Chapter 9

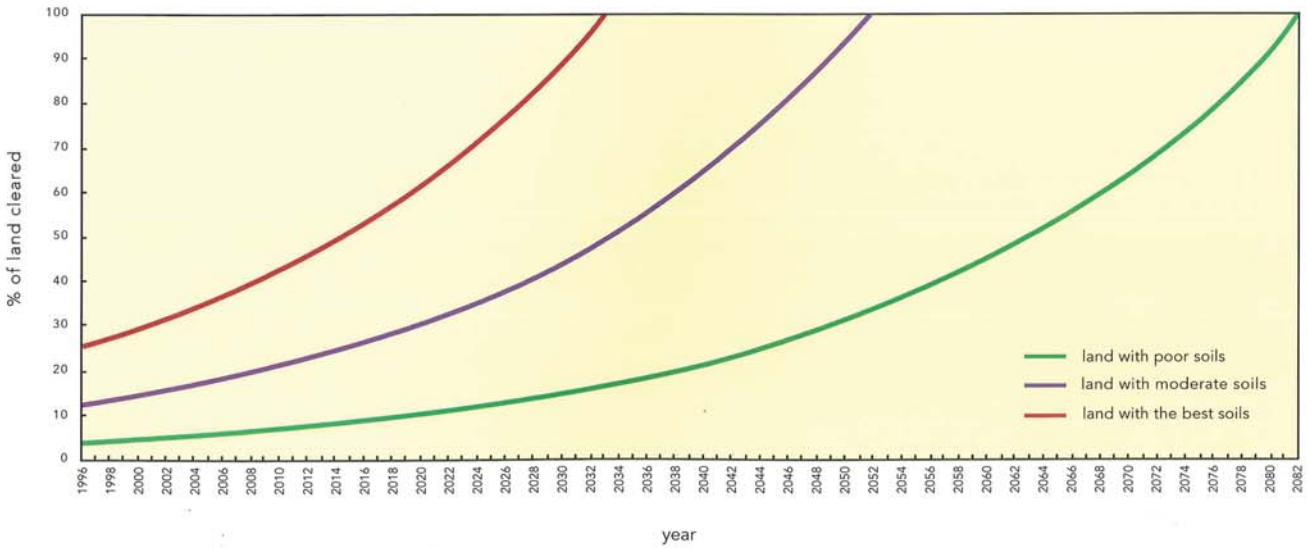
Caprivi in years to come

Much of this book has looked at current environmental issues and some aspects of these in the past. In looking ahead, there is a need to be mindful of how Caprivi's population is developing, what efforts are being made to look after natural resources, and how land can be used. It is hard to escape the general conclusion that land in Caprivi is often misused. For much of the area there are no policies to direct what happens, and where there are policies and legislation they are sometimes ignored. Stock numbers have risen dramatically and to a point where pastures may have become overgrazed; frequent fires have destroyed woodlands and have resulted in the loss of nutrients from soils that are inherently poor; and land for cultivation is being cleared at an alarming rate while little effort is made to restore nutrients to the ground.

Considerations for the future

In 1996 the total number of people in Caprivi was about 110 000, having grown at a rate of over 4% over the past 20–30 years. At 4% growth, we can expect the population to double every 18 or 19 years, reaching about 190 000 by the year 2010 and over six million by the end of the next century! Some would argue that population growth will slow, as increasing levels of education lead to smaller families and AIDS takes its grim toll. Estimates for Zambia suggest that population growth rates could fall to about 1.2% by the year 2010 as a result of the AIDS epidemic, compared to 3.1% in the absence of this disease. Life expectancy in Zambia is now 60.1 years, but could fall to about 30 years by 2010 due to AIDS[1].

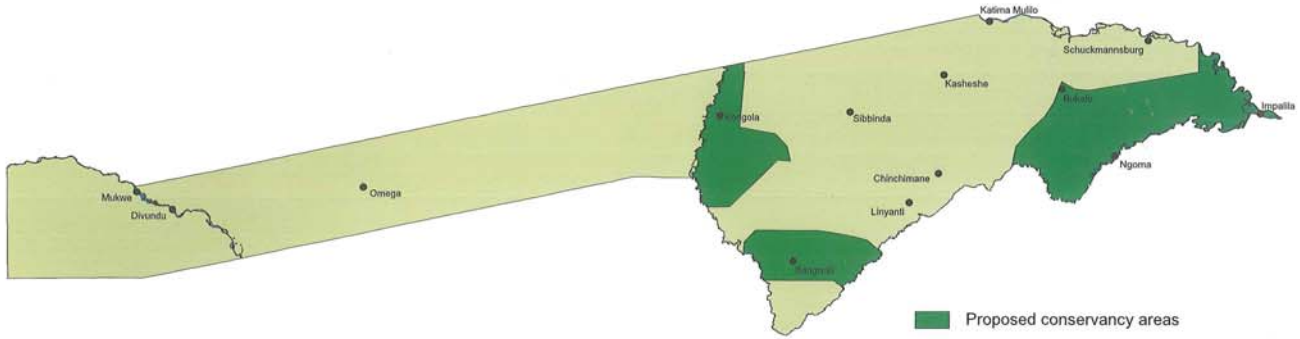
These figures are all estimates and it is difficult to predict exactly how numbers of people will change in the future. It is clear, however, that



Projected increases in the clearance of land for cultivation ▲

If the rate of clearing continues as it has over the past 53 years (page 29), all land in Caprivi will have been cleared for crops by the year 2082. This calculation includes all areas, whether or not the soils are suited to crop farming. All areas with soils rated as having the "best" potential for cultivation will have been cleared by 2033 — just 36 years into the future and within the lifetime of many Caprivians now living. All areas with soils rated as having only moderate potential will have been cleared by the year 2052, and all areas with poor soils will have been cleared by about 2082.

House of bottles — as resources become short, more people will have to resort to alternatives (PT)



Conservancies — communities take charge of their wildlife ▲

Conservancy programmes aim to encourage communities to conserve wildlife and appropriate habitats. In return, the community obtains income benefits from the wildlife, for example, by selling hunting rights to wealthy hunters and granting tourism concessions. These activities are in addition to farming and other practices, and are not intended as alternatives. The hope is that peoples' livelihoods will improve, and that they will attach greater value to animals and unspoilt habitats, more readily accepting occasional damage caused by wild animals, and being more tolerant of formal conservation areas and activities.

Caprivi's population will grow a good deal. We can also predict confidently that demands for land will increase, and more land will be cleared for cultivation each year.

But we could argue that if population growth was to slow down, there may not be as many new farmers needing new land. Crop cultivation practices could also change. If farmers fertilized their land they could harvest similar yields from smaller field areas, and there would be less need to clear new land if existing fields remained fertile. However, there is little evidence to predict that farmers will radically change their cultivation practices. Also, if yields increased, farmers would probably still farm similar areas, rather than reducing the sizes of their fields. Higher yields would improve their incomes — both for consumption and as cash sales. Finally, as more people become wealthier and have surplus cash, demands on land for farming are likely to increase. This is already happening, with commercial farmers now clearing large new farms. These "big" farmers are likely to get access to some of the best land, often at the expense of poorer farmers and people with other uses for the land.

Another scenario for the future would hope that large numbers of people might move off the land to take up jobs in other sectors such as trade, industry and tourism. Again, there is no clear evidence that this is likely to happen to a degree that would significantly change demands on land for farming. Caprivi has no tradition of large-scale migrant labour which might expose and predispose many people to entrepreneurial opportunities. The number of jobs offered by expanding commercial farming and tourism developments will be limited, and there is little likelihood of job-intensive industrial and manufacturing sectors developing to any great extent.

All of this means that there will be greater pressure on areas that are not occupied by people and cattle. Remaining natural resources will have greater value as more and more people compete for access and use of those resources. What can be done? We face several alternatives. We could sit back and ignore these problems. Alternatively we could acknowledge them and hope that somebody will do something about them for us. The other option is to set about improving the treatment of land by developing policies and implementing practices which make the best use of land.

Conservation and ideas on land uses

Against these gloomy scenarios, what can be said about a continued future for Caprivi's natural resources and wildlife? Until recently, formal conservation activities have largely been confined to the five proclaimed reserves. Areas that have enjoyed the greatest attention and assumed value are Mahango Game Park; Mudumu and Mamili national parks; the so-called Buffalo Core Conservation Area across the Okavango River from Mahango; and the triangular strip of land between the Kwando River and eastern border of the Caprivi Game Park.

Most of the emphasis has been placed on the need to look after the populations of large mammals in these conservation areas. Other areas have been treated more arbitrarily. For example, a variety of non-conservation activities are accepted in the Caprivi Game Park, there has been little attempt to conserve woodlands in the state forest, and Popa Falls is largely regarded as an accommodation resort.

Two processes are developing which hope to give wildlife and natural resources much greater value. Both processes are based on the assumption that the future of the environment will be more secure if it is regarded as having a higher value.

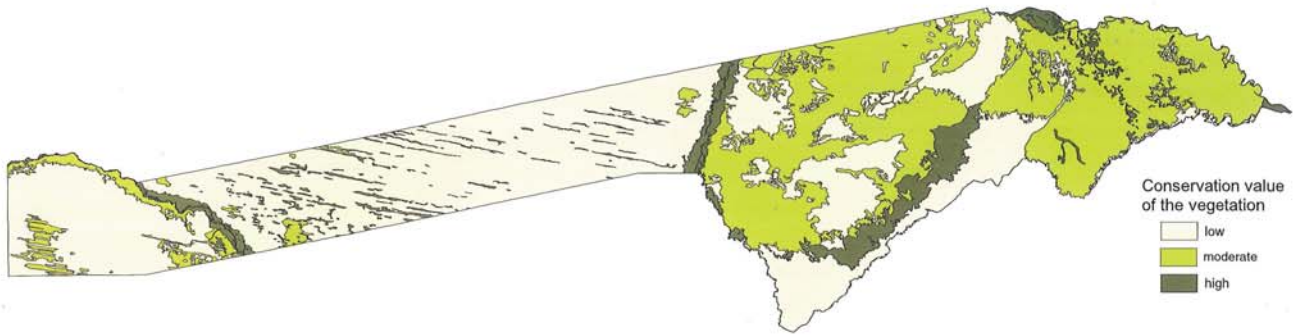
The first process involves promoting tourism. Almost all tourism to the Caprivi is based on the region's wildlife and scenic attractions, and could be expanded substantially[2]. Such expansion would have huge benefits, contributing up to four times as much to the national economy as it does now. The incomes and welfare of people in Caprivi would also increase as they gained employment in the tourism and supporting sectors, and were exposed to a bigger market for the sale of craft, services and other items. People likely to see the best economic gains from tourism would be those living close to protected areas[3]. An expanded tourism sector would enhance the value of protected areas and those surrounding them. It would also create better links between the interests of people living in surrounding areas and those responsible for managing protected areas.

The second process seeks to involve people in conservation efforts within their communities[4]. This follows the recognition that conservation cannot occur within the boundaries of parks alone. Local people have certain rights to the wildlife in their area, and they should be able to reap benefits to ensure wildlife a prolonged future. One programme in Caprivi has promoted the development of conservancies, which are areas managed by, and for the benefit of, local people. A number of conservancies are being developed, some of which are closer to being operational than others. A parallel programme focusing on woodland resources has also been started. Communities are being encouraged to cut and maintain firebreaks and to take an active role in the conservation and management of the vegetation in their area. The involvement of communities in monitoring natural resources has also been promoted. Some people are employed as game guards to patrol areas rich in wildlife, while others monitor the use of natural resources in villages.

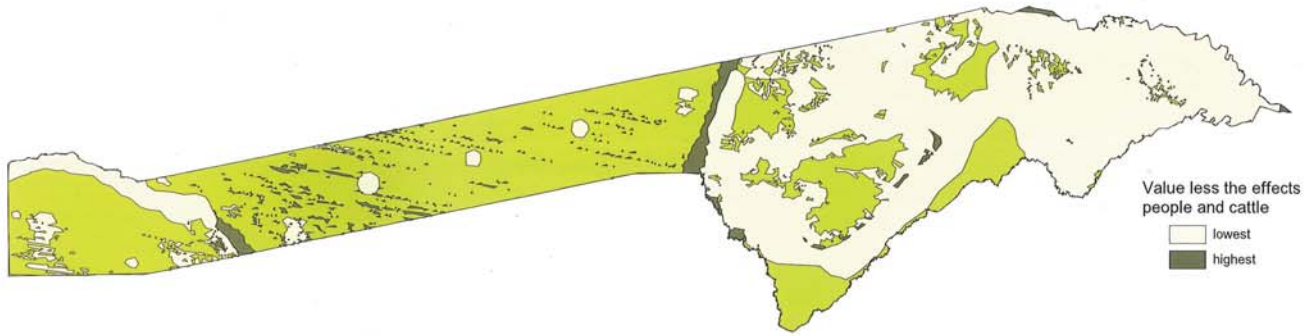
The potential of different areas of Caprivi for conservation and subsistence farming — an evaluation

The following six maps provide some ideas on the suitability of land for conservation purposes and for subsistence farming. The analyses bring together pieces of information presented earlier in this book, and are designed to help highlight those areas where these land uses might be most appropriate[5]. In attempting to value various resources, several assumptions have necessarily been made about what is desirable, workable or useful.

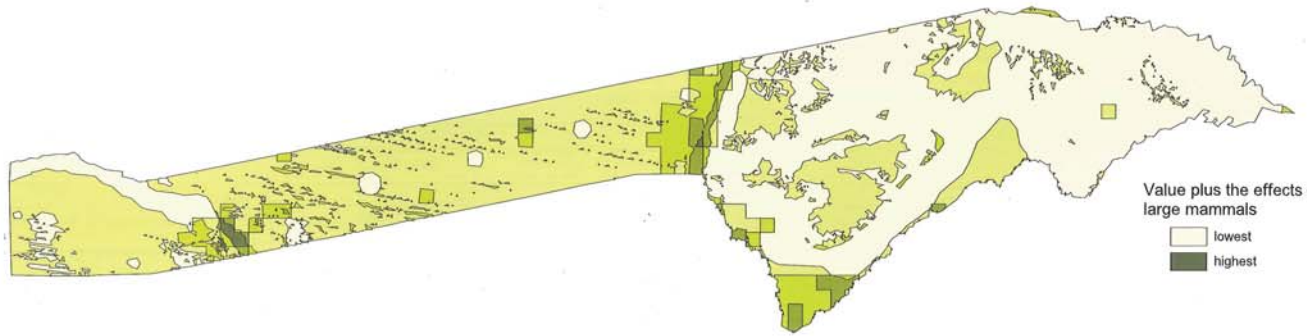
1. An assessment was made of the conservation value of each vegetation unit described in Chapter 5. The three classes (low, moderate or high) provide an overall value which reflects the diversity of plants and animals; the importance of the vegetation unit on regional, national and international levels; the degree of threat by degradation; and the degree to which the vegetation types are conserved elsewhere. Nine units were given high values: Open water, Zambezi woodland, *Omuramba* fringe woodland, Linyanti woodland, Impalila woodlands, Salambala camelthorn woodland, Maningimanzi woodland and channels, and Okavango–Kwando valley woodland and Okavango–Kwando grassland.

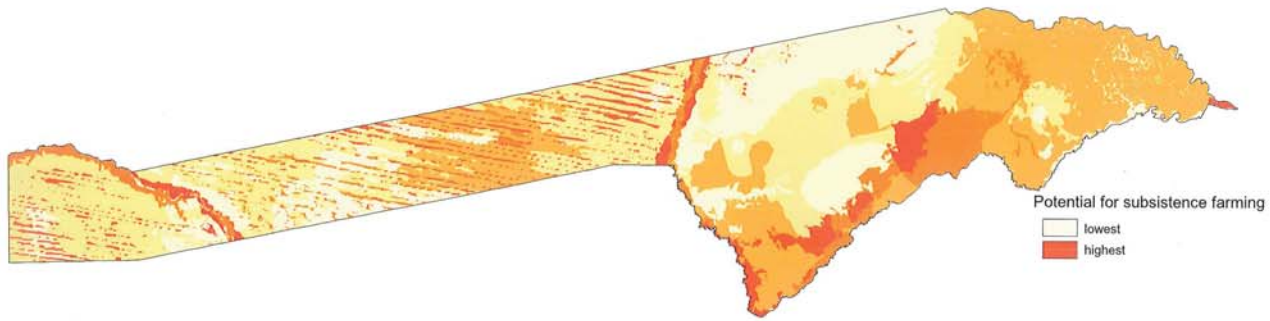


2. In this map, all areas having densities of more than 10 people/km² or 10 cattle/km² have been reassigned to having low conservation value. This is because they are likely to be degraded, and because there are greater chances of conflict between subsistence activities and conservation. Almost all Open water, Zambezi woodland, Linyanti woodland and Salambala camelthorn woodland areas are heavily used by people and cattle. Small areas of Impalila woodlands and Maningimanzi woodland and channels remain available for conservation, as do larger areas of Okavango–Kwando woodland, Okavango–Kwando grassland and *Omuramba* fringe woodland. The small group of islands near Andara, although not visible on the map, deserve special mention because they harbour some of the only riverine woodland in the region and remain largely uninhabited (photo on page 18).

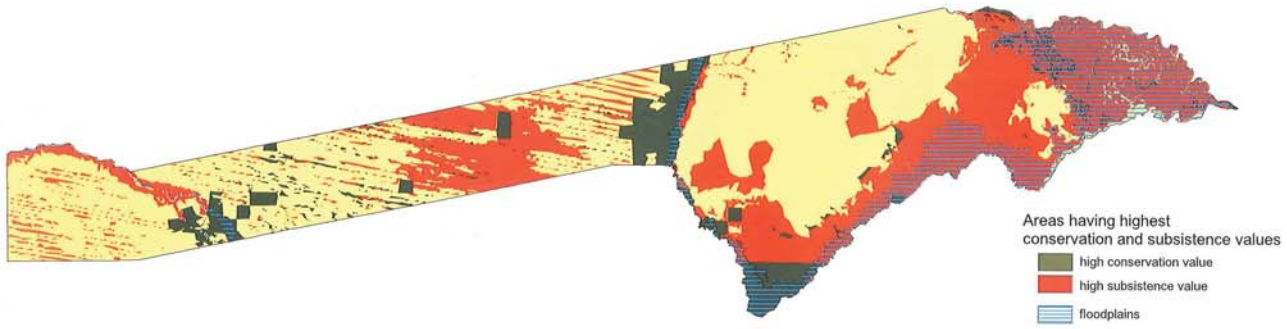


3. Here the presence of large mammals as an indicator of value for conservation has been added. While this information is based on just one survey in 1995 (see page 31), the general patterns of distribution and abundance agree with information collected in other years. There are three reasons why higher densities of large mammals provide additional conservation value:
   - the animals are valuable in their own right,
   - they provide an important attraction to tourists and thereby contribute to tourism revenue, and
   - their presence shows that natural habitats are in good condition.

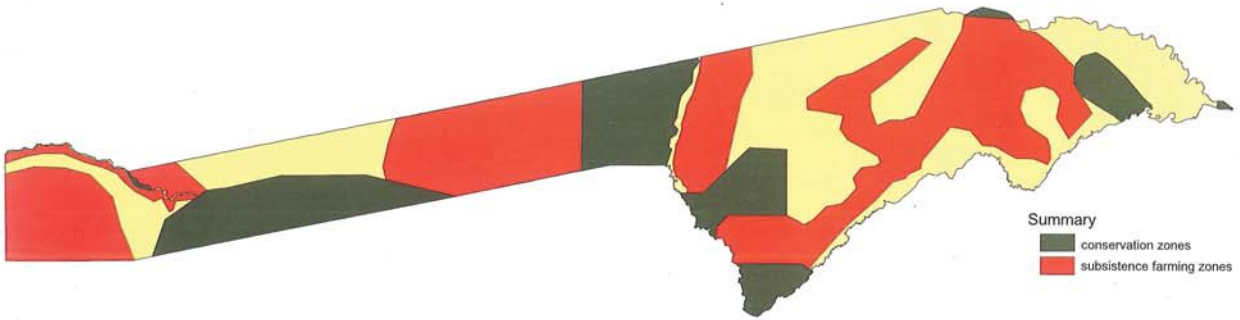




◀4. Land values for subsistence farming were assessed by combining the potential values of soil for crops (page 17), ground water quality (page 39), vegetation resources (page 24), and pasture quality (page 27). The relative importance of these factors will vary from area to area, but the combination highlights those areas where, on average, subsistence farming may be most viable. All sandy areas have low values because they offer little potential for crop or stock farming, while lower-lying areas in dune and river valleys offer greater potential. The large zone running along the Linyanti Swamps has high overall potential, but water supplies in that area may present a problem.



◀5. This fifth map lifts out areas which have the highest values for conservation (from map 3) and those having the highest values for subsistence farming (from map 4). Areas that do not rate highly for either purpose are pale yellow. The map also shows areas that are susceptible to flooding. Even though they can provide good, temporary farming opportunities, any plans to develop and settle people on the floodplains will probably be jeopardized if rain and river levels return to what they were in the 1950s, 1960s and 1970s.



▼6. The final map summarizes those zones in which subsistence and conservation activities might best be developed or maintained. Areas rated highly for conservation include the existing Mahango Game Reserve and Mamili and Mudumu national parks. Other areas justifying some kind of protection are the northern fringe of the Maningimanzi woodland and channels, part of Impalila Island, islands in the Okavango River at Andara, and the eastern third and south-western section of the Caprivi strip. An additional proposal would be to offer protection to an area in the eastern floodplains which could link to the Chobe National Park. This would allow wildlife now hemmed in on the Chobe River to use part of the floodplains. This particular area is subject to a high risk of flooding (page 37) and is consequently not suited to subsistence settlement. Perhaps the best way to conserve all of these areas would be to foster the development of tourism, rather than applying conventional conservation protection to them. Each of these areas has features which could be attractive to tourists, and that kind of development would bring economic benefits to Caprivi and also to people living near those areas.

Broad zones shown in orange are those that emerge from these analyses as being suited to continued or new subsistence activities. These are in the Mukwe area, the central section of the Caprivi strip, the east bank of the Kwando River, north and north-west of the Linyanti Swamps, around Lake Liambezi, along the central section of the Golden Highway, and in a broad band between Katima Mulilo southwards to the Chobe Swamps and Ngoma. Within these broad zones there will be a good deal of local variation, especially in soil quality and water availability, and that variation will determine where subsistence activities are most viable. Areas left as yellow appear not to be particularly suited to either subsistence or conservation uses. They include the floodplain areas, where land-use practices depend on river levels and rainfalls, and the state forest woodlands. Every effort should be made to improve the management of these woodlands, especially through the control of fires, and to restore them in the longer term.

The case for a conservation zone around Caprivi

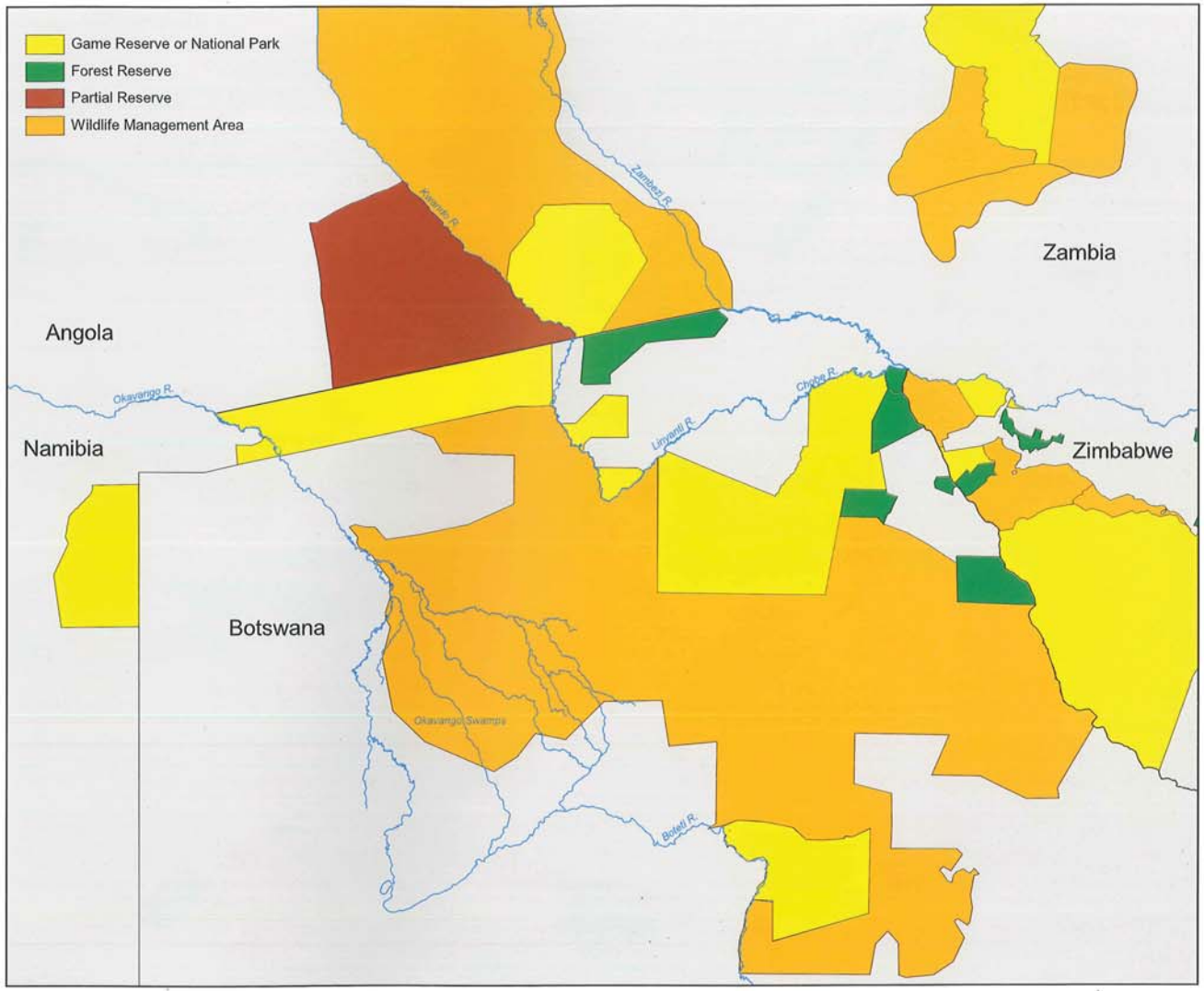
As described in Chapter 2, Caprivi is surrounded by Angola, Zambia, Botswana and Zimbabwe, and the borders cut across broader landscapes of wetlands and Kalahari woodlands. As a result, many animals move across these borders, living both in conserved areas within Namibia and in neighbouring countries. Leaders of today need to give immediate attention to declaring a world conservation zone to encompass this area. This is not the place to recommend the precise boundaries of the zone, but it should include features shown in the adjacent map and perhaps extend northwards, further into Zambia and Angola. Such a proposal is not a new one and has often been on the minds of people concerned about the region's future[6].

Apart from being well-endowed with protected areas, this region also supports large numbers of wildlife. For example, about 120 000 to 130 000 elephants live in this area, perhaps 20–30% of all African elephants[7]. In addition, some of the most important water resources in southern Africa are in the region. These waters need every kind of protection possible, both for people living in the area and for those using that water elsewhere.

This zone is also worth a great deal of money because it holds several valuable tourist destinations. The value of these attractions depends to a large extent on the successful conservation of both wildlife and attractive, unspoilt habitats. Botswana's most lucrative tourist destinations are here (the Okavango Swamps and Chobe), as are Zimbabwe's (Victoria Falls, Lake Kariba and Hwange). The Kafue National Park and Victoria Falls are popular venues for visitors to Zambia. About 9% of all tourists to Namibia include Caprivi on their trip. Because tourists often visit more than one attraction, even in different countries, there is a need to see the whole area as a broad attraction to tourists and tourism revenue.

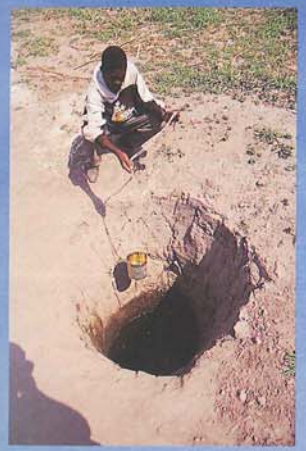
Recognition of this broader area as a world conservation zone would strengthen the need to maintain existing protected areas, and would help guard against detrimental development projects. It would also help persuade different countries to keep their borders open, rather than carving up the region with barrier fences. Tourism and tourist revenues for each country would have added value because the status and prominence of the whole region would be raised. The beauty of the region, its people, water and wildlife resources would indeed face a far more secure future!

Restricted to small areas, elephants become stressed and destructive (PT)



Designated conservation areas in and around Caprivi ▲

The distribution of protected areas in adjoining countries shows how Caprivi's protected areas fit into a regional network of parks, forest reserves and game management areas. Not shown on the map are a large number of community programmes, for example the many Campfire project areas in Zimbabwe, conservancies in Namibia's Caprivi and Otjozondjupa regions, and community wildlife projects in Botswana and Zambia. Each of these countries has gone to considerable efforts to integrate the interests of people living here with environmental conservation. Many of these areas also remain sparsely populated and relatively free of the effects of agricultural degradation.



Appendix

Vegetation units

Compiled by CJH Hines

The structural type given at the end of each description follow: Edward, D. 1983. A broad-scale structural classification of vegetation for practical purposes. *Bothalia* 14:705–712.

Open water

Apart from the obvious rivers, the unit also covers the permanent wetland systems associated with open water and channels on the eastern Zambezi floodplain. Plants characteristic of the margins of these permanent waters are *Phragmites australis* (15–50% cover), *Cyperus papyrus* (15–50% cover), *Salvinia molesta*, *Nymphaea* sp., *Polygonum* sp. and numerous sedge species. The size of this unit varies considerably between years, depending on river levels and the extent of flooding.
Area: 166 km²

Floodplains

Bukalo–Liambezi grassland — This unit is found in the extensive braided drainage system running off the Zambezi floodplain, down the Bukalo Channel and on to the upper drainage of the Liambezi system. As with most of the grasslands of the eastern Caprivi they comprise a mosaic of wetter and drier habitats. Wetter soils are dominated by extensive areas of *Cynodon dactylon* lawns which provide an important grazing resource. Where peat-rich soils occur in these wetter areas, *Imperata cylindrica* is common, occurring in almost mono-specific stands of 25–40% cover. The drier upslope areas are generally sandy with coarse, unpalatable species such as *Hyperthelia dissoluta*, *Hyparrhenia hirta*, *Trachypogon spicatus* and *Eragrostis* spp. occurring at low cover values (5–10%). The soils in this system are heavily utilized for arable agriculture, particularly in the lower sections of the Bukalo Channel and Liambezi drainage.
Structure: Tall open grassland
Area: 223 km²

Chobe grassland–hummock mosaic — This unit is distributed on a series of low sandy plains and hummocks along the Chobe River. Areas of higher ground and hummocks are well wooded with species such as *Acacia erioloba*, *Lonchocarpus capassa*, *Kigelia africana* and *Diospyros mespiliformis* characteristic in the tall tree layer (15–18 m, <5%). An understory of small trees and shrubs (total cover 20–30%) including *Croton megalobotrys*, *Acacia hebeclada*, *Diospyros lycioides* and *Grewia flava* is usually present. The grasslands are dominated by coarse perennials such as *Hyparrhenia hirta*, *Loudetia simplex*, *Aristida stipitata* and *Hyperthelia dissoluta* (20–30% total cover). Some patches of *Cynodon dactylon* lawns also occur here, but they are not particularly extensive.
Structure: Tall open grassland
Area: 294 km²

Chobe Swamp grassland — The grasslands of the Chobe watershed in the area east of Lake Liambezi are similar to those of the Bukalo–Liambezi grassland unit. *Hyperthelia dissoluta*, *Hyparrhenia hirta*, *Setaria sphacelata* and *Loudetia simplex* are all characteristic of this unit at total cover values of between 10–25%. Woody species are rare with the exception of small dense hummocks of *Diospyros lycioides* which are widely distributed in the landscape.
Structure: Tall open grassland
Area: 177 km²

Chobe wetland — These wetlands are limited to the area running along the banks of the Chobe River from Ngoma towards Impalila Island. They are dominated by hydrophytic grasses such as *Vossia cuspidata*, *Echinochloa pyramidalis*, *Phragmites australis* and *Leersia hexandra* at high cover values (25–50% total cover). *Cyperus papyrus* forms large floating rafts or mats. Woody species are rare and normally only found along well developed banks where *Syzygium guineense* and *Rhus quartiniana* are characteristic.
Structure: Wetland mosaic
Area: 73 km²

Dry Mamili grassland — Tall, coarse grasslands are found throughout the northern section of the Mamili National Park. This drier habitat is subject to less frequent flooding than the Wet Mamili grassland. The wooded hummocks here are largely absent and the woody component is restricted to small (3–6 m), isolated *Combretum imberbe* and *Terminalia sericea* trees. The area is predominantly grassland which is made up of a mosaic of coarse tall species such as *Hyparrhenia hirta*, *Cymbopogon excavatus*, *Andropogon schirensis* and *Setaria sphacelata* (total cover of 15–30%), with extensive patches of *Cynodon dactylon* lawns.
Structure: Tall closed grassland
Area: 340 km²

Kwando–Linyanti grassland — This unit describes the tall, flooded grasslands which dominate the seasonally inundated areas along the margins of the Kwando River where it enters the Linyanti swamp system. There are several distinct sub-units in the area, which can only be distinguished in the field. Generally, *Miscanthus junceus* forms dense stands together with *Vetiveria nigritana* as co-dominant. These stands can have cover values of up to 60% but are not extensive. This unit is found on the drier end of the seasonally flooded areas, and is not found in areas of perennial inundation. *Echinochloa stagnina* forms floating mats in areas of extended flooding often occurring with *Vossia cuspidata* and *Echinochloa pyramidalis*. *Phragmites australis* forms extensive dense reed beds throughout this unit.
Structure: High open grassland and wetland mosaic
Area: 121 km²

Liambezi–Linyanti grassland — This grassland unit describes the extensive and largely unwooded grasslands of the Liambezi basin and the fringe of grasslands north of the Linyanti River. Soils are peat-rich organic forms or loamy clays. Most of these are heavily utilized for arable agriculture. The principal grass species are patchily distributed in relation to the relative wetness of soils. Characteristic species include *Eragrostis cf. lappula*, *Imperata cylindrica*, *Loudetia simplex*, *Hemarthria altissima* and extensive patches of *Cynodon dactylon* lawns. Total cover values in the grass layer are between 25–50%.
Structure: Tall open grassland
Area: 617 km²

Okavango–Kwando grassland — The seasonally flooded grasslands and wetlands that line the margins of the Okavango and Kwando rivers are important grazing resources for both wildlife and livestock. Much of the area covered by this unit is made up of extensive mats of *Echinochloa stagnina*, *E. pyramidalis* and *Vossia cuspidata* which can have cover values of 30–60%. Tall emergent grasses such as *Vetiveria nigritana* and *Miscanthus junceus* are also characteristic. *Cynodon dactylon* forms lawns on the water margin and drawndown zone. Perennially wet areas tend to be dominated by *Phragmites australis* and *Cyperus papyrus*. Few woody species occur, but *Rhus quartiniana*, *Acacia hebeclada* and *Sesbania* sp. are characteristic at low cover values (1–3%).
Structure: Tall open grassland and wetland mosaic
Area: 182 km²

Wet Mamili grassland — These grasslands occurring throughout the southern section of the Mamili National Park are periodically subjected to extended periods of flooding. The soils here are variously clay-loams or peat-rich organic deposits both of which remain wet long after flooding has receded. Grasses here are predominantly hydrophytic or water tolerant species with *Imperata cylindrica* the commonest at high cover values (15–25%) and *Hemarthria altissima* dominating wetter habitats with cover values of up to 20%. Wet channels are dominated by a variety of sedges and *Phragmites australis*. Other common species in this unit include *Eragrostis cf. lappula*, *Digitaria brazzae*, *Hyparrhenia rufa*, *Loudetia simplex* and *Tristachya superba*. Small upland hummocks form islands of large trees such as *Acacia nigrescens*, *Garcinia livingstonei*, *Lonchocarpus capassa* and *Diospyros mespiliformis* (1–5% total cover). A distinct understory of *Euclea divinorum*, *Diospyros lycioides* and *Combretum hereroense* occurs on these hummocks.
Structure: High closed grassland
Area: 95 km²

Zambezi floodplain channels — These wetlands are similar to the rivers and open water unit, with the exception that woody species such as *Rhus quartiniana*, *Sesbania* sp. and *Syzygium guineense* can provide cover of up to 5%. These wetlands are characterized by dense, almost monospecific stands of *Phragmites australis*, *Cyperus papyrus*, *Echinochloa pyramidalis* or *Vossia cuspidata* which all occur at high cover values (15–30%). Other grass species such as *Cynodon dactylon*, *Leersia hexandra*, *Miscanthus junceus* and *Hemarthria altissima* are characteristic of the "drier" part of these wetlands. These wetlands dry out irregularly and the highly organic soils called "sitapa" are cultivated for maize production.
Area: 64 km²

Zambezi floodplain grassland — These grasslands cover a large area of the eastern floodplains. This area is a complex, fine-scaled mosaic of wet to dry habitats, the complexity of which is not adequately reflected in this large single unit. However, the separation of the component facies of the mosaic is not possible at the broad scale of this project. The whole area is predominantly grasslands with small islands of woody species widely separated throughout the floodplains. Some woody species such as *Faidherbia albida*, *Terminalia sericea* and *Combretum imberbe* can be found as scattered, isolated individual plants on the floodplains. The wettest facies of the grasslands is dominated by various sedges and grass species such as *Leersia hexandra*, *Hemarthria altissima* and *Phragmites australis*. The moist slopes near channels are commonly dominated by *Imperata cylindrica*, *Setaria sphacelata* and *Miscanthus junceus*, but most importantly by *Cynodon dactylon* lawns which are a valuable grazing resource. Grasses characteristic of drier areas include *Loudetia simplex*, *Eragrostis* sp., *Trachypogon spicatus*,

Digitaria brazzae and *Andropogon schirensis*. Dry sandy habitats are dominated by *Eragrostis pallens*, *Tristachya superba* and *Hyparrhenia* sp. Parts of these floodplains are intensively grazed by livestock, but the resource as a whole can be considered a poor quality grazing resource. Organic channel soils deposits (termed "sitapa") are highly prized arable agricultural areas and much of the maize grown in the Caprivi is grown on these soils.
Structure: Tall open grassland
Area: 1 168 km²

Zambezi transition grassland — This unit describes the extensive and dominant grassland mosaic of unpalatable, coarse species which cover much of the transition area lying between the Kalahari sand upland and the Zambezi floodplain grasslands of eastern Caprivi. Woody plants are uncommon and are usually isolated individuals scattered through the landscape, with some hummocks occupied by *Hyphaene ventricosa*, *Combretum hereroense* and *Euclea divinorum*. The following grass species are characteristic of the association: *Vetiveria nigritana*, *Hyperthelia dissoluta*, *Cymbopogon* sp., *Tristachya superba*, *Aristida stipitata*, *Loudetia simplex* (5–10%), *Andropogon schirensis* (1–5%), *Setaria sphacelata*, *Eragrostis rotifer*, *Imperata cylindrica* and *Diheteropogon* sp. Total cover in the grass layer is generally 10–25%. The relative proportions and occurrence of the different species varies considerably depending on soils, degree of wetness or flooding and soil drainage conditions. For example, *Imperata cylindrica* is most common in areas of extended flooding with organic peat-rich soils, whereas the other species listed (e.g. *Hyperthelia dissoluta*) tend to form a complex on the drier sandy soils less subject to ponding and inundation. *Cynodon dactylon* may form extensive lawns or subcover in taller grassland units. This species is regarded as one of the most important grazing resources on the floodplains. These grasslands form a mosaic with the other units of the floodplains and it is not possible to differentiate them on aerial photographs. *Cynodon* tends to occur on heavier soils and is heavily grazed throughout the year. Zambezi transition grasslands are extensively burnt every year and provide some grazing, but are of generally poor quality and are not heavily used by local stock owners.
Structure: Tall open grassland
Area: 308 km²

Zambezi woodland — These woodlands occur as a series of wooded "islands" throughout the area of transition between the western uplands and the eastern floodplains of eastern Caprivi. They are distinctive in that they form discrete units in an area made up predominantly of grasslands. Total cover in the tall tree (18 m) layer is between 25–50% and is made up characteristically of *Parinari curatellifolia*, *Kigelia africana*, *Diospyros mespiliformis*, *Trichilia emetica*, *Acacia sieberana*, *Lonchocarpus capassa* and *Afzelia quanzensis*. A lower tree layer (8–12 m) is usually present with *Garcinia livingstonei*, *Piliostigma thonningii*, *Acacia sieberana* and *Albizia versicolor* occurring. Palms (*Hyphaene* and *Phoenix*) are also characteristic, usually at low cover values. The shrub layer can be dense (20–40% cover) with *Antidesma venosum*, *Phyllanthus reticulatus*, *Grewia* sp., *Diospyros lycioides* and *Euclea divinorum* being characteristic. Grass cover is variable with annuals such as *Aristida* sp., *Chloris virgata* and *Eragrostis trichophora*, dominating at some sites and perennials such as *Cynodon dactylon*, *Panicum maximum* and *Digitaria* sp., dominating at others. Cover value for grasses range from 5–15% total cover. Soils are generally heavier clay-rich loams and are not extensively cultivated. The grazing resources although not extensive are considered important by local farmers. These woodland "islands" have considerable conservation value in that they are centres of high diversity in otherwise depauperate landscapes.
Structure: High closed woodland
Area: 100 km²

Riverine woodlands

Maningimanzi woodland and channels — The Maningimanzi area, east of Katima Mulilo, is a broad sandy plain made up largely of old river sandbars incised by deep river channels. This broken landscape floods regularly and the vegetation of the area is defined in two distinct sub-units. The sandy areas are covered predominantly by high (15–18m) *Terminalia sericea* woodlands providing 25–50% cover. Other trees include *Albizia versicolor* and *Burkea africana* (1–5%). Shrubs are almost absent under the *Terminalia* canopy and grasses are sparsely distributed. The open water habitats of the river channels and backwaters are covered by *Phragmites australis*, *Typha capensis*, *Vossia cuspidata*, *Echinochloa pyramidalis* and emergent macrophytes. The margins are dominated by dense stands of *Syzygium guineense* and *Rhus quartiniana* (5–15%), with species such as *Trichilia emetica*, *Garcinia livingstonei* and *Kigelia africana* characteristic of the drier margins.
Structure: High closed woodland and wetland mosaic
Area: 88 km²

Okavango–Kwando valley woodland — This unit is found only on the floodplain margins, levees and old fluvial courses along the Okavango and Kwando rivers. The woody component of this unit is well stratified with a high (18 m) stratum comprising *Acacia nigrescens*, *Acacia erioloba*, *Ficus sycomorus*, *Kigelia africana*, *Lonchocarpus capassa* and *Diospyros mespiliformis* being characteristic, especially in a narrow band close to river channels and floodplain margins. Total cover in the high tree layer is usually between 15–30%. A distinct stratum of trees 10–12 m in height is usually found in slightly drier habitats and is characterized by *Acacia tortilis*, *Albizia harveyi*, *Terminalia prunioides* and *Combretum imberbe* at low total cover values (5–10%). *Euclea divinorum*, *Diospyros lycioides* and *Combretum hereroense* characterize the shrub layer but usually provide <5% cover. The loamy soils found within this vegetation unit represent some of the best potential arable soils in the Caprivi and have been extensively cleared for farming on both the Okavango and Kwando rivers. Some are, however, prone to saline accumulation, particularly close to the margins of river courses and channels. These woodlands have some of the highest species diversity indexes (birds and plants) of any habitats in the Caprivi. They are heavily utilized by wildlife and livestock and are probably one of the most threatened habitats in the region. They are largely unprotected, with the exception of areas within the Mahango Game Reserve.
Structure: Tall open woodland
Area: 236 km²

Okavango valley fields and shrubland — This unit reflects the heavy utilization of the Okavango River fringe for arable agriculture, where it is now difficult to assess the original vegetation types of the area. Most of this area is used for growing pearl millet and other small grain crops. Old fields are rapidly encroached by species such as *Dichrostachys cinerea* and *Maytenus heterophylla*, as well as a variety of herbaceous weeds and pioneers. Grasses are predominantly annuals such as *Urochloa brachyura* and *Dactyloctenium giganteum* which often occur in dense (75% cover), monospecific stands.
Structure: High closed shrubland
Area: 187 km²

Mopane woodlands

Gunkwe *mulapos* — This grassland unit is limited to the braided system of drainage lines which run through the extensive Kalahari sand deposits running south-west from Katima Mulilo. The bottomland soils here are loamy clays, and are poorly drained, with some areas subject to prolonged inundation during the wet season. Woody species are limited to small patches of scrub *Colophospermum mopane*, *Terminalia sericea* and *Combretum hereroense* with total cover values never exceeding 5%. Grasses are patchily distributed relative to how well soils are drained, the length of flooding and saline accumulation. On the wetter soils *Eragrostis rotifer*, *Diplachne fusca*, *Setaria sphacelata* and *Dichanthium* sp. are common at cover values of 10–20%. *Cynodon dactylon* forms mat-like patches in areas which are quickly drained but are heavy clays. *Sporobolus fimbriatus*, *Sporobolus coromandelianus* and other low growing species occur on drier clay soils. Patches of large coarse grasses such as *Cymbopogon* sp., *Andropogon* sp., *Heteropogon contortus* and *Hyperthelia dissoluta* are found in areas of sandier soils where water accumulates for short periods. Other than the *Cynodon* lawns these grasslands are of a generally poor quality and the soils are not suitable for arable agriculture.
Structure: Tall open grassland
Area: 148 km²

Linyanti woodland — This unit occurs along a broad belt stretching between the margin of the Linyanti Swamps and the extensive mopane woodlands of the central parts of the eastern Caprivi. This area is heavily settled and much of this unit has been cleared for arable agriculture, fuel and construction wood. The soils are predominantly sandy loams, with small patches of heavier clay-loams which are seldom cultivated. *Acacia erioloba* and *Lonchocarpus capassa* form a distinctive tall tree stratum (15 m) at cover values of 5–15%. They can be found together with *Combretum imberbe* and *Acacia nigrescens* (12 m) which tend to have a patchy distribution and contribute little cover (1–5%). *Terminalia sericea* occurs throughout the area, usually as a large tree (12 m) at cover values of 10–25%. It also occurs in the short tree and shrub strata where it occurs together with *Ziziphus mucronata*, *Combretum hereroense*, *Rhus tenuinervis*, *Grewia flavescens* and *Acacia fleckii*. The cover of the shrub stratum can vary considerably from 5–30%. Perennial grasses are characteristic of the ground layer, although in many areas there is evidence of overgrazing and some of these species are rare or absent. *Stipagrostis uniplumis*, *Digitaria eriantha*, *Eragrostis rigidior*, *Schmidtia pappophoroides* and *Panicum maximum* are all typical of this unit and can contribute up to 25% cover.
Structure: High closed woodland
Area: 623 km²

Mopane–*Aristida* woodland — These woodlands occur only in eastern Caprivi and represent one of the largest and most important vegetation units in the area. Soils are generally heavy clay-loams which are mostly unsuitable for arable agriculture because most are subject to some saline accumulation. Grazing quality is poor and biodiversity low. The greatest value of this particular vegetation resource (and all the other *Colophospermum mopane* dominated units) is as a source of durable construction wood and an important source of fuel wood for the urban centres of the eastern Caprivi. *Colophospermum mopane* is often the only large tree species found in this unit. It varies considerably in size

(8–18 m) and cover (10–30%). In certain areas where soils are better drained, species such as *Acacia erioloba*, *Acacia nigrescens* and *Albizia harveyi* may be found, but these are generally rare and at low cover percentages (<1%). A shrub layer is generally absent but species such as *Euclea divinorum*, *Diospyros lycioides*, *Ximenia americana* and *Croton gratissimus* can be found, usually on termitaria. The grass layer is dominated by coarse, unpalatable annuals such as *Aristida adscensionis*, *Aristida rhiniochloa*, *Chloris virgata*, *Urochloa brachyura* and *Eragrostis viscosa*. Where there are small pockets of reworked alluvial sands *Terminalia sericea* may occur at low cover values and the grass layer may contain species such as *Eragrostis rigidior* and *Digitaria eriantha*.
Structure: Tall closed woodland
Area: 2 374 km²

Mopane–*Burkea* woodland — This unit is found in the central eastern Caprivi and is characterized by a mosaic of heavy clay-loam soils and pockets of deep sands, resulting in a mix of species not normally found together. *Colophospermum mopane* occurs in two distinct forms. The tree form up to 12 m is usually sparse (1–5%) and often found on the margins of small pans, whereas the shrub form (<2 m) dominates the landscape at 15–25% cover. On the pockets of reworked sands, Kalahari sand species such as *Burkea africana* (10–12 m, 5–10% cover), *Erythrolphleum africanum* (8–10 m, 1–5% cover) and *Combretum collinum* (8–10 m, 5–10% cover) are characteristic. Other than *Colophospermum mopane* there are few other species in the shrub layer. Grasses are of variable quality, but are generally of low grazing value. Typical species include *Aristida adscensionis*, *Aristida rhiniochloa*, *Aristida stipoides*, *Chloris virgata* and *Melinis repens* on the heavier soils (5–15% total cover) and *Eragrostis rigidior*, *Schmidtia pappophoroides* and *Stipagrostis uniplumis* on the sandier soils (1–5% total cover).
Structure: Tall closed woodland
Area: 845 km²

Mopane–*Terminalia* woodland — This unit is found in two discreet units within the eastern Caprivi, both of which are associated with the reworking of extensive areas of Kalahari sand and heavier clays resulting in a complex mosaic of highly leached, white sands (dominated by *Terminalia sericea*) interrupted by patches of clay-loams (on which *Colophospermum mopane* dominates). The bands of *Terminalia sericea* have few other woody species, with *Erythrophleum africanum*, *Burkea africana* and *Combretum collinum* the most important but at cover values of about 1%. *Acacia fleckii* is common in the shrub layer at 1–3% cover. Grasses occur at low cover values (1–5%) and are generally unpalatable species such as *Tricholaena monachne* and *Aristida stipoides*. *Colophospermum mopane* (5–10 m) dominates the unit as a whole (probably about 70% of the mosaic of vegetation in the unit is *Colophospermum mopane*) and occurs at cover values of 20–40% cover. Once again there are few other tree species and the shrub layer is largely absent. Grasses are typical of other *Colophospermum mopane* dominated habitats with species such as *Aristida adscensionis* being common.
Structure: Tall closed woodland
Area: 375 km²

Mudumu *Mulapo* woodland — This unit is defined in two discrete areas in the eastern Caprivi. The most extensive area is along the Mudumu Mulapo which runs east off the Kwando River, the smaller unit occurs south of Bukalo. In both these areas the Kalahari sands have been extensively reworked by fluvial action, resulting in a landscape dominated by deep, dystrophic, highly leached sands, interrupted occasionally by small pockets of clay-loams. The vegetation on the sands is characterized by large (8–12 m) *Terminalia sericea* at 10–20% cover. Other species typical of Kalahari sand habitats such as *Burkea africana*, *Baphia massaiensis*, *Bauhinia petersiana* and *Combretum collinum* also occur at low cover values (1–5%). The grass layer here is dominated by coarse grasses such as *Eragrostis pallens* (10–20%), *Aristida meridionalis*, *Aristida stipitata*, *Andropogon chinensis* and *Panicum kalaharense*. The pockets of heavier soils are dominated by low (2–4 m) *Colophospermum mopane* at cover values of 10–20%. Other woody species are uncommon. The grass layer is dominated by annual grasses such as *Aristida* sp., *Chloris virgata* and *Eragrostis viscosa*. This unit has very low values for agriculture, conservation and biodiversity.
Structure: Tall closed woodland
Area: 229 km²

Salambala camelthorn woodland — This unit is limited in extent and is specifically associated with a fluvial dune system south of Katima Mulilo in the Salambala area. It is easily recognizable on satellite imagery and aerial photography of the area. The woody component of this unit is clearly stratified and is characterized by high (15 m) *Acacia erioloba* trees occurring at cover values of up to 20% with a distinct substratum of shrubs and small trees. Other large tree species include *Lonchocarpus capassa*, *Afzelia quanzensis*, *Combretum collinum*, *Berchemia discolor* and *Acacia nigrescens* at low cover values. *Terminalia sericea* dominates the low tree layer (8–12 m) and shrub layers at cover values of <20%. The shrub understory has a variable species composition but comprises <15% cover throughout. Characteristic species include *Dichrostachys cinerea*, *Rhus pyroides*, *Grewia flavescens* and *Euclea divinorum*. The grass layer is dominated by annuals such as *Dactyloctenium giganteum*, *Panicum cf. maximum*, *Aristida stipoides* and *Tricholaena monachne*. Perennials such as *Schmidtia pappophoroides*, *Eragrostis rigidior* and *Digitaria eriantha* occur at low densities. Soils are grey-brown medium to fine grained sands and sandy loams which are well drained, but are thought to have only moderate development potentials for arable agriculture. Although the grass layer is dominated by annuals it is nevertheless an important grazing resource in the area.
Structure: High closed woodland
Area: 20 km²

Kalahari woodlands

***Burkea–Combretum* woodland** — Units are found through-out the region, largely west of the Kwando River, which form a continuum with the *Burkea*–kiaat–false mopane woodlands and the *Burkea* shrubland. The *Burkea–Terminalia* woodland of eastern Caprivi may represent the same woodland type, but are separated because of the influence of fluvial processes in the local topography and the presence of *Colophospermum mopane*. This unit is typically dominated by *Burkea africana* (10–15 m) at varying densities (15–25%). Species such as *Pterocarpus angolensis*, *Guibourtia coleosperma* and *Ricinodendron rautanenii* all occur within this unit, but at low cover values. The overall structure of the vegetation is considerably more open than *Burkea*–kiaat–false mopane woodland. *Terminalia sericea* dominates the low tree layer (10–15%, 4–8 m high) together with *Combretum collinum*, *Erythrophleum africanum*, *Combretum psidioides* and *Ochna pulchra*. The shrub layer is generally open (15%) with *Baphia massaiensis*, *Bauhinia petersiana* and *Grewia retinervis* contributing most of the cover. *Diospyros chamaethamnus*, a mat-forming woody species, can provide up to 10% cover, and is especially common in areas burnt frequently. The grass cover is generally low (5–10% total cover) with *Schmidtia pappophoroides*, *Digitaria eriantha*, *Eragrostis pallens* and *Stipagrostis uniplumis* being characteristic. Soils are deep, dystrophic sands on dune slopes and sandy plains, and have low potential for farming. Grazing is likely to be of moderate to poor quality.
Structure: High closed woodland
Area: 2 717 km²

***Burkea*–kiaat–false mopane woodland** — This woodland occurs in two widely separated areas of deep sands. West of the Okavango River it is common and widespread, mostly on deflated dunes and undulating sandy plains. It also occurs as a broad band of woodland running west and south of Katima Mulilo in an area of Kalahari sands which have been extensively reworked by fluvial action. These woodlands may represent a "mature" form of the *Burkea–Combretum* woodland described above, the biggest difference between the two being the higher canopy cover of the main species in this unit. *Burkea africana* dominates the tall (13–15 m) tree layer at cover values of 10–25%, which together with *Guibourtia coleosperma* (5–15% cover), *Pterocarpus angolensis* (5%) and *Ricinodendron rautanenii* (5%) provides a dense woodland. The small tree layer (4–8 m) is dominated by *Terminalia sericea*, *Erythrophleum africanum*, *Combretum psidioides*, *Combretum collinum* and *Lonchocarpus nelsii* at total cover values of 10–20%. The shrub layer is characterized by *Bauhinia petersiana* and *Grewia retinervis*. Grasses are predominantly perennials with species such as *Schmidtia pappophoroides*, *Stipagrostis uniplumis*, *Aristida stipitata* and *Digitaria eriantha* dominating at low cover (10–15%).
Structure: High closed woodland
Area: 1 142 km²

***Burkea* shrubland** — These shrublands may represent a degraded form of the previous two units and *Burkea–Terminalia* woodland (below) or an edaphic form of shrublands which has the same component species as those units but has assumed a completely different structure. Soils are dystrophic sands and have little agricultural value, either as an arable resource or for grazing purposes. Trees over four metres high are rare and seldom contribute more than one percent total cover. Characteristic species include *Burkea africana*, *Pterocarpus angolensis*, *Combretum collinum* and *Acacia erioloba*. The shrub layer is generally characterized by *Terminalia sericea* (dominant at 15–30% cover), *Lonchocarpus nelsii*, *Bauhinia petersiana*, *Baphia massaiensis*, *Burkea africana* and *Grewia retinervis*. Total cover in the shrub layer can be as high as 50% in badly encroached or disturbed areas. Grasses are generally unpalatable annuals or woody perennials such as *Eragrostis pallens*, *Aristida stipoides* and *Aristida stipitata*.
Structure: High closed shrubland
Area: 393 km²

***Burkea*–teak woodland** — Occurs on deep Kalahari sands in an area of well-developed dunes in the central Caprivi strip. The woody vegetation is clearly stratified with a tall (15–18 m) tree layer comprising *Burkea africana* (10–20%), *Baikiaea plurijuga* (10–20%), *Guibourtia coleosperma* (1–5%), *Pterocarpus angolensis* (1–5%) and *Ricinodendron rautenenii* (1–5%). A tree layer 6–8 m high (10–15% total cover) is present and

dominated by *Terminalia sericea*, *Erthrophleum africanum* and *Combretum collinum*. Shrub cover is low (5–15%) and is mostly provided by *Bauhinia petersiana*, *Grewia retinervis* and *Baphia massaiensis*. Grasses are predominantly annuals but *Schmidtia pappophoroides*, *Stipagrostis uniplumis* and *Digitaria eriantha* all occur at cover values of 1–5%.
Structure: High closed woodland
Area: 1 037 km²

***Burkea–Terminalia* woodland** — This discrete unit in eastern Caprivi and is formed on a large sandy ridge running south and east of Bukalo towards Ngoma. The sand has been extensively reworked by the flow of water which has resulted in a mosaic of extensive sand deposits and small lenses of heavier soils characterized by *Colophospermum mopane*. Those areas which represent transition soils between the sands and heavy clays are favoured for cultivation. This unit has much the same component species as *Burkea–Combretum* woodland and *Burkea*–kiaat–false mopane woodland, with the exception that *Terminalia sericea* occurs at much higher cover (15–25%) in the low tree layer, and that apart from *Burkea africana* the other large tree species, e.g. *Pterocarpus* are rare or absent. *Combretum* species are also relatively more important in here than in *Burkea–Combretum* woodland and *Burkea*–kiaat–false mopane woodland. The quality of the grasses is poor because annuals dominate (*Aristida adscensionis*, *Eragrostis dinteri*, *Aristida stipoides*, *Urochloa brachyura*) and the perennials which do occur are woody and unpalatable, e.g. *Eragrostis pallens*, *Aristida stipitata*. This may be a reflection of the poor quality of the soils, most having been reworked and leached by the action of water.
Structure: High closed woodland
Area: 242 km²

***Omuramba* fringe woodland** — This vegetation unit forms a distinct fringe along the lower slopes of dunes or *omuramba* margins throughout the Caprivi strip. *Acacia erioloba*, *Combretum imberbe* and *Acacia nigrescens* form a distinct tree layer 10–15 m high at cover values of 10–25%. Elements of vegetation characteristic of both heavy soils and Kalahari sands occur and *Terminalia sericea* dominates the low tree layer (four metres) at 10–15%. Other tree species characteristic but providing little cover include *Acacia fleckii*, *Lonchocarpus nelsii*, *Peltophorum africanum*, *Combretum hereroense* and *Burkea africana*. The shrub layer is dominated by *Dichrostachys cinerea*, *Baphia massaiensis*, *Bauhinia petersiana* and *Croton gratissimus*, usually at low cover percentages. Perennial grasses characterize the ground layer with *Schmidtia pappophoroides*, *Digitaria eriantha* and *Panicum maximum* providing the bulk of the cover (10–20%). This unit provides important grazing habitat for wildlife within the West Caprivi and has high potential for arable agriculture. Given the diversity of species recorded within this unit it has a high conservation value.
Structure: High closed woodland
Area: 257 km²

***Omuramba* grassland** — These grasslands occur in the *omuramba* bottoms throughout the Kalahari sand areas. They mostly lack woody vegetation with the exception of large (12 m) isolated *Acacia erioloba*, *Combretum imberbe* and *Combretum hereroense* which are scattered throughout at low cover values (1–5%). *Imperata cylindrica* dominates the wetter areas of the *omuramba* bottoms occurring at 10–30% cover. The drier grasslands are characteristically made up of a variety of palatable grazing species such as *Schmidtia pappophoroides*, *Brachiaria nigropedata*, *Digitaria eriantha* and *Anthephora pubescens* at moderate cover values 15–25%. Other characteristic species are *Hyperthelia dissoluta*, and *Stipagrostis uniplumis*, *Melinis repens*, *Heteropogon contortus* and *Urochloa brachyura*. These grasslands represent some of the best grazing resources in the Kalahari sand areas of the Caprivi. Additionally the soils are mostly sandy loams which are extensively cultivated near settlements.
Structure: Tall closed grassland
Area: 855 km²

Open camelthorn woodland — This unit has a limited distribution in the eastern section of the Caprivi strip on clay-loam soils which are generally poorly drained and subject to ponding. The vegetation is characterized by well-distributed, tall (15 m) *Acacia erioloba* at low cover values (<10%), with a distinct understory of low trees (four metres). Typically this understory comprises *Acacia hebeclada* (in well defined clumps), *Dichrostachys cinerea*, *Acacia luederitzii*, *Combretum imberbe* and *Combretum hereroense*. *Diospyros lycioides* and *Grewia flava* are the commonest shrubs in this unit. Perennial grasses are well-represented in the ground layer of this unit, with *Schmidtia pappophoroides*, *Digitaria eriantha* and *Eragrostis rigidior* being the most important species, with cover values of up to 20%. Annual grasses such *Urochloa brachyura*, *Aristida adscensionis* and *Panicum* sp. are common but do not contribute significantly to the cover. Given the relatively high cover values of palatable grass species this unit is presumed to have high value as a grazing resource.
Structure: High closed woodland
Area: 80 km²

Teak savanna — This unit occurs extensively in both the Caprivi strip and in eastern Caprivi but is largely absent west of the Okavango River. It occurs in areas of deflated dunes where the landscape is made up of gently rolling sandy plains. *Baikiaea plurijuga* is the most important tree species (8–15 m high) in this unit, occurring at moderate cover densities of 15–20%, giving the landscape a savanna-like appearance. *Terminalia sericea* (4–6 m) also occurs at low cover values, as do *Burkea africana*, *Pterocarpus angolensis* and *Guibourtia coleosperma* (10–15 m). The shrub layer is open to sparse with species such as *Baphia massaiensis*, *Bauhinia petersiana* and *Grewia retinervis* contributing to the cover but with a total cover of 10–15%. In areas which are frequently burnt the low growing *Diospyros chamaethamnus* can dominate large areas. Perennial grasses such as *Digitaria eriantha*, *Schmidtia pappophoroides*, *Aristida stipitata* and *Eragrostis pallens* are characteristic of this unit and can contribute 10–20% cover. Considering the relatively high proportion of palatable grass species these woodlands are important wildlife grazing areas, especially during the wet season where some surface water is available. However, they are considered to have poor potentials for livestock grazing because of the poor nutrient status of the vegetation and lack of water.
Structure: High open woodland
Area: 945 km²

Teak shrubland — This is thought to represent a degraded form of teak woodland described below. It only occurs east of the Kwando River in areas which have been extensively logged in the past, and the logging probably opened the woodlands up sufficiently to allow fire to have a major effect on their structure. These woodlands are characterized by sparsely distributed large *Baikiaea plurijuga* and *Acacia erioloba* at low cover values (10–15%) with a distinct, dense shrub understory made up largely of *Combretum elaeagnoides* (10–20%), *Terminalia sericea* (10–20%), *Croton gratissimus* (5–8%) and *Bauhinia petersiana* (5–10%). Grasses are predominantly annuals such as *Dactyloctenium giganteum*, *Aristida stipoides*, *Eragrostis dinteri* and *Melinis repens*. Some perennials such as *Schmidtia pappophoroides* and *Digitaria eriantha* do occur at low cover values. This unit is widespread in eastern Caprivi but has little value in that the soils are predominantly sands poor in nutrients, the vegetation has been degraded by repeated burning and, thus, has low value for conservation.
Structure: High open woodland
Area: 1 530 km²

Teak woodland — These woodlands are widely distributed and found on deep, well drained sandy plains and dunes. The woody component of this unit is dominated by large (10–20 m) *Baikiaea plurijuga* which form dense stands with cover values of 25–60%. *Burkea africana*, *Ricinodendron rautanenii*, *Guibourtia coleosperma* and *Pterocarpus angolensis* all occur as tall trees but at low cover values (1–5%). The shrub layer is characterized by *Baphia massaiensis*, *Bauhinia petersiana* and *Markhamia acuminata* which can provide a very dense layer of up to 50% cover. Grasses are predominantly annuals with species such as *Melinis repens*, *Eragrostis dinteri*, *Tricholaena monachne* and *Megaloprotachne albescens* being characteristic at low cover values. This unit occurs on deep, dystrophic sands, usually on the crests of well vegetated dunes or pockets of deep sand. They can be seen clearly on aerial photographs and satellite imagery as dense woodlands. Their potential for grazing and cultivation is poor, but they have high value as a timber resource. *Baikiaea plurijuga* woodlands have been severely overutilized for commercial timber production or have been fire damaged in certain parts of the Caprivi, so those remaining sites of intact forest have a relatively high conservation value.
Structure: High closed woodland
Area: 1 741 km²

Impalila woodlands

The basalt rocks that form Impalila Island have resulted in an environment quite different from the rest of Caprivi. The combination of rich soils, surface rocks and a complex mosaic of wetland and dryland habitats contributes to an extremely diverse vegetation which is unique in the Caprivi. Many species of trees and plants with essentially eastern and tropical African distributions (e.g. *Pappea capensis*) reach their distribution limits here and occur nowhere else in Namibia. The island, therefore, has a high conservation value related to its high biodiversity. Drier vegetation is dominated by *Colophospermum mopane*, with species such as *Terminalia prunioides*, *Adansonia digitata*, *Afzelia quanzensis*, *Sclerocarya birrea* and *Acacia tortilis* being characteristic. The margins of the island are characterized by species typical of river levees such as *Diospyros mespiliformis*, *Lonchocarpus capassa*, *Ficus sycomorus*, *Cassine transvaalensis* and *Kigelia africana*. The river margin habitats are dominated by extensive dense thickets of *Syzygium guineense*. Cattle numbers are seasonally high on Impalila Island and the grass layer is consequently denuded and extensive patches of unpalatable species such as *Aristida rhiniochloa*, *Aristida adscensionis* and *Chloris gayana* are common. In areas where damper soils occur *Cynodon dactylon* may form patchy lawns.
Structure: Tall closed woodland
Area: 18 km²

Notes

Chapter 2

1 The 21° E line of longitude forms the western boundary of Caprivi with Kavango, its neighbouring region in Namibia. From the intersection of this line with the Okavango River, the northern boundary follows the midstream of the river to Dikuyu Island from where it runs in a straight line to a point in the Zambezi River (17°28'29" S, 24°14'50" E), separating it from Angola and Zambia. The eastern boundary of Caprivi with Zambia then follows the midstream of the Zambezi River to the confluence of the Chobe River. The southern boundary with Botswana then follows the midstream of the Chobe–Linyanti–Kwando river system to 18° S. At the intersection of the Kwando River and this line of latitude, the border cuts along straight lines westwards and largely parallel to, and 32.2 km from, the northern boundary, to 21° E.

2 Information for these maps was calculated by interpolating rainfall averages and standard deviations from weather stations in Namibia (Katima Mulilo, Andara, Rundu), Botswana (Shakawe, Maun, Kasane, Gumare, Kavimba, Seronga, Sehitwa) and Zambia (Livingstone, Senanga, Masese, Sesheke).

Chapter 3

1 The borders of the six constituencies were gazetted in 1992, as follows:

Mukwe Constituency

From a point where the line of longitude 21° E intersects the middle of the Okavango River, east along the middle of the river to Dikuyu Island, then along the straight line Namibia/Angola border to the middle of the Kwando River, then along the middle of that river south to the Namibia/Botswana border, and then west along this border to the 21° E meridian; thence northwards along that meridian to the point of the beginning.

Kongola Constituency

Beginning at the point where the Kwando River enters Namibia, eastwards along the Namibia/Zambia straight line border to a point with system 22/25 co-ordinate Y+87000; then along grid direction 341°30' to meet the middle of the Katima Mulilo-Kongola road or "Golden Highway"; then along the middle of the road westwards until it crosses the middle of the Kwando River at Kongola Bridge; then northwards along the middle of the river to the point of the beginning.

Linyandi Constituency

Beginning at the Kongola Bridge crossing of the Kwando River, along the middle of the Kongola-Katima Mulilo "Golden Highway" in an eastwards direction to system 22/23 co-ordinate Y-83500; then south-eastwards in a straight line to a point in the middle of the Linyanti River at system 22/25 co-ordinate Y+95000, so as to include the Linyanti community in the constituency; then along the middle of the Linyanti and Kwando rivers to the point of the beginning.

Sibinda Constituency

Beginning at the point where the middle of the Katima Mulilo-Kongola "Golden Highway" is intersected by system 22/25 grid direction 341°30' coming from co-ordinate Y+87000 on the Namibia/Zambia border, along that direction prolonged through Lake Liambezi until it meets the Namibia/Botswana border; then south-west along the middle of the Linyanti River to the point with system 22/25 co-ordinate Y+95000; then along a straight line in a north-westerly direction to the point in the middle of the "Golden Highway" at system 22/25 co-ordinate Y-83500; then following the middle of the "Highway" to the point of the beginning.

Katima Mulilo Constituency

Beginning at the point on the Namibia/Zambia border with system 22/25 co-ordinate Y+87000, then eastwards along the Zambian border to the middle of the main channel of the Zambezi River; then along the middle of the main channel downstream to a point with co-ordinates Y+71000 and X-499000; then in an south-easterly direction to a point with co-ordinate Y+24000 in the middle of the Chobe River; then westwards along the Namibia/Botswana border to the point where the Sibinda Constituency begins, and then along a straight line in a grid direction 161°30' to the point of the beginning.

Kabe Constituency

This constituency consists of that part of Caprivi which is east of the Katima Mulilo Constituency.

2 Deloitte and Touche Consulting Group. 1997. Tourism development planning framework for the Caprivi Region. *Report*. Ministry of Environment and Tourism. Namibia.

Chapter 4

1 The Environmental Profiles Project organized to have 1:20 000 aerial photographs taken of the whole region in 1996. Those for eastern Caprivi and the strip along the Okavango River could be used to map and count all households. Photographs for the rest of the region were only taken in mid-1997 after these analyses were done. Other methods were used to estimate household numbers in these areas. In the Mukwe area south of the main tar road, oblique aerial photographs were taken of all villages to count and map households; estimates of the number of people in each village in the Caprivi strip were provided by M Brenzinger. To estimate population figures, household numbers were multiplied by the average household sizes for each enumeration area, as recorded in the 1991 Population and Housing Census. For five areas copies of 1:30 000 photographs taken in 1943 were obtained to provide comparisons on the numbers of households in those areas.

2 Densities were calculated using ArcView 3.0's Spatial Analyst to distribute the number of people in each cluster of households over an area with a radius of five kilometres.

3 CSO. 1995. 1991 Population and Housing Census: basic analysis with highlights. *Report*. National Planning Commission. Namibia.

4 CSO. Undated a. Living conditions in Namibia: the 1993/94 Namibian Household Income and Expenditure Survey. *Report*. National Planning Commission. Namibia.

5 CSO. Undated b. Basic tables of communal agriculture: 1994/95 Namibia Agricultural Census. *Report*. National Planning Commission. Namibia.

6 Average household sizes were calculated by overlaying a map of enumeration areas used in the 1991 Population and Housing Census with a map of households. Average household sizes were calculated for each enumeration area and then allocated to the households within each enumeration area. The map of households was finally converted to a 500x500 m grid to produce a more even representation.

7 UNDP. 1996. Namibia human development report. *Report*. United Nations Development Programme. Namibia.

8 UNDP. 1997. Namibia human development report. *Report*. United Nations Development Programme. Namibia.

9 Pretorius, JL. 1975. *The Fwe of the Eastern Caprivi Zipfel*. Unpublished MA thesis. University of Stellenbosch; Van der Vegte, JH, Forster, CW & Forse, WB. 1983. Eastern Caprivi regional development strategy. *Report*. South West African Administration; 1991 Population and Housing Census data; Environmental Profiles Project data.

Chapter 5

1 Steps taken in the compilation of the vegetation map were as follows. Three Landsat TM images taken in June and July 1994 were processed using bands 4, 5 and 3. The three images excluded the eastern tip of the eastern floodplains and information for this area was added separately using existing 1:50 000 SPOT xs false colour composites from June 1992. Enhancements were made using intensity, hue and saturation decorrelation, and the three decorrelated layers were combined into a normal red, green and blue image. Lastly photographic images were printed at scales of 1:150 000 retaining a pixel size of 30x30 m. The boundaries of apparently homogenous units were digitised off these images. Sample data on soils and vegetation taken at 137 sites were overlaid on the units and additional descriptive information was provided by aerial and ground surveys.

2 CSO. 1994. 1991 Population and Housing Census. *Report B*. National Planning Commission. Namibia.

3 Ashley, C & LaFranchi, C. 1997. Livelihood strategies of rural households in Caprivi: implications for conservancies and natural resource management. *Research Discussion Paper # 20*. Directorate of Environmental Affairs, Ministry of Environment and Tourism. Namibia.

4 Data on population densities were combined with the map of highest, moderate and lowest non-agricultural resource values to produce three categories:

- *"Least" pressure areas* have low population densities of <1 person/km², or have "highest" woodland resource values and population densities of 1–20 people/km².
- *"Medium" pressure areas* have moderate resource values and population densities of 20–50 people/km², or "highest" resources with densities of 50–100 people/km².
- *"Greatest" pressure areas* are those with lowest resources and densities >1 person/km², those with moderate resources and densities of >50 people/km², and those with "highest" resource values and densities of >100 people/km².

This rating is based on the assumption that in areas with few useful trees (poor resources) there will be significant pressure put on the few trees if there are reasonable numbers of people, and that pressures will increase as population densities become greater. It is also assumed that people exert little direct pressure on vegetation in the three protected areas.

5 Trigg, S. 1997. Fire monitoring in the Caprivi. *Report*. Environmental Profiles Project, Directorate of Environmental Affairs, Ministry of Environment and Tourism. Namibia.

Chapter 6

1 Based on stock census data provided by the Directorate of Veterinary Services, Ministry of Agriculture, Water and Rural Development.

2 Paskin, R. & Hoffmann, G. 1995. Socio-veterinary study: East Caprivi. *Report*. Directorate of Veterinary Services, Ministry of Agriculture, Water and Rural Development. Namibia.

3 Densities were calculated using ArcView 3.0's Spatial Analyst to calculate densities by spreading the number of cattle counted over an area with a radius of 10 km around each crushpen, assuming that all cattle counted have come from within 10 km of the crushpen. Because of the lung

disease outbreak in Botswana, most cattle in the Caprivi strip were moved away from their normal locations. For this analysis, cattle numbers collected in 1995 at Omega, Dwarspan and Chetto were used for 1996.

4 Opperman, DPJ, Viljoen, MF, du Toit, D & Wilke, PI. 1982. Landbou-ontwikkelingsplan vir die Oos-Caprivi. *Report*. Publishers unknown; Hines, CJH. 1997. Salambala Conservancy: a preliminary resource assessment. *Report*. WWF/LIFE. Namibia; Hines, CJH & Burke, A. 1997. Vegetation survey of NOLIDEP pilot communities. *Report*. NOLIDEP. Namibia.

5 CSO. Undated. Basic tables of communal agriculture: 1994/95 Namibia Agricultural Census. *Report*. National Planning Commission. Namibia.

6 Ashley, C. & LaFranchi, C. 1997. Livelihood strategies of rural households in Caprivi: implications for conservancies and natural resource management. *Research Discussion Paper # 20*. Directorate of Environmental Affairs, Ministry of Environment and Tourism. Namibia.

7 Directorate of Planning. 1997. Farm management survey of the Kavango Region, Namibia. *Analysis Report 1*. Ministry of Agriculture, Water and Rural Development. Namibia.

8 The Profiles Project arranged for 1:20 000 aerial photographs to be taken of the region in 1996. Those for eastern Caprivi and the strip and along the Okavango River could be used to map and count all areas cleared for crop farming. For other areas, cleared areas were mapped off 1:80 000 aerial photographs taken in 1996 for the Surveyor-General's office. Fields were digitized and stored in a GIS database, allowing areas to be calculated and the data to be analysed in relation to other geographic information.

Chapter 7

1 Barnes, J. 1997. Internal note on the economic value of tourism in the proposed Okavango National Park. Directorate of Environmental Affairs, Ministry of Environment and Tourism. Namibia.

2 The position and number of animals at each sighting was recorded during the aerial survey, as was the flight path and width of area counted on each side of the aeroplane. A 5x5 km grid was assembled for the whole region, and the proportion of each block sampled was calculated by overlaying the flight path and width of area surveyed. From that sampling proportion, it was then possible to estimate an extrapolated density of animals.

3 O'Connell, C. 1995. East/West Caprivi natural resource monitoring project: elephant/human conflicts. *Report*. Ministry of Environment and Tourism. Namibia.

4 Rodwell, TC. 1996. Caprivi elephant monitoring project. *Report*. Ministry of Environment and Tourism. Namibia

5 Craig, C. 1997. The ELESMAP project. *Report*. Namibia Nature Foundation. Namibia.

6 Compiled from: Ministry of Environment and Tourism game count data; and Rodwell, TC, Tagg, J & Grobler, M. 1996. Wildlife resources in the Caprivi, Namibia: The results of an aerial census in 1994 and comparisons with past surveys. *Research Discussion Paper # 9*. Directorate of Environmental Affairs, Ministry of Environment and Tourism. Namibia.

7 This information was compiled and analysed from data assembled by the Ministry of Environment and Tourism and Southern African Bird Atlas Project. Shannon diversity indices were estimated by calculating the number of species recorded in relation to the number of atlas cards collected for each quarter-degree square. Only squares with five or more atlas cards were used in the analysis.

8 Barnard, P, Brown, CJ, Jarvis, AM, Robertson, A & van Rooyen, L. In press. Extending the Namibian protected area network to safeguard hotspots of endemism and diversity. *Biodiversity Conservation*.

9 Schlettwein, CHG, Simmons, RE, MacDonald, A & Grobler, HJW. 1991. Flora, fauna and conservation of East Caprivi Wetlands. *Madoqua* 17: 67–76.

10 Tvedten, I, Girvan, L, Maasdorp, M, Pomuti, A & van Rooy, G. 1994. Freshwater fisheries and fish management in Namibia. *Report*. SSD. University of Namibia.

11 Curtis, B, Roberts, KS, Griffin, M, Bethune, S, Hay, CJ & Kolberg, H. In press. Species richness and conservation of Namibian freshwater macro-invertebrates, fish and amphibians. *Biodiversity Conservation*.

12 Van der Waal, B. 1990. Aspects of the fishery of the eastern Caprivi, Namibia. *Madoqua* 17:1–16.

Chapter 8

1 Graphs compiled from data held and provided by the Department of Water Affairs

2 Van Langenhove, G & Rukira, L. 1995. Investigation into recent river flow regime changes in the southern African region: conditions in Namibia. Paper presented to 27th meeting of the Standing Committee for Hydrology of SARCCUS, Maseru, Lesotho.

3 These analyses were requested by the Environmental Profiles Project and were done as part of a MSc thesis by Francois Binzouli. (Binzouli, F. 1997. *Assessment and zonation of the 1989 flood along the Zambezi River for environmental management in Eastern Caprivi, NE Namibia, using multi-temporal remote sensed imagery and GIS*. MSc thesis. International Institute for Aerospace Survey and Earth Sciences. The Netherlands.) TM Landsat imagery was interpreted to map out the distribution of flood waters from five images taken at intervals between March and August 1989, four of which are shown here.

4 These figures were obtained by counting all households and estimated numbers of people in areas which may be flooded. The great majority of settlements are on ground that is higher than the surrounding floodplains, but fields and grazing pastures are usually on lower ground.

5 This is the area appearing as rivers and open water in the June 1994 LandSat images used to map vegetation units (Chapter 5)

6 Schlettwein, CHG, Simmons, RE, MacDonald, A & Grobler, HJW. 1991. Flora, fauna and conservation of East Caprivi wetlands. *Madoqua* 17: 67–76.

7 Taylor, E. 1997. The status of *Salvinia molesta* infestation in the eastern Caprivi wetlands — 1996 report, update and recommendations. Department of Water Affairs, Ministry of Agriculture, Water and Rural Development. Namibia.

8 Analysed from data collected during the 1991 Population and Housing Census.

9 SIAPAC. 1997. Integrated summary report: community consultation and survey programme. *Report*. Department of Water Affairs, Ministry of Agriculture, Water and Rural Development. Namibia.

10 DWA. 1994. Feasibility study for the development of water supply for the area between Katima Mulilo and Kongola in the eastern Caprivi. Report No. 2300/6/1/2/P1. Ministry of Agriculture, Water and Rural Development. Namibia.

11 Data held and provided by the Department of Water Affairs were used to interpolate depth and quality values between the values recorded for those boreholes for which data were recorded. Quality of water is rated on the basis of TDS (total dissolved solids) as follows: A = <990, B = 991–1980, C = 1981–2640 and D = >2641 TDS.

Chapter 9

1 UNDP. 1997. Namibia human development report. *Report*. United Nations Development Programme. Namibia.

2 Deloitte & Touche Consulting Group. 1997. Tourism development planning framework for the Caprivi Region. *Report*. Ministry of Environment and Tourism. Namibia.

3 Barnes, JI. 1995. The value of non-agricultural land use in some Namibian communal areas: a data base for planning. *Research Discussion Paper # 6*. Directorate of Environmental Affairs, Ministry of Environment and Tourism. Namibia.

4 Jones, BTB. 1995. Wildlife management, utilization and tourism in communal areas. *Research Discussion Paper # 5*. Directorate of Environmental Affairs, Ministry of Environment and Tourism. Namibia.

5 Each vegetation unit was given a rating — 1 (low), 2 (moderate), 3 (high) — to reflect overall value for conservation (map 1), as described in the text. These units were then overlaid with data on the densities of people and cattle. Those areas having more than 10 people or 10 cattle per km^2 were reassigned to the "low" conservation category (map 2). To this new set of data were then added the densities of large mammals, as counted in the 1995 aerial survey. Densities were grouped in three categories: 1 = less than one animal/km^2, 2 = 1–10 animal/km^2, 3 = more than 10 animal/km^2 and the values for these three categories were added to the three values for conservation value. The result of the addition gave a final rating for conservation purposes (map 3), and all areas having a rating of 4 and above were taken as having priority for conservation. Values for subsistence farming are based on soil potential for crops (weighted four times), pasture quality (weighted twice), vegetation resource (not weighted) and water quality (not weighted). The assessment thus attaches the greatest importance to soil potential and pasture quality since these are at the core of subsistence activity. The weighted values for each component were added together to provide the index shown in map 4.

6 Gibson, J. 1995. Proposal for a southern African wildlife sanctuary in the wetlands associated with the source of the Zambezi. In: Matiza, T, Crafter, S & Dale, P. (Eds). *Water resource use in the Zambezi Basin*. International Union for the Conservation of Nature.

7 Craig, C. 1997. The ELESMAP project. *Report*. Namibia Nature Foundation. Namibia.

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