover types prepared by the Vegetation Mapping Project at the Directorate of Forestry, while broad vegetation types are available from Giess' "Preliminary vegetation map of South West Africa". These were digitised by the National Remote Sensing Centre for Namibia's Biodiversity Country Study.

Table 1. Data sources.

Type	Source	Area	Format	Interpretation
Forest cover	SPOT XS processed by NRSC	northern Namibia, approximately E of 18° longitude	1: 50 000	<ul style="list-style-type: none"> <li>▪ Vegetation structural diversity</li> <li>▪ Land use</li> </ul>
	LANDSAT TM processed by NRSC	northern Namibia, approximately W of 18° longitude	1: 100 000	
Vegetation	Giess 1971 digitised by NRSC	Namibia	scale not known	<ul style="list-style-type: none"> <li>▪ Vegetation type</li> </ul>
Administrative boundaries	digitised by NRSC	Namibia	1: 250 000	<ul style="list-style-type: none"> <li>▪ Regions</li> </ul>
National Parks and Game Parks	Topographic maps	northern Namibia	1: 250 000	<ul style="list-style-type: none"> <li>▪ Conservation categories</li> </ul>
Conservancies	DEA, Farm boundaries of topographic maps	northern Namibia	1: 50 000	
State Forest	Directorate of Forestry, GPS readings	East Caprivi		
Community Forest	Directorate of Forestry, GPS readings	North Central		

### 2.2 Conservation Categories

In this study six conservation categories of relevance to the study area were identified within Namibia's Protected Area Network (Table 2).

National and game parks secure the highest protection status for an area and associated ecosystems, as they are largely maintained as sanctuaries for wildlife. They are controlled by



the Government and no hunting, removal of animals or plants and introduction of domestic animals is allowed within the boundaries of these reserves.

Conservancies were introduced as a measure to conserve natural resources on private and communal land. They usually comprise several farms or a large tract of communal land where the landowners agree to manage their resources jointly in an ecologically sensitive manner. Hunting and limited resource utilisation, as well as farming is thus permitted within conservancies. This survey included already established conservancies as well as to be proclaimed conservancies in communal and commercial farmland.

State forests are managed and controlled by the relevant government department, but do allow commercial and private utilisation, subject to a licence agreement. In the absence of guidelines for utilisation within these reserves, state forests are considered to provide only a low protection status.

Community forests, similar to conservancies, serve as a measure to protect forest resources by giving the resident communities rights over their forest resources, but communities are committed - in form of a management plan - to utilise these resources in a sustainable manner.

Table 2. Conservation categories.

Category	Land tenure	Legal basis
National Park	State	Nature Conservation Ordinance (4 of 1975)
Game Park		
Game Camp		
State Forest Reserve	State	draft Forest Bill
Conservancy	Private or communal	Nature Conservation Ordinance (4 of 1975)
Community Forest	Communal	draft Forest Bill

## 2.3 GIS Component

The GIS component of this project was undertaken by Patrick Graz of the Polytechnic Namibia. The main steps are summarised below, while Appendix A presents a detailed technical report of the GIS component.

### 2.3.1 Forest Cover Types

The main steps of the GIS component for forest cover types comprised:

- manual verification of forest cover types
- development of summarised, consistent mapping units across all northern regions
- combination of forest type coverages in Arc/Info
- preparation of combined attribute tables
- preparation of area statistics and
- production of maps.

The complexity of the mapped forest cover types which resulted in well over 100 combinations of land form, forest type, land use, vegetation density, vegetation height and dominant species, required substantial merging of initial mapping units. Since dominant species were not recorded consistently across all northern regions and many forest cover types only listed "mixed species" as dominant, species were omitted entirely. As broad height

classes are included in the initial classification of forest, savanna and grassland, more detailed height classes were omitted in the analysis. This resulted in 26 mapping units presented in maps and a further consolidation to 17 forest cover units presented as area statistics.

### 2.3.2 Vegetation Types

Area statistics for vegetation types were extracted directly per region from Giess' vegetation map (Giess 1971).

A detailed description of the procedure and methodology is provided in Appendix A.

## 2.4 Data Summaries

For forest cover types the area statistics for each region were converted to percentages and then summarised according to percentage of conservation category per region. In addition, the percentage area covered by each forest cover type was calculated and presented per region. For comparative purposes, an overall summary of the same data structure was prepared for entire northern Namibia (Table 3 and 4), as well as the percentage of conservation category per northern Namibia's total area. For more convenient presentation, the four central regions, Oshona, Omusati, Ohangwena and Oshikoto were combined as North Central.

The percentage conservation category covered by Giess' vegetation types was derived from the area statistics and presented per region and northern Namibia as outlined above.

## 2.4 Evaluation

Although no data comparing the effectiveness of state controlled *versus* community and privately managed reserves are presently available for Namibia, the more strictly applied and enforced guidelines for state-controlled reserves under the Nature Conservation Ordinance are considered to provide a higher protection status than non-state controlled reserves, such as conservancies and community forests.

In general terms, although not presented in map format and backed up by hard data, the survey also included a review of Namibia's protected area network in the light of climatic gradients, land forms and habitats. It also incorporated biodiversity aspects in broad terms based on published information (Barnard 1998) and the consultant's professional judgement and experience with other biodiversity related projects.

### 3. The Protected Area Network in Namibia's Northern Regions

#### 3.1 Giess' Vegetation Types in Protected Area Network

Although lacking data on plant species diversity and structure, Giess' preliminary vegetation map gives a first approximation of broad landform and vegetation units and is a useful tool for stratification of further more detailed data collection and analysis.

Savannas are defined as tropical and subtropical vegetation type co-dominated by woody plants and grasses (Cowling *et al.* 1997). According to Edwards (1983), tree cover above 75 percent defines a forest, and tree cover below 75 percent combined with less than 10 percent shrub cover defines a woodland.

##### 3.1.1 Northern Namibia

The majority of northern Namibia (41 %) has been classified as forest savanna and woodland in Giess' preliminary vegetation map; the second most important component constitutes mopane savanna (39 %) (Fig. 1; Table 3). Nearly 20 % of these two broad vegetation types receive some form of conservation status, although not in form of state protected areas. The state-controlled portion just about reaches the 10 % recommended by the world conservation union (IUCN 1992). For forest savanna and woodland, 10.2 % are state protected, while 11.9 % in case of mopane savanna. This can be attributed to Etosha National Park which is one of the largest parks in southern Africa and contributes the majority of the protected mopane savanna. Nearly all of Etosha pan which is classified as saline desert falls into this protected area. On the other hand, a very small proportion (7.5 %) of mountain savanna and karstveld is protected through a commercial conservancy, and nothing falls within the state-controlled protected area (Barnard 1998). Two thirds of the northern Namib are protected by the state-controlled Skeleton Coast Park, while thornbush savanna receives no protection at all in northern Namibia.

##### 3.1.2 Kunene

The most prominent vegetation type in Kunene is mopane woodland of which 20 % receives protection; 15.2 % as state controlled area, 5.4 % in form of conservancy and community forest. However, what has been combined in one large unit of mopane woodland stretches over

- a) a wide rainfall and climatic gradient from arid to semi-arid (ranging from 50 to 500 mm per annum),
- b) three biomes (Rutherford & Westfall 1994) and
- c) seven broad landform categories (FAO 1984).

These mopane woodlands also include one of the eight "biodiversity hotspots" or centres of endemism, the Kaokoveld, which have been identified in southern Africa (Cowling & Hilton Taylor 1994) as well as some of the few riparian woodlands along Namibia's scant perennial rivers. These are situated in the western part of the mopane woodlands, of which only a small section in the south receives some protection in form of communal conservancies (Appendix E).

The northern Namib and saline desert are sufficiently protected by two of Namibia's large National Parks, Etosha and Skeleton Coast. The small piece of mountain savanna and karstveld receives some protection, while a little fragment of thornbush savanna is not protected (Fig. 2). All of Kunene's small portion of forest savanna and woodland falls into Etosha National Park and is thus fully protected (Appendix E).

### 3.1.3 North Central

In contrast to Kunene, none of North Central's vegetation types reach the recommended 10 % IUCN threshold. The largest contribution to vegetation cover is forest and mopane savanna both of which receive some protection in form of community forests (Fig. 3). One section of the conservancy in mountain savanna falls into North Central and the northern margin of the Etosha pan, classified as saline desert, is not protected (Appendix E). No state controlled protected area exists in North Central.

Similar to Kunene, on the basis of climate, substrate and differences in drainage regime the two large units forest and mopane savanna are expected to show a finer differentiation than delineated on the preliminary vegetation map. While the heavily populated central part of the region (essentially Oshana and Omusati) comprises largely semi-natural, cultivated areas with few scattered trees, but no woodlands or savanna, the eastern and western parts of North Central contain vast woodland areas well worth representation in Namibia's Protected Area Network (e.g. west of Olushandja Dam and along the eastern border with the Okavango region).

### 3.1.4 Otjozondjupa

The northern part of Otjozondjupa, which falls into the study area, is mainly covered by forest savanna and woodland and seizes the largest section of mountain savanna and karstveld (Appendix E: map 1). Over 30 % of Otjozondjupa's forest savanna and woodland are protected through the large Nyae Nyae conservancy. Neither the small portion of mopane nor thornbush savanna receive any protection (Fig. 4). No state controlled protected area is in this region.

### 3.1.5 Okavango

Nearly 100 % of the Okavango is covered with forest savanna and woodland. Just about 10 % of these woodlands are protected as game park and game camp (Fig. 5). Again, as with Kunene and North Central, the large Okavango region stretches across a rainfall gradient, comprises five main landform types (FAO 1984) and is bordered in the north by one of Namibia's perennial rivers, supporting riparian woodlands. The forest ecosystems are thus expected to be more diverse than reflected in the two main vegetation types.

### 3.1.6 Caprivi

All of Caprivi is covered by forest savanna and woodland, over 50 % of which is protected. The largest portion (43 %) of conservation areas is state-controlled (Fig. 6). Although this may point towards adequate protection, it needs to be investigated whether or not a sample of the majority of the in a more detailed survey identified 36 vegetation types (Hines in Mendelsohn & Roberts 1997) are represented. Of particular conservation value as an outpost

of tropical flora in Namibia are the Impalila islands which are presently protected as a conservancy, but receive no state-controlled protection.

### **3.2 Forest Cover Types within the Protected Area Network**

Although the data supporting the forest cover types are lacking information about species composition and consequently plant diversity, the combination of forest cover types, plant density and land use facilitated a preliminary evaluation of representation of potential structural diversity. The various degrees of coverage from open to dense likely reflect different species and structural diversity and hence possibly different forest ecosystems. All savanna and forest types are thus considered of conservation value, while forest types changed by extensive and intensive agriculture are perceived less important for forest conservation.

#### **3.2.1 Northern Namibia**

Forests, as defined by Forestry's vegetation mapping project, comprise areas with dominant trees above 5 m height (Chakanga 1995). About 27 % of northern Namibia falls into this category, while 56 % is covered by savanna of various density (Fig. 7). Extensive agriculture occurs in all forest cover types and collectively makes up approximately 6 % of the land area (Table 4). Overall, of all forest cover types without agriculture, only dense savanna, and very open savanna receive less than 10 % state controlled protection. Extensive and intensive agriculture fall below the 10 % mark but forest types under this land use are not considered of high conservation value.

#### **3.2.2 Kunene**

Due to Etosha National Park's position in this region, most forest and savanna types are presented well above the 10 % margin and mostly receive state-controlled protection. Only open and very open forest falls below the 10 % margin. Forest types in the east and to lesser extent in the south of the Kunene region receive protection in form of the communal conservancies Grootberg and Torra and the community forests Uukolonkadhi and Uukwaludhi (Appendix E). The north-western escarpment and Kaokoveld plateau, however, with very different species and many plant species of high conservation value, are not protected at all.

#### **3.2.3 North Central**

In contrast to Kunene, only dense and very open savanna receives some form of protection as community forests (Uukolonkadhi and Uukwaludhi) and above the 10 % IUCN margin. No forest cover type receives any state-controlled protection. The central and northern part of North Central is characterised by extensive agriculture, but the south-east (e.g. area north of Mangetti) and western part house a variety of forest cover types which are likely worth preserving (Appendix E). However, extensive agriculture in former woodland areas is part of the Namibian cultural heritage and a representative sample of semi-natural forest types should be included in the protected area network.

### **3.2.4 Otjozondjupa**

The largest forest cover contribution in Otjozondjupa is medium dense savanna and except for very open forest, all forest cover types in this region are well presented, most with above 20 %, in the large communal Nyae Nyae conservancy (Fig. 10 and Appendix E). There are, however, no state controlled protected areas in this region.

### **3.2.5 Okavango**

At 70 %, the largest part of the Okavango is covered by forests of various density (Appendix E). However, savanna types are better represented within protected areas than forests, only dense forest exceeds the 10 margin, while dense and open savanna reach 20 % (Fig. 11). None of the fossil sand dunes of the Kalahari in the west of the Okavango receive any protection.

### **3.2.6 Caprivi**

All forest units in the Caprivi are well represented, largely in state-controlled reserves. Savanna types, in turn, receive very little protection (Fig 12). Drainage areas, grassland and marshland also receive adequate protection at present (Appendix E).

#### 4. Implications for Forest Conservation in Namibia

At present nearly 14 % of Namibia's total land area is protected by proclaimed parks and reserves, 18 % in state protected areas in northern Namibia alone (Fig. 13). This is well above the IUCN recommended figure of 10 % of land area (Barnard 1998). However, 10 % of all "ecological regions and their major variations" should be protected according to Namibian Government Policy (Brown 1992). This has certainly not been achieved, as no savanna and woodland type according to Giess exceed the 10 % margin of representation in state protected areas for entire Namibia (Barnard 1998).

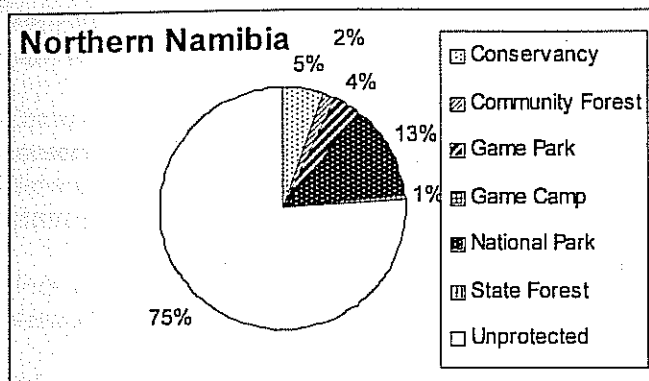


Figure 13. Protection status of land (in percentage of total area) in northern Namibia.

In the past, rather than protecting a representative sample of all ecological regions and habitats, Namibia's Parks were proclaimed with the sole aim of creating wildlife sanctuaries and often resulted in setting aside areas that are not suitable for any land use other than tourism and hunting.

However, the basic principle of conservation of biodiversity is to maintain functioning ecosystems allowing preservation and exchange of genetic material. Thus one aspect of conservation is adequate representation of all of Namibia's ecosystems; the second, equally important aspect is the development of a network of interconnected ecosystems rather than individual patches of land set aside in isolation for conservation.

By identifying gaps within the current Protected Area Network (PAN) and developing appropriate management and preservation strategies for identified areas, forest conservation in Namibia can make an invaluable contribution to achieving a more balanced PAN.

Although a detailed analysis on biodiversity level was beyond the scope of this study, the combination of GIS based analysis together with professional judgement and experience of biodiversity related projects facilitated the identification of several aspects which could assist in directing future studies towards guidelines for forest conservation:

- Review and amendment of current forest conservation categories
- Protection of habitats with high conservation value
- Representation of habitats and forest cover types
- Representation within regions
- Expansion of state controlled protected area network
- Assessment of conservation value of communal and private reserves and
- Priority areas for forest conservation.

#### 4.1 Review and amendment of current forest conservation categories

Although the draft forestry legislation makes provision for conservation areas for the preservation of the natural environment in form of nature reserve, no details regarding management and resource utilisation are provided. Thus whether or not these nature reserves provide the same high level of protection status as national parks and game parks proclaimed under the Nature Conservation Ordinance of 1974, cannot be established. State forest, on the other hand, do not prohibit commercial or private use of forest resources, although these activities are restricted by a licence system. As such, these would fall under the lowest IUCN conservation category 6 "Managed Resource Protected Area" (IUCN 1992). Without management objectives with an ecological approach in mind, and implemented in management plans accordingly, state forest's contribution to the Namibian Protected Area Network in terms of forest ecosystems may be very limited – with appropriate management objectives their contribution could be invaluable.

Community forests, on the other hand, appear to follow the same conservation philosophy as conservancies and have the potential to make a similar contribution to the Protected Area Network as conservancies, albeit both on a somewhat lower level of protection than parks and nature reserves.

Both levels of protection status should, however, be integrated equally in a Protected Area Network.

Other categories of "classified forests", such as State Forest Reserves and Regional Forest Reserves as proposed in the draft Forest Act of 1997, could potentially be amended to follow more closely the IUCN categories.

#### 4.2 Protection of habitats with high conservation value

At present the entire north-western escarpment which includes the Kaokoveld centre of endemism receives no protection at all. Identified as an area of extremely high conservation value in a previous review (Barnard *et al.* 1998), this study reiterates the need for preservation of a representative parts of this area, ideally in form of a nature reserve or equally high protection status. Ideally a reserve in this area should combine an ephemeral river catchment with Kunene River riparian woodland and a section of escarpment.

Another important habitat is riparian woodland, in the west along the Kunene River and in the east along the Kavango River. Except for the very dry western part of the Kunene River, which crosses the Skeleton Coast Park, no riparian woodlands along the Kunene River receive any protection. Only a small section of the Kavango River, largely on the eastern banks, is presently protected. Although most of the woodlands along the western Kavango River have disappeared due to population pressure, there are few, small remnants of original riparian woodland, such as near the Mission Station Takwasa. These should be protected before further clearing and livestock irreversibly change the present vegetation.

Ephemeral rivers, their associated woodlands and catchments play an extremely important role as linear oasis in the dry western part of Namibia (Jacobsen *et al.* 1995). At present none of the upper reaches of the three main western flowing rivers in the study area receive any protection.

Mountain savanna and karstveld only receives some protection in form of a commercial conservancy. Because of its special status for biodiversity in southern Africa (Barnard *et al.*



1998), this is not adequate and protection of a representative part of this area with a higher protection status should be considered.

The Impalila Islands in the Caprivi were identified as outposts of tropical vegetation and are thus special in Namibia. They are presently part of a conservancy, but heavy livestock grazing has already depleted the undergrowth and changed the composition of the grasslands (Hines in Mendelsohn & Roberts 1997). A stricter protection excluding grazing and other utilisation of the vegetation should thus be considered at least for some part of the islands.

#### **4.3 Representation of habitats and forest cover types**

In addition to the habitats and vegetation types of high conservation value, the fossil sand dunes in the west of the Okavango receive no protection at all. As land forms quite different from the eastern sandveld, these harbour forest and woodlands with different plant species composition to the east (Page 1980). They are thus worth representation in Namibia's Protected Area Network.

This study also identified the forest cover types "dense savanna" and "very open savanna" as inadequately protected in northern Namibia, receiving less than 10 % state controlled protection.

As part of the Namibian cultural heritage, semi-natural forest ecosystems, such as palm savanna and concentrations of indigenous fruit trees should also be represented in a forest conservation network (e.g. the area north of Oshakati towards Engela).

#### **4.4 Representation within regions**

Overall, none of the four regions combined as North Central in this study, nor the northern Otjozondjupa region have any state-controlled protected areas.

In Kunene, the forest cover types "very open forest" and "open forest" fall below the IUCN recommended 10 % margin. These could possibly be included by establishing a protected area along the Hoanib River just west of Sesfontein.

As mentioned above, mountain savanna as well as the forest cover type "very open forest" require protection in the Otjozondjupa region.

#### **4.5 Expansion of state controlled protected area network**

Spatially, disregarding land tenure and administrative hurdles, establishment of protected areas with high level of conservation status

- at the northern edge of the escarpment (Baynes Mountains to Marienfluss),
- in the western Kalahari dunes north of Tsintsabis (stretching across southwestern Okavango – eastern Oshikoto) and
- in the Otavi Mountains

would give a better representation of presently underrepresented ecosystems and regions, at the same time reducing distances between present protected areas and thus creating more of an actual network.

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#### **4.6 Assessment of conservation value of communal and private reserves**

In Okavango and Caprivi, and to a lesser extent in Otjozondjupa, slash-and-burn agriculture and regular veld fires contribute tremendously to the alteration of forest ecosystems. While veld fires are not easily controlled in any form of protected area, slash-and-burn practise which is allowed in conservancies and communal forests, is prohibited in National and Game Parks under the Nature Conservation Ordinance.

Similar to the presently set up on-going evaluation of Community-based Natural Resource Management areas, many of which are conservancies, testing of efficiency of conservation efforts in community forests in comparison to state-controlled reserves will be essential.

#### **4.7 Priority areas for forest conservation in northern Namibia**

Largely based on bio-geographical parameters (centres of endemism, tropical outposts), spatial arrangement and current threats, the priority from high to low (left to right) for protected areas was assigned as:

North-western escarpment and Kunene River riparian woodlands (Kaokoveld) ⇒ riparian woodlands of the Okavango River ⇒ mountain savanna and karstveld ⇒ Hoanib River west of Sesfontein ⇒ Fossil dunes in western Okavango ⇒ Impalila islands ⇒ palm tree savanna.

The table below (Tab. 5) summarises the findings of the pilot study and provides recommendations for areas and aspects which should receive attention in further more detailed studies.

Table 5. Not sufficiently protected habitats and areas recommended for protection in northern Namibia.

Region	Habitat or vegetation type	Recommendations
Kunene	North-western escarpment and mountains	<ul style="list-style-type: none"> <li>▪ Baynes Mountains with Kunene River</li> <li>▪ van Zyl's Pass to Okamanga Mountains</li> <li>▪ Tonnesen Mountains and upper Hoarusib River</li> </ul>
	Riparian woodland	<ul style="list-style-type: none"> <li>▪ Kunene River</li> </ul>
	Ephemeral rivers and catchments	<ul style="list-style-type: none"> <li>▪ Hoanib River west of Sesfontein</li> <li>▪ Tonnesen Mountains and upper Hoarusib River</li> </ul>
North Central	Eastern woodlands	<ul style="list-style-type: none"> <li>▪ Woodlands in eastern Oshikoto, e.g. area north of Tsintsabis</li> </ul>
	Semi natural woodlands of cultural importance	<ul style="list-style-type: none"> <li>▪ Palm savanna</li> </ul>
Otjozondjupa	Mountain savanna and karstveld	<ul style="list-style-type: none"> <li>▪ Otavi mountains</li> </ul>
Okavango	Riparian woodlands	<ul style="list-style-type: none"> <li>▪ Remnants of riparian woodlands, e.g. Takwasa Mission Station</li> </ul>
	Western woodlands on fossil dunes	<ul style="list-style-type: none"> <li>▪ Woodlands north-east of Tsintsabis</li> </ul>
Caprivi	Impalila islands	<ul style="list-style-type: none"> <li>▪ Implementation of higher protection status</li> </ul>

## 5. Recommendations

### 5.1 Forestry legislation

- Adapt IUCN recommended protected areas categories for Namibia with forest ecosystem and ecological aspects in mind.
- Develop management guidelines for all forest conservation categories.
- Provide for semi-natural forest ecosystems, such as palm savanna and concentrations of indigenous fruit trees within a forest conservation network.

### 5.2 Combined conservation efforts

- Co-ordinate conservation efforts through exchange of data (e.g. by making this study and digital results available to other governmental conservation-orientated projects).

### 5.3 Short-term – suggestion for phase two

- Investigate priority areas identified in this study (see Table 5) in more detail.

For a more detailed analysis, focus on areas presently underrepresented and possibly more diverse than the present data suggest (e.g. Giess' mopane savanna which includes the northern escarpment, forest savanna and woodland, including riparian forests).

- Phase more detailed analysis of potential future conservation areas in line with availability of data from Environmental Profiles Programme.  
The more detailed vegetation surveys with data on species composition and structure available via the Environmental Profiles Programme will likely enable a more detailed assessment of forest ecosystems.
- Extend assessment of forest conservation areas to south of 20° S latitude.  
Although "true forests" do not reach much further south than 20 latitude, southern Namibia does provide some areas worth protecting from a forest point of view. These are, for example, the Quiver tree "forests" in the Keetmanshoop area, one of which is presently situated in communal area, one on private farmland, and the riparian woodlands of the Orange River.
- Rather than just using vegetation types as indicators, include habitat diversity, landforms, soils and agro-ecological zoning as parameters for evaluation of forest conservation value in subsequent studies.
- Test the reliability of forest cover data and update boundary discrepancies.  
By comparing forest cover data of Caprivi with the vegetation map from the Environmental Profile of Caprivi, the value of the forest cover data could be assessed in more detail.  
Also, boundary discrepancies between Okavango, Ohangwena and Oshikoto reflecting the change from SPOT to LANDSAT within forest cover types need to be adapted, should forest cover types form the basis for further assessments.

#### **5.4 Medium term objectives**

- Investigate the incorporation of forest inventory data for assessment of conservation value.
- To guarantee implementation of ecologically sound management, develop detailed guidelines for ecological sound management in conservancies, community forest, state forests and regional forest reserves.

#### **5.5 Long-term objectives**

- To supplement Namibia's Protected Area Network, proclaim forest protected areas according to the suggestions put forward in this study and subsequent more detailed analysis.
- Investigate biodiversity parameters of forest ecosystems in non state-controlled private and communal reserves in comparison to high status state-controlled reserves to evaluate their effectiveness.

## 6. Shortcomings

- While the consultants realised at the outset of this pilot study that the data backing up the vegetation map and forest cover maps are not sufficient to make detailed recommendations for forest conservation, the testing of a GIS approach, development of a methodology and updating of present conservation categories in digitised format were considered of potential benefit to further work and possibly other applications.
- The forest cover types do not give any information on plant diversity.
- Height classes were omitted, because of potential errors in image interpretation.
- Discrepancies occurred between forest cover types at boundary between SPOT and LANDSAT images due to alteration in field data collection.
- As insufficient field data backed up the satellite image interpretation for the forest cover types, the boundaries of mapped units are not always correct.
- Giess' preliminary vegetation map is too general and at too large scale to make recommendations on forest ecosystem level.

## 7. References

- Barnard, P. (ed.) 1998. *Biological diversity in Namibia – a country study*. Namibian National Biodiversity Task Force, Windhoek.
- Barnard, P., Brown, C.J., Jarvis, A.M. & Robertson, A. 1998. Extending the Namibian protected area network to safeguard hotspots of endemism and diversity. *Biodiversity and Conservation* 7:531-547.
- Brown, C.J. (ed.) 1992. *Namibia's Green Plan*. Draft policy document, Republic of Namibia, Windhoek.
- Chakanga, M. 1995. *Forest Cover Reconnaissance Mapping Project*. Directorate of Forestry, Republic of Namibia, Windhoek.
- Chenje, M. & Johnson, P. 1994. *State of the Environment in Southern Africa*. IUCN World Conservation Union, Penrose Press, Johannesburg.
- Cowling, R.M. & Hilton-Taylor, C. 1994. Patterns of plant diversity and endemism in southern Africa: an overview. *Strelitzia* 1:31-52.
- Cowling, R.M., Richardson, D.M. & Pierce, S.M. 1997. *Vegetation of Southern Africa*. Cambridge University Press, Cambridge.
- Edwards, D. 1983. A broad-scale structural classification of vegetation for practical purposes. *Bothalia* 14:705-712.
- FAO 1984. *Assessment of Potential Land Suitability - Namibia: Land Regions and Land Use Potential*. Food and Agriculture Organisation, Rome.
- Giess, W. 1971. A preliminary vegetation map of South West Africa. *Dinteria* 4:5-114.
- IUCN 1992. *Protected Areas of the World - a Review of National Systems*. IUCN Publication Service Unit, Gland and Cambridge.
- Jacobson, P.J. & Jacobson, K. M. & Seely, M.K. 1995. *Ephemeral Rivers and their Catchments*. Desert Research Foundation of Namibia, Windhoek.
- Mendelsohn, J. & Roberts, C. 1997. *An Environmental Profile and Atlas of Caprivi*. Environmental Profiles Project, Directorate of Environmental Affairs, Windhoek.
- Page, D. 1980. *N' Raamwerk vir ontwikkeling van Kavango*. Instituut vir Beplanningsnavorsing, Universiteit Stellenbosch.
- Rutherford, M.C. & Westfall, R.H. 1994. Biomes of southern Africa: an objective categorization. *Mem. Bot. Surv. S. Afr.* Vol. 63.

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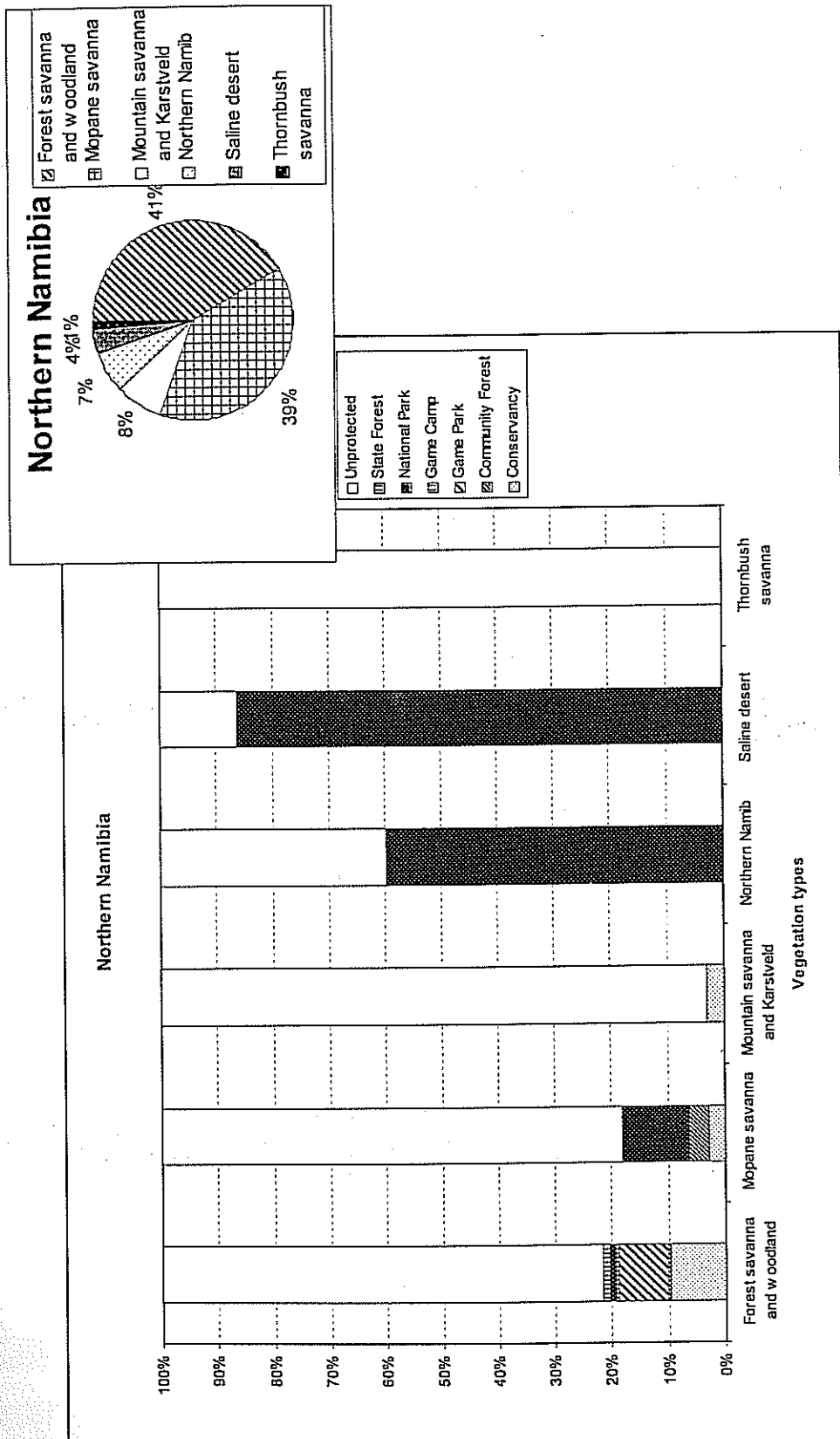


Figure 1. Protected areas per vegetation type according to Giess (1971).

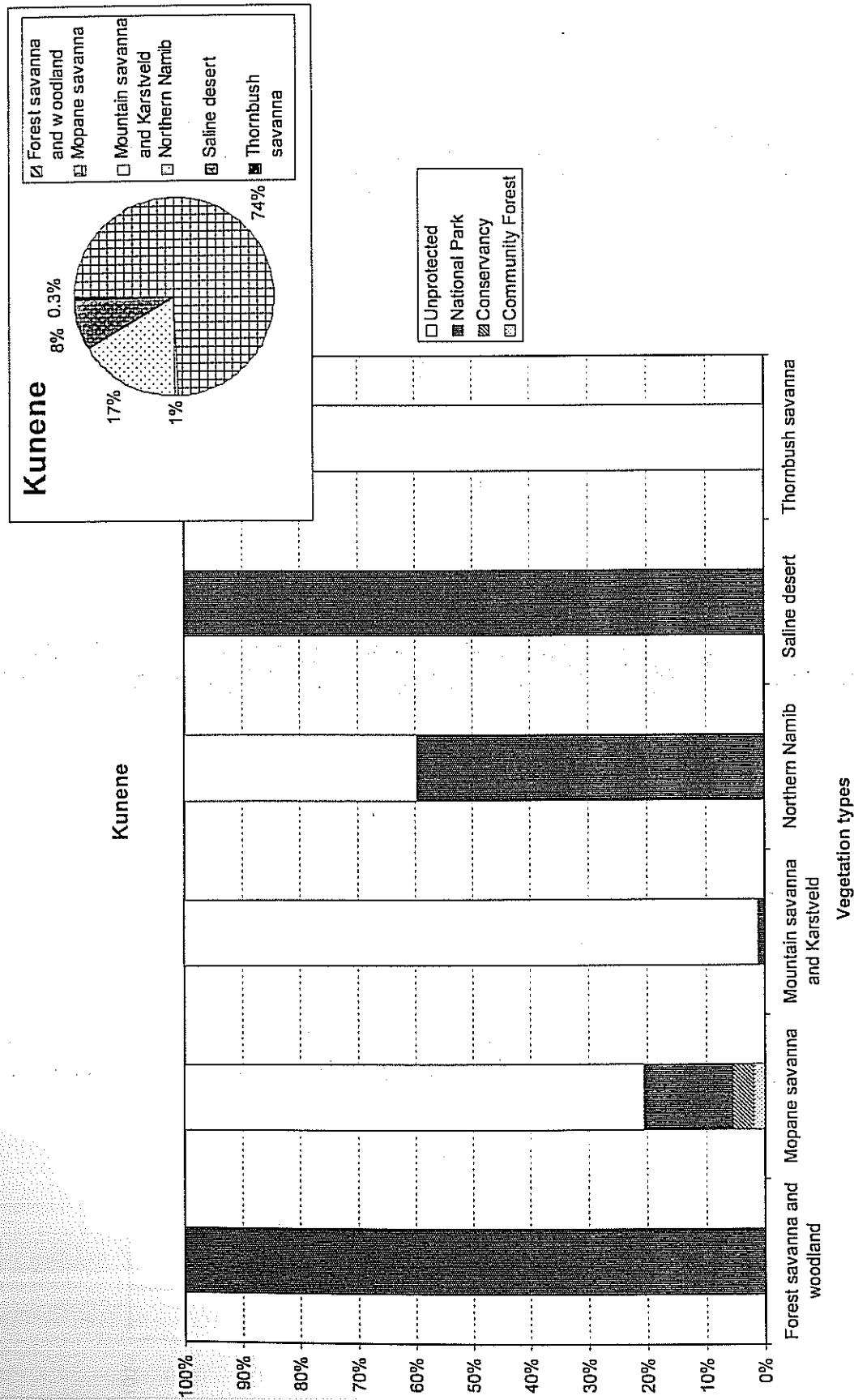


Figure 2. Protected areas per vegetation type according to Giess (1971).



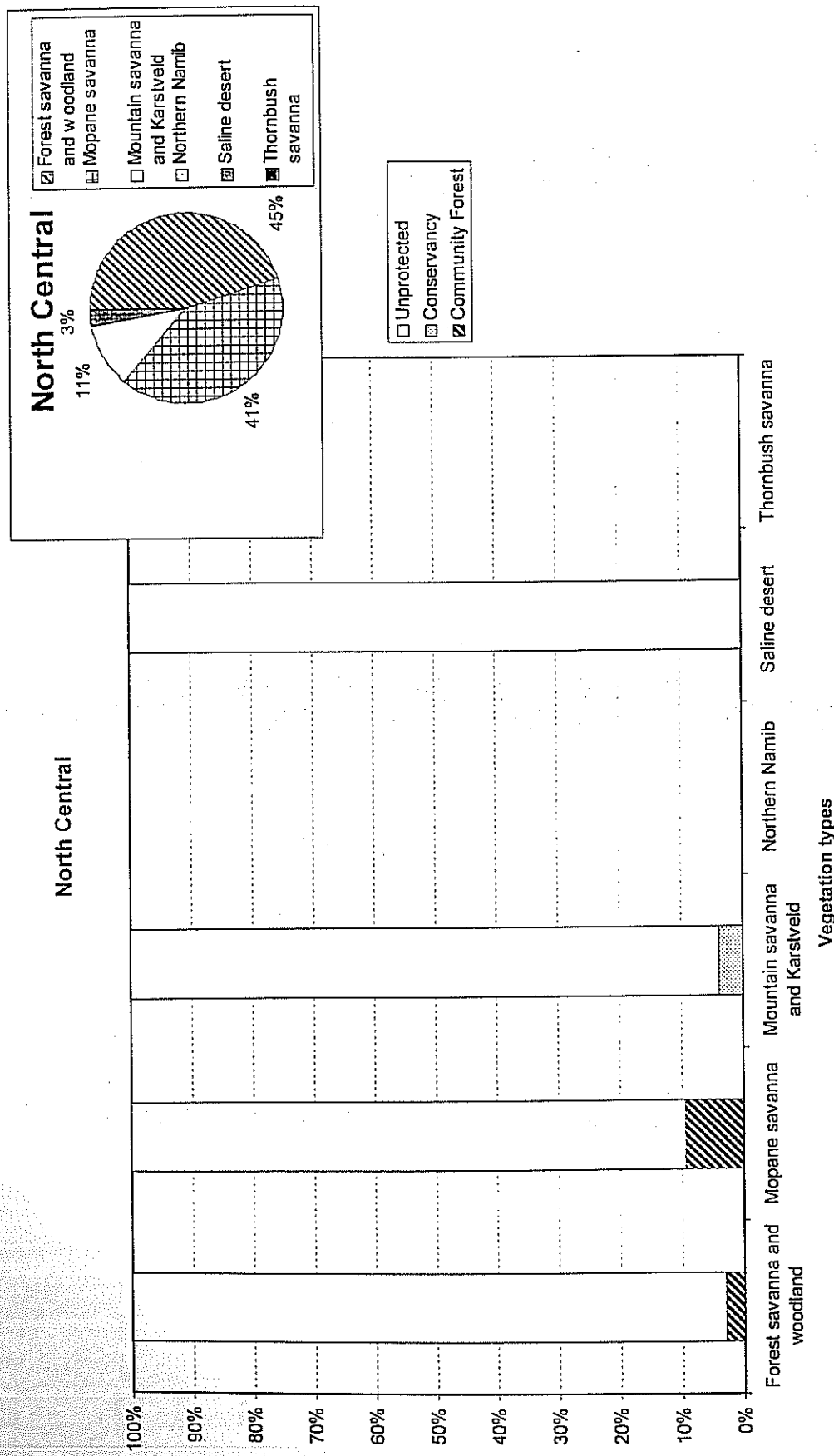


Figure 3. Protected areas per vegetation type according to Giess (1971).

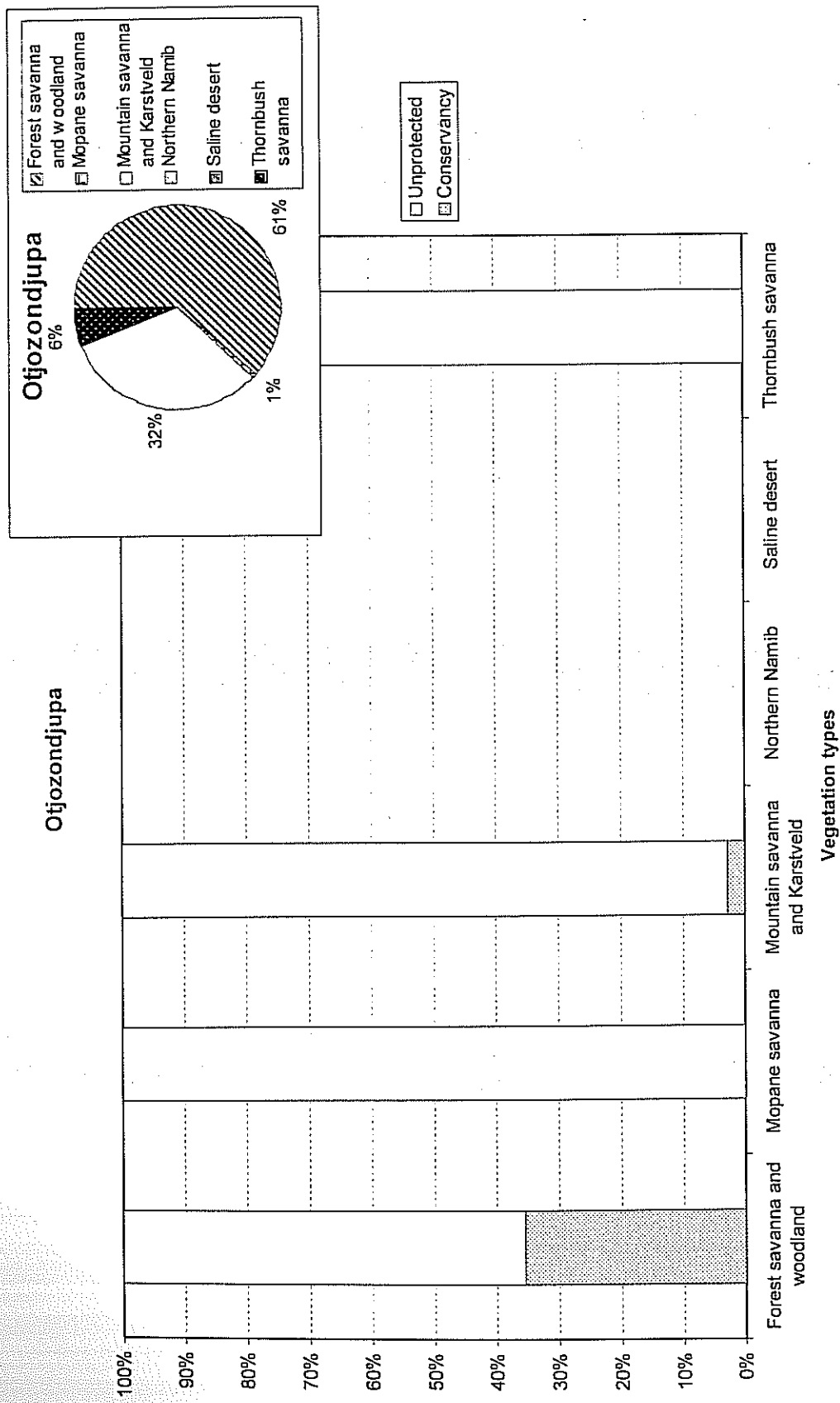


Figure 4. Protected areas according to vegetation type in Otjozondjupa according to Giess (1971).

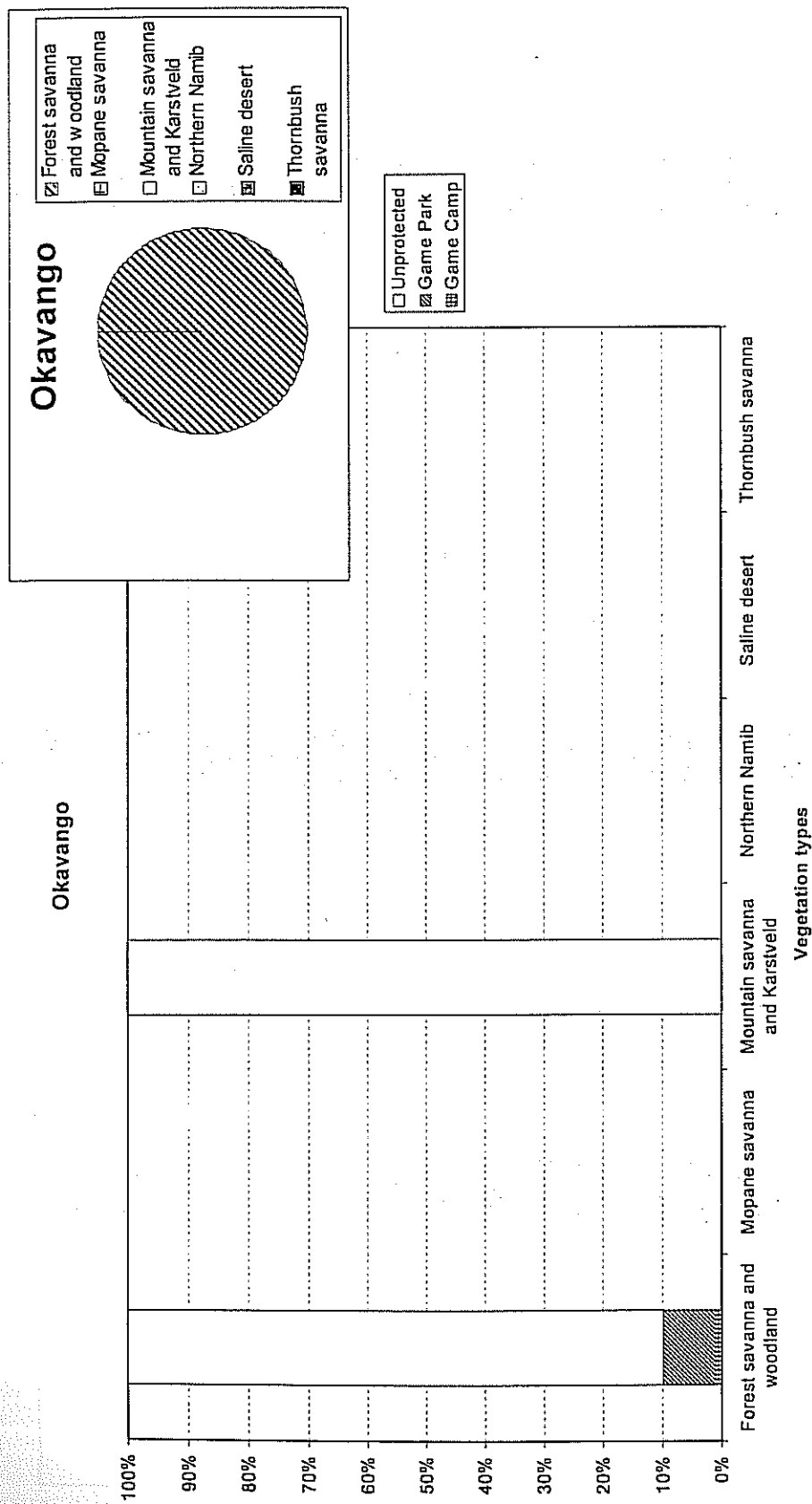


Figure 5. Protected areas according to vegetation type in Okavango according to Giess (1971).

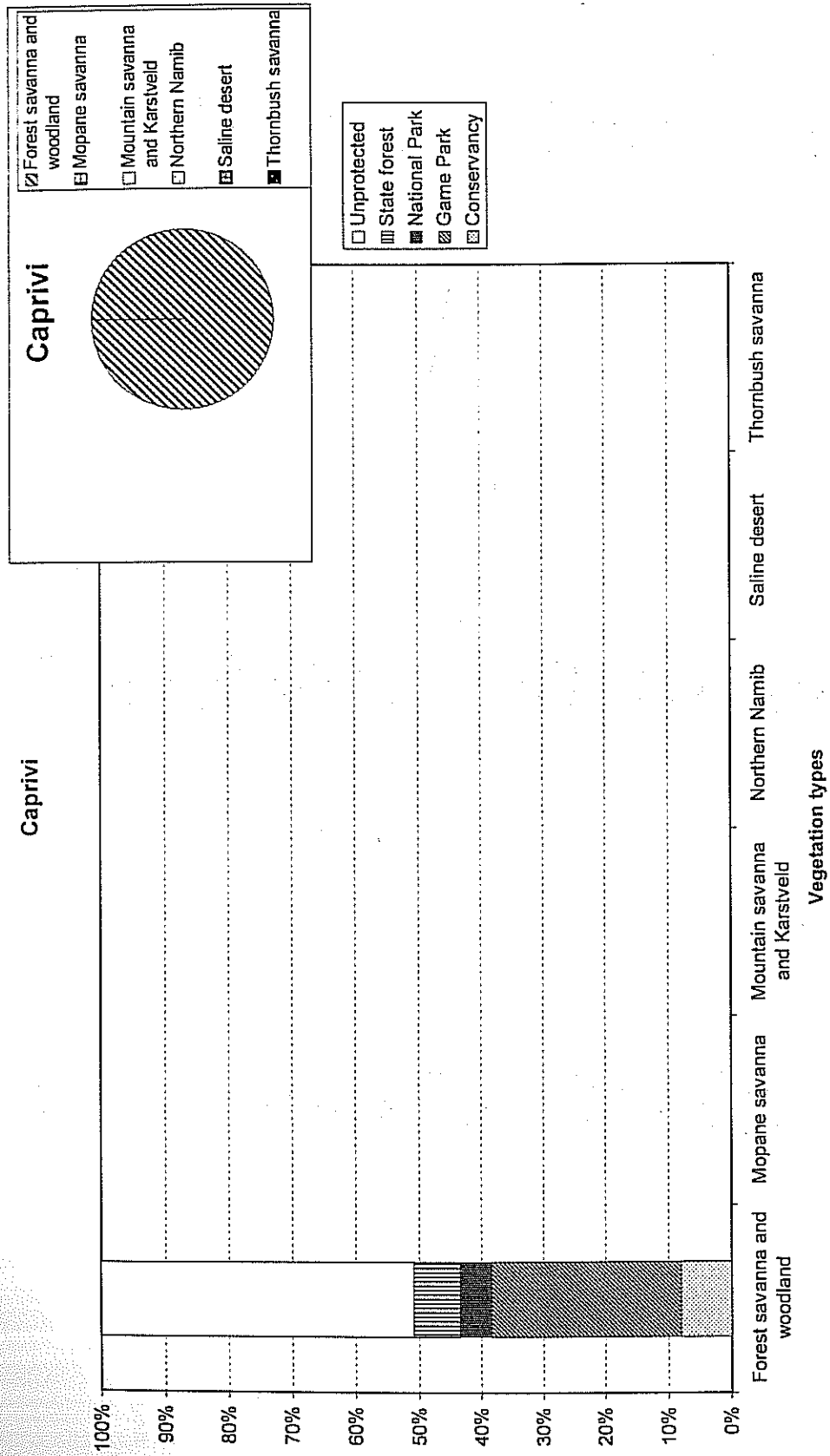
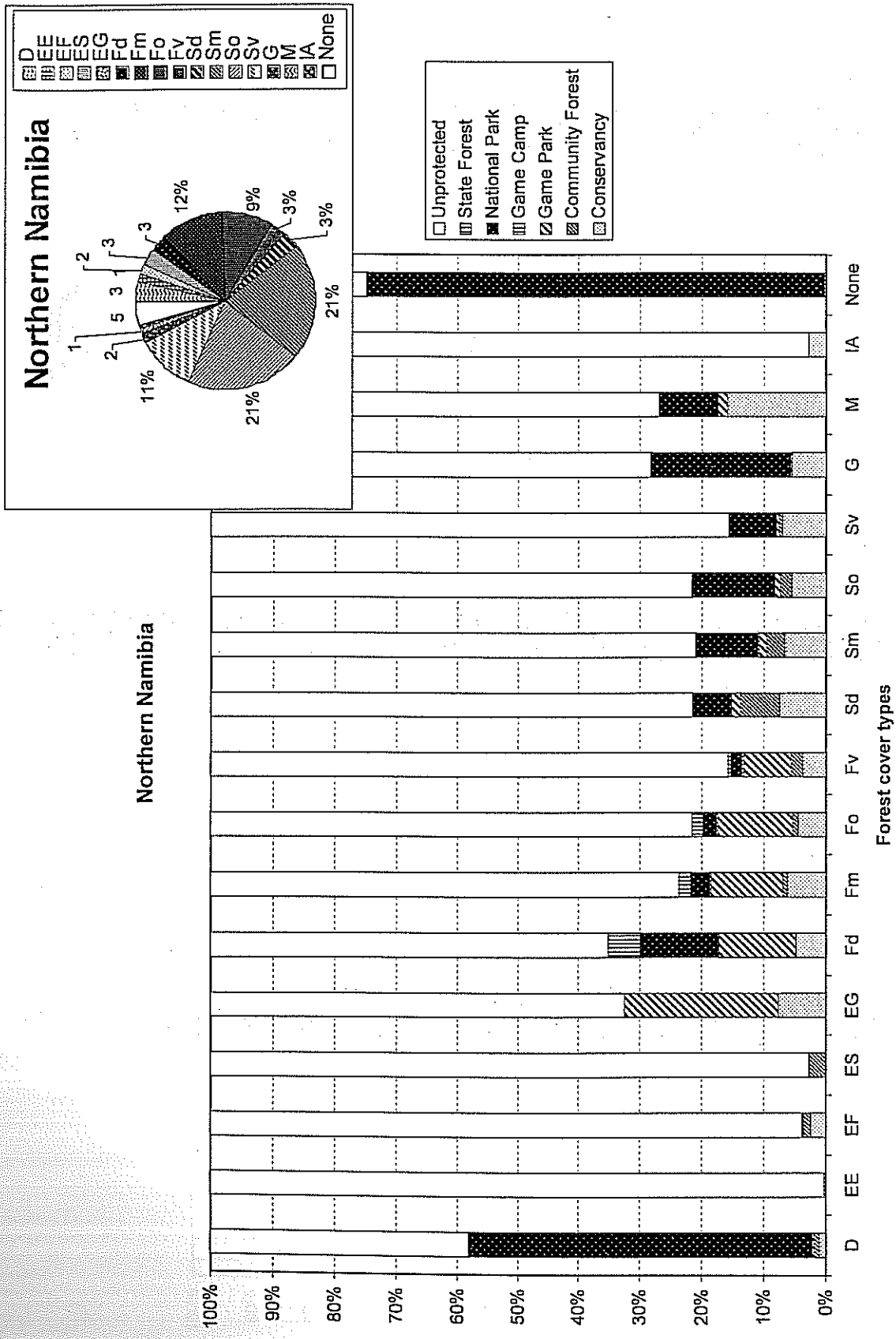
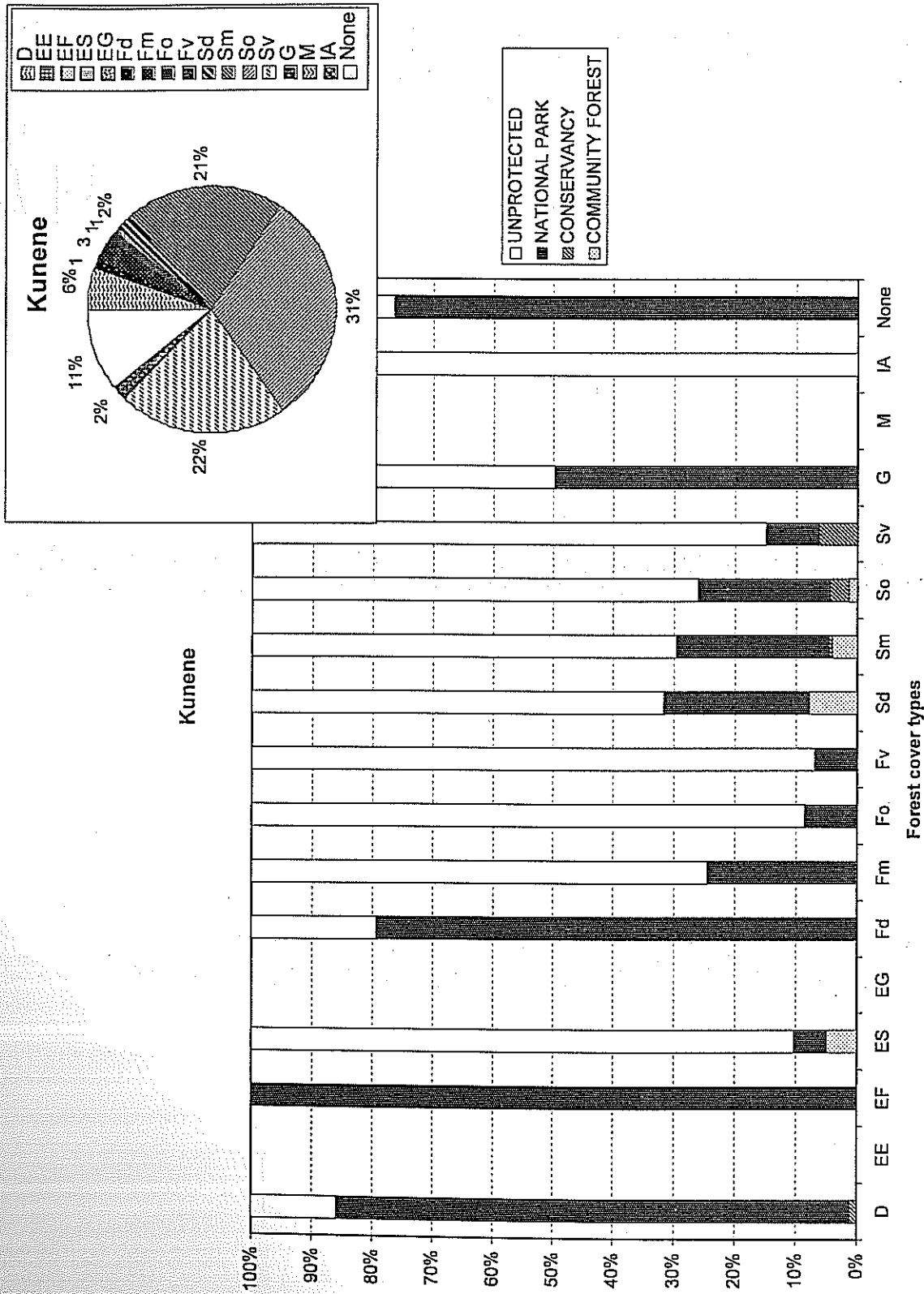


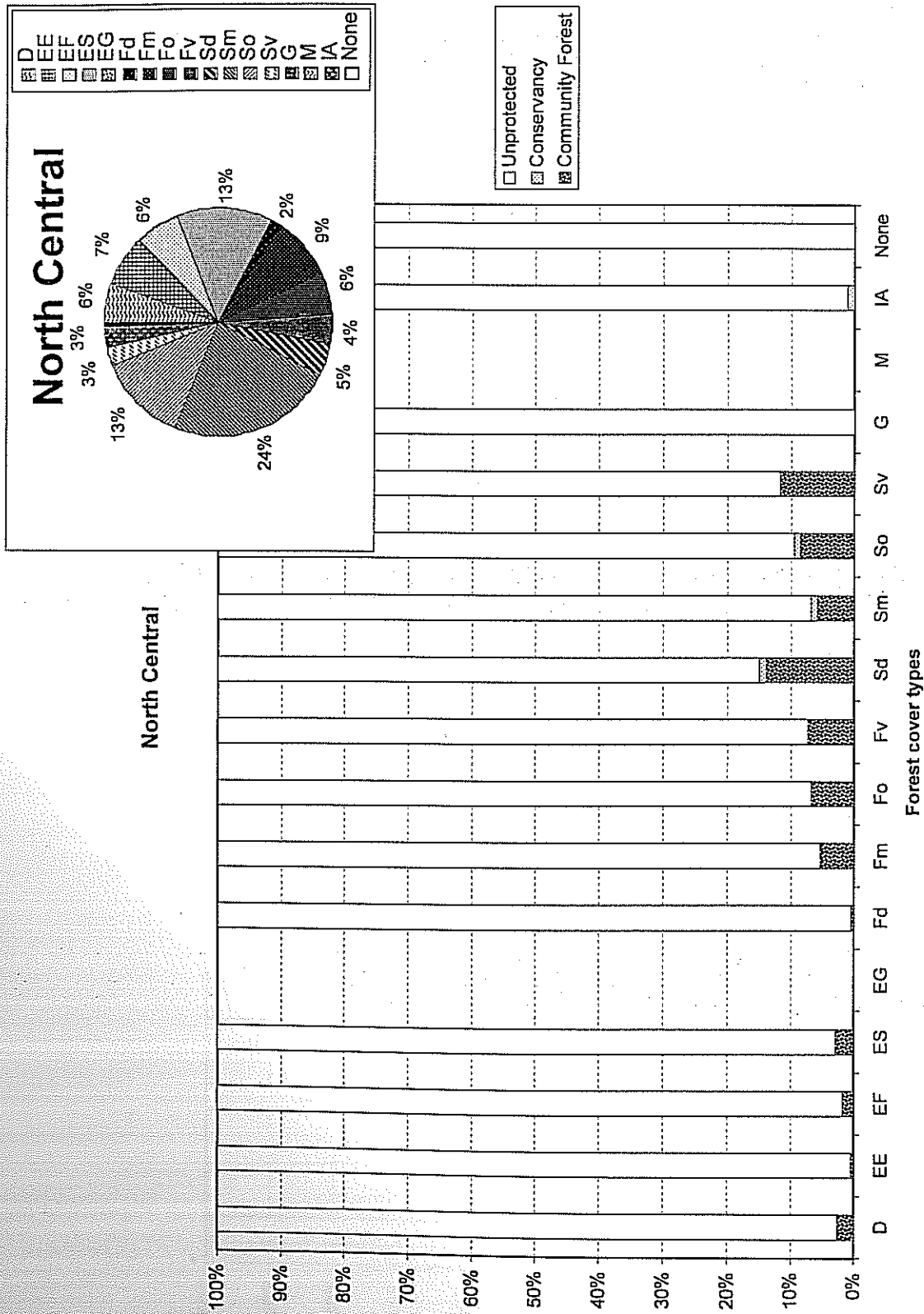
Figure 6. Protected areas per vegetation type in Caprivi according to Giess (1971).



**Figure 7.** Protected areas per forest cover type (D= drainage; E= extensive agriculture; F= forest; S= savanna; G=grassland; M= marshland; IA= intensive agriculture; d= dense; m= medium; o= open; v= very open; none = no vegetation).



**Figure 8.** Protected areas per forest cover type (D= drainage; E= extensive agriculture; F= forest; S= savanna; G=grassland; M= marshland; IA= intensive agriculture; d= dense; m= medium; o= open; v= very open; none = no vegetation).



**Figure 9.** Protected areas per forest cover type (D= drainage; E= extensive agriculture; F= forest; S= savanna; G=grassland; M= marshland; IA= intensive agriculture; d= dense; m= medium; o= open; v= very open; none = no vegetation).

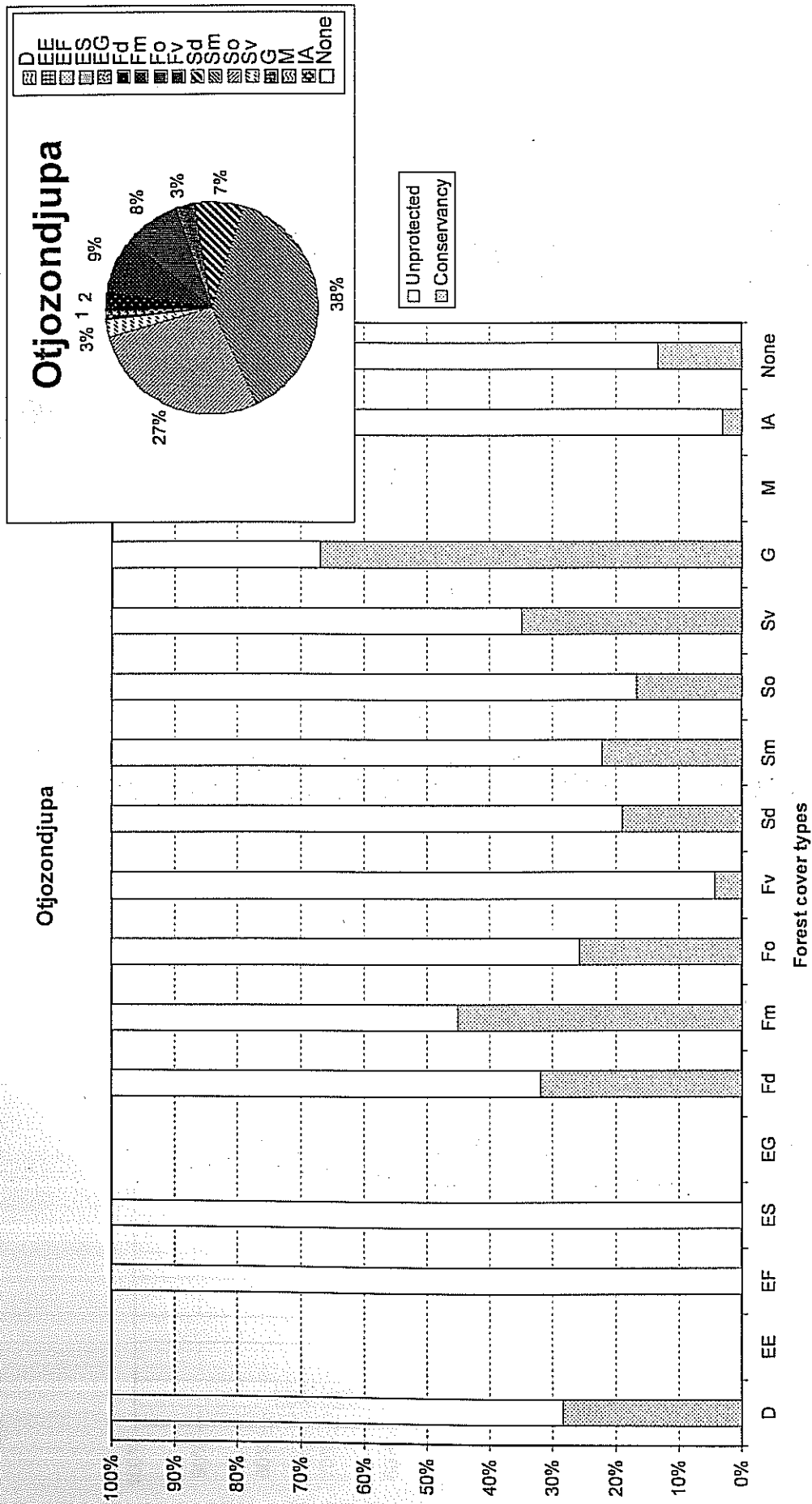
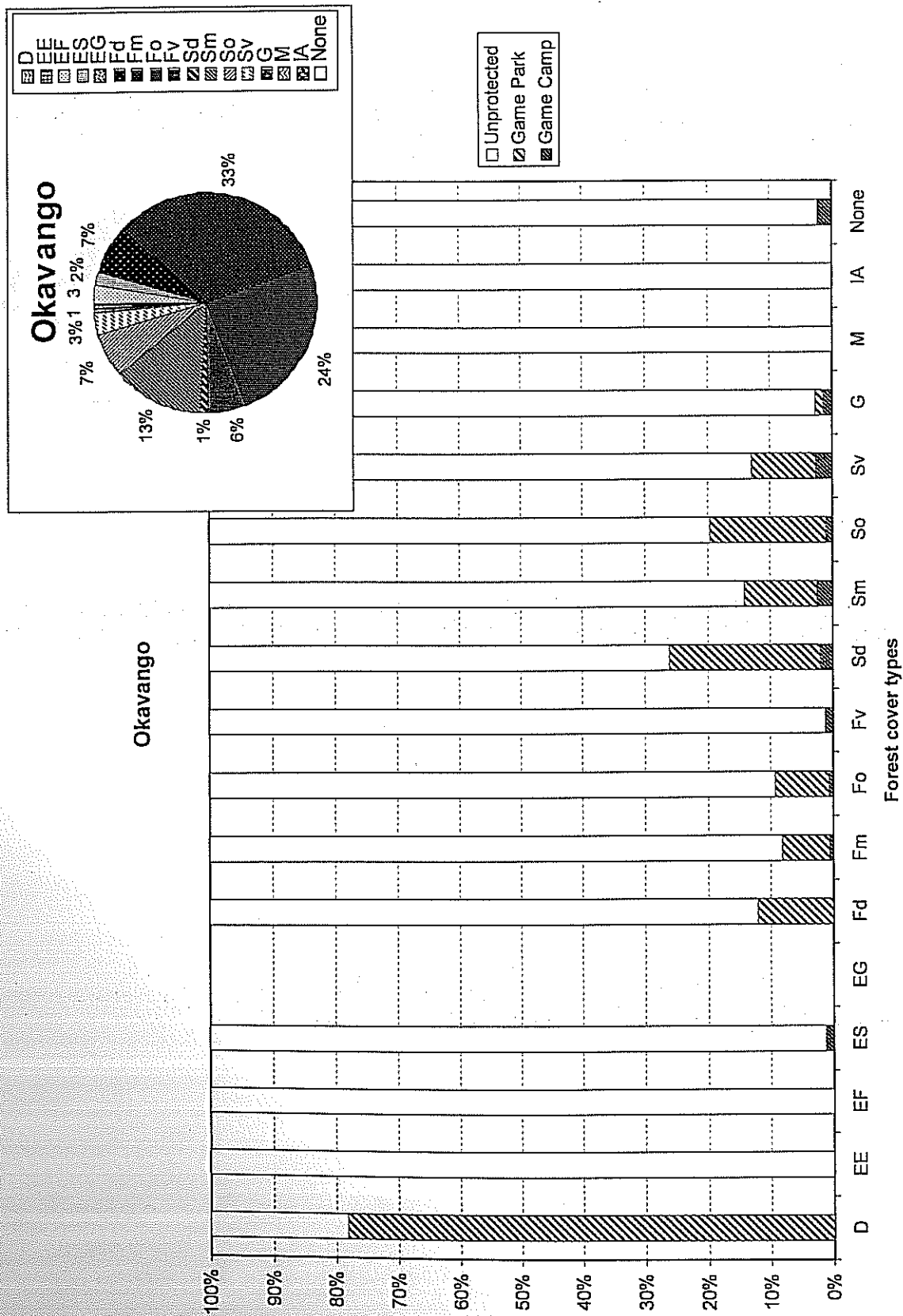


Figure 10. Protected areas per forest cover type (D= drainage; E= extensive agriculture; F= forest; S= savanna; G=grassland; M= marshland; IA= intensive agriculture; d= dense; m= medium; o= open; v= very open; none = no vegetation).





**Figure 11.** Protected areas per forest cover type (D= drainage; E= extensive agriculture; F= forest; S= savanna; G=grassland; M= marshland; IA= intensive agriculture; d= dense; m= medium; o= open; v= very open; none = no vegetation).

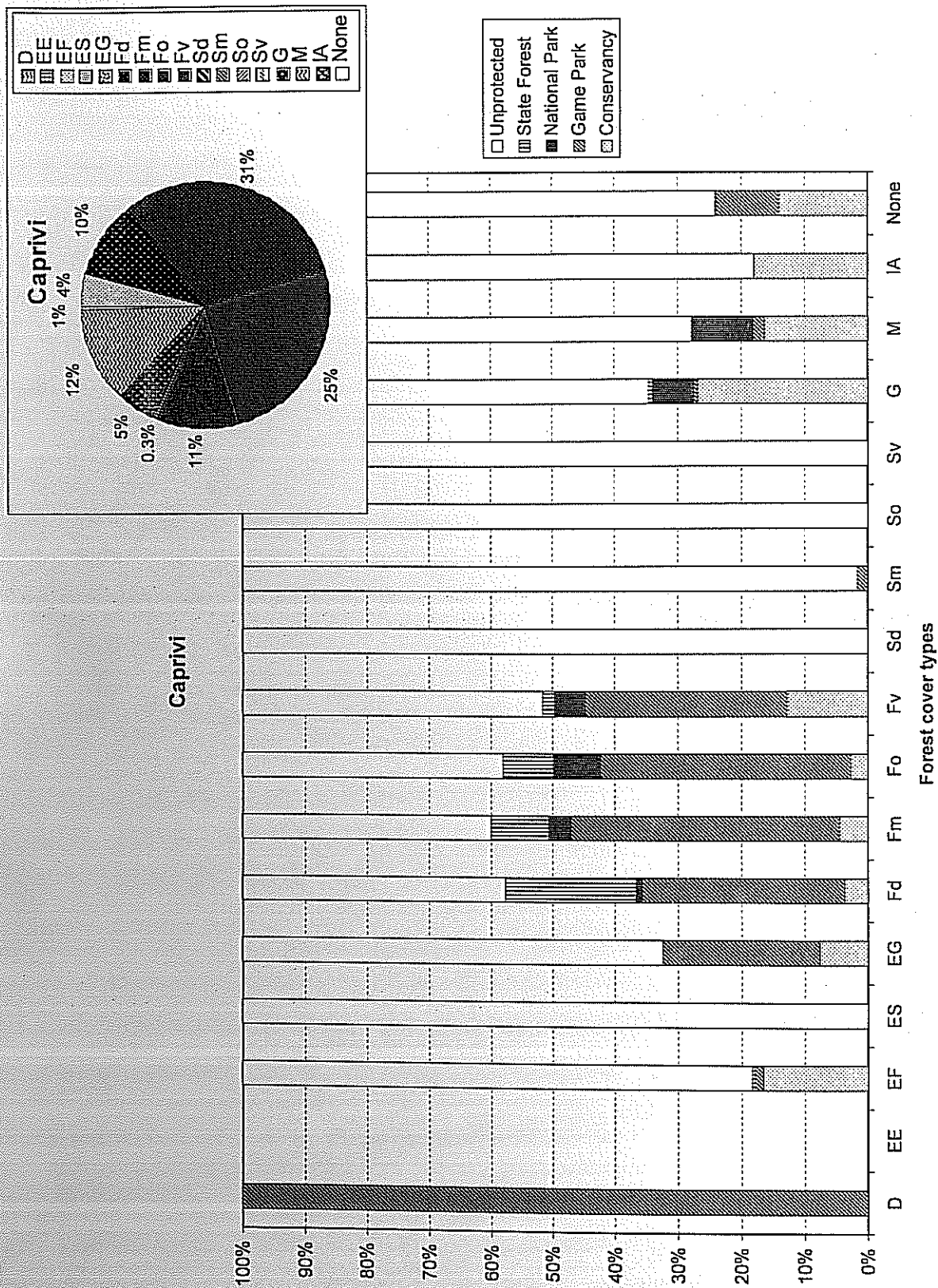


Figure 12. Protected areas per forest cover type (D= drainage; E= extensive agriculture; F= forest; S= savanna; G=grassland; M= marshland; IA= intensive agriculture; d= dense; m= medium; o= open; v= very open; none = no vegetation).

