

TABLE 15

Utilization by elephant of some large trees in the  
riparian strip between Sidudu and Serondela

Species	Sample	Pre-1965 Use					1965 Use*				
		I	II	III	IV	Felled	I	II	III	IV	Felled
<u>Acacia nigrescens</u>	688	65	89	197	214	123	-	40	106	135	1
<u>Acacia giraffae</u>	462	135	15	74	175	63	1	4	36	223	-
<u>Lonchocarpus capassa</u>	180	7	13	49	101	10	-	3	16	124	-
<u>Strychnos stuhlmannii</u>	237	3	12	24	160	38	-	-	10	183	-
<u>Phyllogeiton discolor</u>	529	44	43	181	196	65	-	13	90	315	-
<b>Total</b>	2096	254	172	525	846	299	1	60	258	1190	1

\* Lower 1965 sample resulted from trees which died as the result of pre-1965 use, i.e. over 28 percent of the standing trees were already dead, having mostly been killed within the past 2 to 4 years.

riparian strip where there are clusters of saplings affording protection to the innermost ones. Pole Evans (1948) does not even mention the species in his brief description of the riverine vegetation in 1937, although it now provides about half the trees and a higher proportion of the regeneration, under 5½ inches d.b.h.

Fifty of 299 (17 percent) of the trees in the first mile strip were badly damaged during 1965 and over 50 percent had been more than half ring barked or pushed over, mostly within the previous few years. While some of these trees could probably recover, repeated use in successive dry seasons is endangering the structure of the plant community on which several other species are dependent. There are, for example, very few healthy A. albida along the Chobe, 20 percent of the Lonchocarpus capassa were badly damaged by 1965 and another 2.7 percent were mutilated in 1965. Amongst the 555 Phyllogeiton discolor, 19.8 percent were killed by 1965 and another 8.5 percent were in class II.

The warden assessed the damage to A. tortilis in 1963 and 1964 along the main Kasane-Ihaha road. In a sample of 124 trees, 13 (10.5 percent) had been killed before 1963, 55 (44.4 percent) were killed in 1963 and another 12 (9.7 percent) were killed in 1964. Ring-barked trees usually collapsed in two to three seasons, so that approximately 60 percent of this attractive species was eliminated in about four years, although since then the adults have escaped such severe attention.

It was noticeable that in some years elephant tended to concentrate on particular species in given areas, while in others these species were hardly touched. Besides A. tortilis this applied to Kirkia acuminata at Ihaha, Commiphora spp. in the same area and A. nigrescens further west, in 1965, while Pterocarpus angolensis and Ricinodendron raut received very heavy use near Ngwezumba in 1963.

#### Conclusion

Elephant pose a considerable management problem in several parts of northeastern Botswana, and serious consideration should be given to the need for reducing their impact on the habitat. The most critical areas in the Chobe Game Reserve are in the northeast and northwest, while outside the reserve they appear to be along the borders of the Wankie National Park.

More information in relation to population trends and management practices is needed from Wankie, while the situation in the northwest of the Chobe Reserve is complicated by a lack of numerical data and the erratic behaviour of the Savuti during the past seven years. There is sufficient information from along the Chobe river, east of Ngoma, to confirm the need to reduce the population pressure on the face of the sand ridge and in the narrow riparian fringe.

It is doubtful if the provision of artificial water holes away from the Chobe river will alleviate the problem, as has been suggested, and it is to be expected that elephant numbers will soon build up to dangerous proportions where this is done, especially if the population is being reinforced from outside the reserve. The only practical solution would therefore seem to be to cull a significant proportion of the elephant converging on the Chobe at the end of the dry season. This would be a management measure only, and should not be planned as a sustained yield project.

Difficulties arise from the worst affected area being open to visitors and from the need for expanding tourist amenities along the Chobe in the near future. This may necessitate a delay in reducing the elephant population as any undue disturbance could reduce the attractiveness of the area for investors and visitors alike, at a sensitive period in the reserve's history and when the limited staff are likely to be fully occupied elsewhere.

If it had been possible to remove a portion of the population during 1966 or 1967, then a provisional target of 200 to 250 head (i.e. about 25 percent of the July 1965 population) would have been appropriate if allowances were made for adjustment in the light of experience from the exercise. The figure will probably need revision, however, depending upon changes in the habitat or elephant population which may occur before a reduction in numbers can be achieved.

Fewer elephant watered along the Chobe in 1966 than 1965 and yet dry season photographs show similar extensive damage to the woody vegetation in particular. The second year was especially favourable on account of the amount of water available away from the river throughout the dry season. In spite of this, the already impoverished habitats were further suppressed and it can be predicted that there will be considerably more damage, when next the pans fail early in the year, unless the pressure on the habitats can be relieved.

If numbers are to be reduced through culling, then consideration should be given to the removal of females and juveniles in order to lower the reproductive potential of the population and save the best tourist animals. Depending upon the availability of funds and staff it may be possible to remove the animals from some distance from the tourist routes, when conventional firearms could be tried. Strict attention should, however, be paid to the need to minimize disturbance, and the use of immobilizing drugs would seem preferable, under local circumstances, especially if the animals are to be shot in small numbers over several months so that the carcasses can be utilized and if this has to be done near tourist routes. Experience gained with this method in the Luangwa valley in Zambia, should prove of value for gauging its usefulness along the Chobe. The results of the first full seasons' operations were encouraging and the removal of some 200 elephant in a fairly restricted area did not disturb the survivors unduly.

#### BLACK RHINOCEROS

#### Diceros bicornis

It is well established that black rhino once had a wide geographical distribution extending over much of northeastern Botswana, and that numbers have been greatly reduced in some areas within the last 20 to 30 years. Bushmen claim an individual has lived for some years along the Rhodesian border between Kakulwani and Panda ma Tenga. Another was seen in the Sidudu valley about 10 years ago, and one was speared but not killed by a bushman near Kasane about this time and is claimed to have been the same animal which was stabbed by a policeman from Kachikau a short while later.

Two game scouts found the spoor of an individual which had descended the sand ridge to water at the Chobe river, between Ngoma and Muchenje in June or July 1963. One of these men had been a cattle drover on the stock route across the eastern Mababe and claimed to have found rhino spoor south of the Goha hills on several occasions in the late forties, although he could not remember personally having seen an animal in this area. Two professional hunters reported spoor on the sand ridge between Gohan and the Savuti and between the Savuti and the Linyanti in 1963 and 1964 and the presence of rhino in the former area has been confirmed by staff of the Tsetse Fly Control Department.

Game ranger S. Holmes a Court followed spoor and contacted a rhino on the Magwigwe sand ridge south of the Savuti in 1964, and there are reports of the species in Botswana near the Kwando river and on Chief's island in the Okavango swamps where crocodile hunters under Mr. "Bobby" Wilmot and a W.N.L.A. air crew both reported seeing three animals about six years ago. Wilmot's party also encountered two in mopane woodland between Jovorega and Tsotsoroga in 1963 or 1964, where they were also seen about the same time by another reliable independent observer. The present author's party found and photographed spoor

some eight miles south of the Gubatsa hills in the western Mababe in October 1965 and found droppings about the same distance east of Jovorega on the boundary of the proposed extension 'C' (figure 14) of the Game Reserve, in June 1966. An individual was contacted on the northeastern edge of the Savuti "swamp" in January 1967. Finally there have been two reports of rhino along the Rhodesian border south of Panda ma Tenga which may represent the wanderings of animals released into the Wankie National Park since 1961.

The extent to which rhino numbers have declined during recent years is borne out by the recollections of several old bushmen, one of whom in particular could remember seeing something like 50 different animals around the foot of the Goha hills when he lived there during his youth (probably about 40 years ago). It is, however, possible that rhino are more numerous than the few recent observations suggest, as they are all from remote unpopulated areas, but if the present relic population is to survive then it will require special protection. It will be necessary to determine where the majority of the animals occur and then to ensure that they are not hunted, at least until numbers build up. Rhino can tolerate a wide range of habitat types, but are usually associated with permanent open water, and present habitat conditions, including wide-scale bush encroachment, may be beneficial for the species, which is, however, very susceptible to hunting. Roth and Child (in press) have shown that the recruitment rate to the breeding herd is low and of the order of seven percent per annum, so that the survival of a population is very dependent upon the longevity of the adults.

#### BURCHELL'S ZEBRA

Equus burchelli

Zebra occur throughout most of northeastern Botswana, where they are subject to considerable movement. They have been recorded in 1725-C-3; 1724-D-4; 1824-A-1, 2, 3 and 4; B-4; CI, 2, 3 and 4; D-2; 1825-A-1 and 3; C-2; D-1; 1823-B-3 and 4; D-1 and 2; 1923-A-2 and 4; B-1, 2 and 3; 1924-D-3; A-1 and 2. Spoor throughout much of 2024-A and B confirm reports of large seasonal concentrations from this and adjacent parts of the Makarikari system.

During the 1965 dry season zebra disappeared from around the headwaters of the Ngwezumba river after the pans dried, except for a few watering at the Ngwezumba pools. They were then numerous in the reserve along the Chobe river, particularly toward Ngoma. On the other hand, the pans retained water throughout the 1966 dry season and zebra which were scarce along the Chobe, remained in the Kwikampa area in large herds. This circumstantial evidence indicates a definite north/south movement in this region governed by the availability of water.

Large concentrations of zebra occurred in the Mababe depression during the 1965/66 and 1966/67 rainy seasons although numbers were very much lower in the 1965 and 1966 dry seasons, even while many of the pans held water during the second of these years. These observations and a comparison of wet and dry season signs indicate the importance to zebra of parts of the south and central Mababe during the wet season, but a large proportion of these animals leave the area during the dry months. Smaller concentrations in the northwest of the depression in May 1966 indicated some were moving toward the Linyanti swamp, while others may have shifted towards the Okavango system.

The tendency for zebra numbers to increase near permanent water during the dry season and for the species to disperse during the rains indicates that the availability of surface water is one of perhaps several factors governing their seasonal movements.

There was considerable disagreement among old residents of northeastern Botswana as to whether they considered the zebra populations had increased, decreased or remained unchanged since they had known a particular area. Several, including a number of residents

around the Makarikari, where the game officer estimated over 15,000 head from the air in 1965, indicated an increase while others, particularly those from further north, reported the opposite.

The species is a popular tourist attraction in game reserves, is sought after by Safari hunters and has assumed considerable value during the past few years, due to the international demand for hides, which fetch up to R15 in Botswana. It would therefore seem advisable to keep a careful check on changing trends in population numbers and to restrict exploitation where this threatens towards overutilization.

#### BUSHPIG

#### Potamochoerus porcus

Bushpig have been recorded along the Chobe river only in 1724-D-4 and 1725-C-3, but Lugard (1909) notes that the species was common along the Linyanti in 1824-A-1, where their presence requires confirmation. It apparently does not occur in the Okavango swamps and has not been recorded in the hunting returns from tsetse fly control operations on the Maun Front.

#### WARTHOG

#### Phacochoerus aethiopicus

Warthog are not common away from the major rivers in northeastern Botswana. They have been noted along the Chobe in 1724-D-4; and 1725-C-3 along the Linyanti and Savuti, or in molapos in 1823-B-3 and 4; D-1 and 2; 1824-A-1 and 2; C-1 and around the headwaters of the Ngwezumba in 1824-B-4 and D-2; and in 1825-A-1 and 3. There are also records from 1824-C-2 and 3; and 1924-A-1 and the species is very numerous along the molapos in the Moremi Game Reserve in 1923-B-1, 2 and 3. It has been shot in large numbers on the Maun Front tsetse advance in 1923-C-3 and 4; 2022-B-3; 2023-A-1 and 2, and occurs in small numbers on the Makarikari where it has been noted in 2024-B-4 and near Nyai Pan in 1924-D-4.

The recent expansion of the vigorous warthog population along the Chobe river has been described elsewhere (Child et al, Ms). Here the species is resident (figure 9) and appears to have benefited from disturbances to the habitats set in motion by past land use; in particular to the spread of the grass Cynodon dactylon, which is much favoured.

Warthog numbers declined along the Savuti when the channel dried up early in 1965. Sixty skulls were located in October 1966 and January 1967 from different parts of the "swamp" and included three sucklings, seven yearlings, five two-year-olds, 14 three-year-olds and 31 older animals which were predominantly males, aged according to Child et al (1965). Warthog were no longer numerous near the "swamp" when the skulls were collected and a total of 52 were classified into sex and/or age classes after considerable searching. These included 42 adults of which 20 were females, 10 males and 12 which were not sexed; three yearlings, born about the time the "swamp" dried, and seven sucklings. Several of the last were very weak and could hardly run, and only one litter contained as many as two sucklings. Only two 1966/67 sucklings were noted in January, and these were very small compared with those along the Chobe, although the physical condition of the adults had improved since October.

The warthog population around the Savuti "swamp" increased rapidly while there was water, but then declined when this dried up. The low number of juvenile and the high proportion of old adult skulls among the last survivors suggested a mortality pattern which favoured the oldest animals in the population, similar to that observed on islands cut off during the formation of Lake Kariba (Child, 1965). The main difference was the high proportion ( $\pm$  80 percent) of old males' skulls, as no differential mortality between the sexes was detected at Kariba.

This population will probably expand again, while the channel continues to feed water into the "swamp". The previous buildup appears to have resulted from the availability of surface water raising the carrying capacity of the habitat and through changes in the habitat which favoured warthog. These included greater soil moisture, allowing the proliferation of several plants sought after by warthog, as well as the spread of grasses such as Cynodon dactylon in heavily trampled areas.

Reports indicate warthog have increased along the Kwaai during the past decade, and they are very numerous along the northern boundary of the Moremi Game Reserve, where one observer counted over 100 leaving a small water hole less than four yards long. Hunting returns from the Maun Front indicate a considerable increase in the population along the southern fringe of the Okavango swamp (Child et al, Ms).

Warthog are of little value as trophy animals, but breed rapidly and provide highly palatable protein, so that it would seem appropriate to encourage their controlled exploitation, where numbers are high and where the local people rely largely on hunting for their meat requirements.

#### HIPPOPOTAMUS

#### Hippopotamus amphibius

Hippo occur in most permanent waters in northeastern Botswana and were noted in 1724 -C-4; D-3 and 4; 1725-C-3 and 4; 1823-B-3 and 4; D-1 and 2; 1824-A-1; B-1; C-1; and 1924-B-1 and 2. They are also widespread in the Okavango swamp and have been reported from the Botletle river. They wander between seasonal pans during the rains when they have been confirmed in 1824-B-4; C-2; along the stock route in 1825-C-1 or 3 and in the Nunga river in 1825-D-1 or 3.

Old people in the Lake Laimbezi area have noticed no significant change in the population, although crop raiding has intensified during recent years (see sub-section on Enclave), but numbers are said to be greatly reduced in the Okavango swamps, and the Game Department is seeking more rigid control over hunting. Although hippo come into conflict with river-bank cultivation, they are an important factor influencing the pattern of flooding in swamps and should not be destroyed unnecessarily.

#### GIRAFFE

#### Giraffa camelopardalis

Giraffe are infrequent visitors to the Chobe flats east of Kachikau, but elsewhere in northeastern Botswana they are one of the more conspicuous species. They have been recorded in 1724-D-4; 1725-C-3; 1823-B-3 and 4; 1824-A-1, 2, 3 and 4; B-2, 3 and 4; C-1, 2, 3 and 4; D-2 and 4; 1825-A-1, 2 and 3; C-1, 2 and 4; 1923-B-1, 2 and 3; 1924-A-1 and 2; D-2 and 4; 1925-A-1 and B-2; 1923-A-1 and 3, and there are reports of giraffe from the west of the Maun Front tsetse area in approximately 2022-B-4.

The species was encountered with similar frequency in the same areas at all seasons and does not appear to be subject to any significant periodic movement patterns. A sample of 360 was classified according to sex and age and, as far as could be determined, included animals in complete groups, although some may have been overlooked when groups spread out to feed. These included 84 full-grown males, 173 full-grown females, 55 juveniles, 43 calves, with the top of the head reaching the crest of the hump on the females' necks, and five unclassified individuals.

This indicated a satisfactory proportion of immature animals although most of the adults were thin and in several areas favoured trees had clearly defined giraffe browse lines at 16 to 18 feet above the ground. Nine giraffe were collected on the Savuti in April 1967, when physical condition was expected to be at its seasonal peak. The animal

in best condition was a female with adult dentition, with 18 mm of subcutaneous fat at the base of the tail, a kidney fat index of 53 and healthy coloured femur marrow (see Child, 1965). The marrow was good in two others and fair in a fourth, but was poor in two adults and in three well-grown juveniles cutting their third lower molars.

Distinct browse lines, characterized by broken stems up to about two inches in diameter were noted on Boscia albitrunca and other species along the Linyanti, and on Timunjelenjele (?) in the Tanafupi/Garufu pan area, where there was also widespread evidence of the use of Terminalia sericea. Heavy use was made of B. albitrunca, Lonchocarpus capassa and Phyllogeiton discolor near the Savuti and in a sample of 131 B. albitrunca in the southwestern Mababe 127 had very distinct browse lines and only one tree showed little use. In the southeastern Mababe L. capassa was very heavily browsed in some areas but hardly touched in others. In a sample of 478 trees, along 6.6 miles of road, soon after the road south from Jovorega to Mababe village enters the Acacia belt, all but 20 (4.2 percent) showed extensive use. A sample of 100 trees three miles further south contained only seven which were heavily browsed. In the first sample most of the trees under 18 feet had been stripped of all branches and many were dead, those above this height showed distinct browse lines with the smaller branches broken by giraffe.

They were also recorded eating Acacia spp. (including A. giraffae, A. tortilis and A. hebeclada), mopane, Combretum spp., (including C. hereroense, C. imberbe, C. mossambicense), Zizyphus mucronata, Baphia obovata, Burkea africana and Dichrostachys cinerea, some of which were quite heavily browsed, locally.

The heavy localized use of several important browse plants and the generally poor condition of adults suggested giraffe populations are over-taxing the habitats in a number of areas. The meat is very popular with the local people and the species is easily hunted, so that it would be unwise to relax the stringent legislation protecting it, but a proper investigation of its biology should be encouraged. This is the type of prescribed topic which might appeal to visiting research workers.

#### DUIKER

#### Sylvicapra grimmia

Duiker may occur throughout the Chobe Game Reserve, but were not encountered in well-developed mopane south of the Ngwezumba river or in the Mababe depression, and numbers were generally low. The species is probably more common around parts of the Okavango swamps, however, as increasingly large numbers have been shot on tsetse control on the Maun Front during the past 25 years.

It has been recorded in small numbers along the Chobe river in 1724-D-4 and 1725-C-3, where it is largely a nocturnal visitor to the Chobe flats, although relatively more common in Kalahari woodland. It has also been noted in 1824-A-2 and 3; B-2 and 4 and C-1 (a single specimen); 1825-A-1 and 3; C-2, 3 and 4; D-1; 1923-B-3; 1924-A-3 and south from Nyai pan to the Botletle river in 1924-D-3 and 4; 2023-B-2; 2024-A-1; B-3; and D-1.

Duiker are notably resistant to hunting, and many of the changing trends in the habitats in northeastern Botswana should favour this species.

#### STEENBUCK

#### Raphicerus campestris

Steenbuck were never recorded on the Chobe flats between Kasane and Kasinka, but one was noted near the base of the sand ridge in 1824-A-2 and there are reports of occasional observations to the north of this. Several were seen along molapos in 1824-A-1, but

numbers are generally higher toward the south of the region. Besides these records, steenbuck were observed on the sand ridge in 1724-D-4 and in 1725-C-3; 1824-A-3 and 4; B-2 and 4; C-1, 2 and 4; 1825-A-1 and 3; C-2; D-1 and 4; 1924-D-2 and 4; 1925-A-1 and 3; B-2; 1926-A-1; 2024-A-1 and 2; B-1, 2, 3 and 4; D-3, and they have been shot in large numbers on the Maun Front in 2023-A-1, 2 and 3.

Of the 52 sexed and aged, 23 were adult males, 25 adult females and 4 were juveniles. This small solitary browsing antelope is resistant to hunting and may have benefited by the general bush encroachment in northeastern Botswana.

#### SHARP'S GRYSBUCK

#### Raphicerus sharpei

Shortridge (1934) quotes a report of this grysbuck occurring along the sand ridge between Kasane and Kavimba but recent records indicate that its range up the Chobe river extends only  $1\frac{1}{2}$  miles into the Chobe Game Reserve where it is apparently confined to 1725-C-3. Most contacts have been along the river although occasional individuals have been reported on the sand ridge.

Numbers are in any case very low, and it would seem advisable to afford the species absolute protection in northeastern Botswana.

#### ORIBI

#### Ourebia ourebia

Oribi have a restricted distribution in Botswana, where they are apparently limited to the extreme north as they are not known to the local people elsewhere. They seem to have disappeared from the limited plains country immediately north of the Goha hills in 1824-A-3 during the past 15 to 20 years, but reports indicate small numbers survive on the Chobe flats in or about 1824-A-2, and Hepburn observed them in 1966 in neighbouring parts of the Caprivi in 1724-C-4 and D-3. Their status along the Magwegana spillway needs checking, as several indirect reports suggest their presence in this little-known region, and Shortridge (1934) indicates their presence in neighbouring parts of the Caprivi.

This population is separate, south of the Zambezi, from the population along the Rhodesian border, which is itself isolated from the populations in the east of that territory (Child and Savory, 1964). In Botswana they are known from 1824-B-4; 1825-A-1, 2, 3 and 4; and B-3, where numbers are still reasonably high, although all old bushmen interviewed in this area agreed that they had declined appreciably during the past 20 to 30 years. This was substantiated by the fact that all the adults whose physical condition was assessed during the present survey were very thin and a lactating adult female collected in September 1966 had very depleted fat reserves, including the femur-bone marrow which was poor.

The species' range only just extends within the limits of the game reserve, although more suitable habitat will be added by the proposed eastern extension of the national park. This sensitive grazing species is in danger of extinction over much of its range in southern Africa and the decline in numbers in northeastern Botswana is in accordance with the general deterioration of perennial grasses. Incorrect burning appears to be the primary agent in this respect in oribi habitats within the game reserve, so that the control of fires along the edges of the Kakulwani plains is a high priority for preventing the disappearance of the species.

REEDBUCKRedunca aurundinum

Reedbuck are not common in the Chobe Game Reserve, although numbers are higher in the Kachikau Enclave and the species is well represented around the Okavango swamps and around Panda ma Tenga. Up to five were recorded in a small area on the Chobe flats in 1725-C-3, and up to seven near the Ngwezumba pools in 1824-B-4, in the 1965 dry season, although they have not been seen since. The only area in the game reserve where reedbuck are at all plentiful is on the Savuti "swamp" in 1824-C-1. Outside the reserve they are known from 1824-A-2; 1923-B-3, and according to Tinley (1966), can be expected in 1923-A-2 and B-1; they have been shot in increasing numbers on the Maun Front; and are said to be plentiful around Panda ma Tenga in 1925-D-1. In the last area they are reasonably common on the Nunga plain, but according to bushmen living there, this is a recent extension of their range from further north, as they were unknown in this area six years ago.

The species can stand considerable hunting, as the hunting returns from the Maun Front demonstrate, but is often sensitive to deterioration of its perennial grassland habitat. It would be desirable to have more of this species range within the proposed national park.

THE KOBSGenus Kobus

Three members of this genus occur on the Chobe and Pookoo flats where they may be seen together. Lechwe and puku were recognized as species requiring special investigation, while Professor W. Elder, a Fulbright Scholar, guest of the Botswana Government, undertook an intensive study of waterbuck. Puku and lechwe were therefore studied in some detail by the author and Dr. von Richter. This project, to be published separately, had a theoretical background, comparing the ecology of the three congeneric grazing species, but was designed to yield information of practical value toward their better management.

It is therefore necessary to indicate the general conclusions reached along the Chobe river, only briefly.

WaterbuckKobus elipsiprymnus

Waterbuck have been recorded within four miles of the Chobe in 1724-D-3 and 4, and in 1725-C-3 and 4. They occur along the Savuti and Linyanti in 1823-B-3; D-1 and 2 and 1824-C-1, and a single male was recorded at Tsotsoroga pan in 1824-C-2 in June 1966. Small numbers have been noted near Ngwezumba pools or Kwikampa pan in 1824-B-4 and it is reported from the Panda ma Tenga area in about 1825-D-1. Two males were noted near Nunga in the south of this square in the five years ending 1965 by members of a bushmen community. There are waterbuck in the Moremi Game Reserve, at least in 1923-B-1 and 2, but the species is generally scarce around the southern and western fringes of the Okavango swamp. A single specimen is recorded in the hunting returns from tsetse operations on the Maun Front and there is a recent report of a young male a little to the north of this.

Waterbuck do not appear to be subject to any seasonal movements along the Chobe (figure 10), where they became more conspicuous on the flats during the dry season. One recognizable male was observed repeatedly over a 24 month period in an area not exceeding 27 acres, and several groups were noted on a number of occasions in the same areas for from three to nine months.

Waterbuck appear to calve throughout the year with a peak in midwinter. Juveniles were plentiful, but social segregation from an early age made it difficult to obtain an accurate calf to female ratio. Nevertheless, the species is reported to be expanding

along the Chobe, where their distribution on the Pookoo flats is similar to that of warthog and appears to be related to the grass Cynodon dactylon, which is also spreading in disturbed areas and is eaten extensively by waterbuck. The physical condition of 21 adult males and 24 adult females was assessed during the 1965 dry season and, although many were very thin, some, particularly east of Serondela, were in better shape than the majority of game concentrated along the river; in 1966 waterbuck were among the animals in best condition at the end of the dry season.

The present status of the vegetation along the Chobe appears to suit waterbuck, but elsewhere in northeastern Botswana numbers are low. Hunting of the species should probably be limited to the shooting of a restricted number of males by holders of expensive licenses.

### Puku

### Kobus vardoni

There is a small relic population of puku on the Chobe and Pookoo flats near Serondela in 1724-D-4 and 1725-C-3. Within historic times this represented the southern limit of a bulge in the species range across the Caprivi. Puku have disappeared from the north bank of the Chobe within the last 40 years. The last stronghold was Imparira island, at the eastern tip of the Caprivi, where they were reported plentiful in 1947. The island was settled for the first time for many years in 1958 and by 1963 the species had disappeared. A small herd on the opposite bank of the Chobe has not been seen since about this time either.

Selous (1881) describes the species as numerous on the Pookoo flats in 1874 when he saw groups of up to 50 and notes that puku extended west along the south bank of the Chobe for about 70 miles from the Chobe/Zambezi confluence. In 1965 four men on foot twice counted the population between Kasane and Simwanza, by working back and forth across this resident species' narrow range. The counts yielded 81 and 83 indicating the entire population in Botswana was under 100 individuals of all ages. These are mostly resident within five miles of Serondela, with occasional individuals as far west as Simwanza and as far east as Kasane.

Table 16 summarizes puku classified into sex and age classes in June through January. The significance of these classifications is to be discussed elsewhere, but it is pertinent to note the high proportion of immature animals which represented 76 per 100 adult-sized females. The physical condition of adults was also generally better than that of other ungulates along the river, and 18 of 36 males and 10 of 33 females were classed as fair.

Numbers have obviously declined since Selous' time, but the population appears to be fairly healthy, although much of the area they once occupied in Botswana is now no longer suitable habitat and poaching from the Caprivi may be significant. Management for the Pookoo flats and close cooperation with the South African authorities in law enforcement suggested later in the report, should favour puku. Numbers are very low, however, and a careful check should be kept of the welfare of this species.

### Lechwe

### Kobus leche

There are two distinct populations of lechwe represented in Botswana. The species occurs along the Linyanti-Chobe system and in the Okavango swamps. It converges on the Chobe when the river is low, in 1724-D-3 and 4 and 1725-C-3, from higher parts of its habitat in the Caprivi, and large herds graze the Chobe flats in Botswana for six or seven months of the year (figure 10). There are also lechwe along the Linyanti where they have been recorded in 1823-B-3 and 4, and 1824-A-1. Their occurrence along the Savuti in 1823-D-1 and 2, and 1824-C-1 is dependent upon the presence of water in the channel.

These two areas are united by suitable habitat, where the species has virtually disappeared during the last generation from areas where Selous found them plentiful in 1874.

The Okavango population is said to be numerically strong, and the species is plentiful in the Moremi Game Reserve in 1923-B-1, 2 and 3.

While the lechwe from the eastern Caprivi are in Botswana, they provide a very valuable attraction to visitors to the Chobe Game Reserve, but numbers have declined rapidly during the past few years. In 1962 Hepburn estimated over two and a half thousand on the flats west from Kabulabula to Ihaha, but the highest count from Ihaha to Kasane in 1965 was 1,414 and in 1966 it was only 778 and some 20 to 25 percent of these were east of Kabulabula. This trend is substantiated by unanimous reports from all over the eastern Caprivi and by the low numbers observed by Hepburn, from a helicopter flight between Kasane and Lake Liambezi, while searching for locusts in 1966.

Very young calves have been recorded between July and January while lechwe were plentiful in Botswana, but most calves born in 1965 and 1966 were dropped from the second week in September with a peak in December. Here there was a definite crest in rutting activity from late October well into December. Lechwe were classified into sex and age classes according to standards developed on the Kafue flats by Robinette and Child (1964). These results, based on a sample of 4,461, gave a calf to full grown female ration of 43 per 100, but this was reduced to approximately 18 per 100 by the time the calves were about 11 months old.

The physical condition of 192 adult males and 940 full-grown females was assessed and, with the exception of a male with damaged testicles, all were classed as poor and the majority were in the extreme. Von Richter examined lechwe near Kabe in the Caprivi in May 1967 and found they were in better condition than they had been along the Chobe during the previous October to January period. This was probably not caused directly by the season of the year when the observations were made, but to differences in the conservation values of the habitats. Those along the Chobe were badly downgraded, while a point line transect done in the Kabe area in 1965 showed that, although the small sandy elevations were severely downgraded, the extensive molapos between had a healthy perennial grass cover.

Many lechwe are hunted by the people of the Caprivi who also poach considerable numbers from the flats on the Botswana side of the Chobe when the species is concentrated along the river. Whether or not this uncontrolled hunting is significant in reducing the lechwe population requires further investigation. In any event the hunting along the north bank of the Chobe with dogs may be responsible for many crossing to the Botswana side to graze during the day, only to return to the Caprivi shortly before sundown. Proximity to the river at this time of the year affords the animals a measure of protection, but on the south bank the grassland is heavily grazed by a range of species, has been downgraded by past land use and is further suppressed by fires associated with the poaching activities. Many of the grasses most favoured by lechwe were so short that they had to be transplanted into boxes and allowed to grow before they could be identified.

The control of the rapid decline in the lechwe population across the Botswana/Caprivi boundary calls for greater protection of their habitats along the Chobe and on the sandy elevations on both sides of the border. This, and the control of hunting, will only be possible through close cooperation between the game reserve authorities and the South African Administration in the Caprivi. Failure to halt the declining trends can be expected to lead to the loss of a valuable tourist attraction in the reserve, and of a useful source of meat and skins for the people of the Caprivi. The only year-round lechwe habitat on the Botswana side of the Chobe is outside the reserve in the north of the Kachikau Enclave.

TABLE 16

Sex and age breakdown of puku along the Chobe  
river, by months

Month	Adults		Juveniles	Calves	Juveniles + calves 100 females
	♂♂	♀♀			
June	32	38	29	13	111
July	14	-	13	-	-
August	14	7	3	1	57
September	29	34	29	18	138.2
October	14	7	3	1	57
November	33	69	35	12	68
December	27	58	22	8	52
January	44	105	41	11	50
Total	207	318	175	64	Average 76

The desirability of incorporating this into the sanctuary is discussed in Part II of this report.

The lechwe pastures along the molapos in the Moremi Game Reserve are mostly heavily grazed and show considerable deterioration of conservation values. A sample of 289 lechwe contained 30 calves and 131 adult-sized females, giving a ratio of 23 calves per 100 females, and the majority were in very poor condition with a number of deaths reported during the 1965/66 rains. This would suggest that the population is approaching a critical stage, but more investigation is needed on the lechwe in the Okavango swamps, before appropriate remedial action can be decided.

### IMPALA

### Aepyceros melampus

Impala have a patchy distribution in northeastern Botswana which is closely associated with that of mopane veld. A herd is said to have disappeared from Nungwe valley between Kasane and Kazungula, in 1725-C-3, during the past four or five years. The only records of the species in this one sixteenth degree square during the present survey was of five, nine to 18 month old dispersing individuals. Three 12 to 14 month old rams were noted near Serondela in 1965 and 1966, and a nine to 10 month male and female were noted at Sidudu in August 1966.

The species is fairly numerous in a narrow band parallel to the Chobe between Kabulabula and Ngoma, in 1724-D-4. This population, centered around Simwanza, is isolated from other impala in Botswana. There are also records from along the Linyanti in 1823-B-3 and 4 and 1824-A-1 and 2, and there is a strong resident population around the Gubatsa hills in 1824-C-1 which extends south into C-3 to link up with the population in the southern Mababe and along the Kwaai in 1923-B-1 and 2; 1924-A-1, 2 and 3. Impala have also been observed in all seasons in the southeastern Mababe in 1824-C-2 and 3, but here numbers seen were highest in the wet season.

There is a small population around the headwaters of the Ngwezumba river and in the mopane along the northern edge of Kakulwani, in 1824-B-4 and 1825-A-3, and the species has been encountered in 1824-D-2. Impala have been seen or reported along the stock route in 1825-C-2 and 3, from mopane near the northern fringe of Nyai Pan in 1924-D-2 and 4, Nata ranch in 1925-D-3, and warden Holmes a Court saw an adult male and female and a young male 15 miles north of Jari pan in January 1966, in 1926-A-3. They are also said to occur west of Gweta in 1824-A-2.

Impala are common in and around the Okavango swamps which occupy most of 1922 and 1923 and have been shot in large numbers on tsetse fly control in 2023-A-1, 2 and 3, and occur in the northern half of 2022. They also occur in a narrow band along the east bank of the Botletle river between Makalamabedi and some miles south of Tsoi in 2023-B-4; 2024-A-1-2 and 3 and B-3. This population may now be isolated from those around the swamp and those to the north east of Lake Dow, and it does not occur in mopane, but in fairly thickly wooded vegetation along the river. The river here appears to form the limit of their geographical distribution as, although the species is plentiful on the north and east bank, it is unknown to the local people on the south and west bank.

Very little is known of the status or trends of the Botletle or central populations, although numbers are reported to have declined markedly around the Ngwezumba source during the past 15 to 20 years since bushmen manned cattle posts in this area.

The population along the Chobe is said to have expanded rapidly over the past four years and this is borne out by the results of the present survey. River counts sampled

the eastern fringe of this population, which is resident along the river, and recorded impala some two miles further east than they were known for the previous four years. None were recorded on counts in June 1965 but, since then fair numbers have been noted on all counts (figure 9). A downward deflection is discernible in both years around October when females become more secretive while calving.

The first calves were noted on November 12 in 1965, when they were about a week old, and on November 3, 1966, when the oldest calves were less than three days old and when most females were still pregnant. Calving was very seasonal and most young are born within two to three weeks although, judging from size, a small proportion may have been dropped four to six weeks after the peak. Rutting activity was noted during the second week in April 1967.

Table 17 summarizes the sex and age class breakdown by months of 409 impala classified from whole groups along the Chobe in 1965 and 1966. As is usual with this species, year round classifications gave a very high calf to adult female ratio as a result of social segregation with calves forming large conspicuous bands during the dry season before a proportion disperse away from the parental home range. Calves, however, remained with the females for at least three months and the December-January figures indicate a high survival rate through early life. The reproductive potential of impala approaches 100 calves per 100 females over one year old and the January figure indicates 84 calves per 100 females survived to an age of two to three months when losses are usually high.

The apparent yearling ratio is lower than in the population, as from about January yearling females, which reach sexual maturity at 17 to 19 months, could not be separated from older females. Further, a proportion of this age class had dispersed from the adult range. Child (1965) found this dispersal took place at about 11 to 12 months of age, but it may start earlier along the Chobe, when the calves are nine to 10 months old as several of this age class were noted outside the species' usual range.

Although this population is increasing and spreading, individuals were mostly classed as in poor condition, as gauged by standards determined by Riney (1960). The physical condition was assessed for 114 adults of which all 23 males were grouped as poor as were 87 of the 91 females, the four exceptions being individuals that were in fair condition during the rains.

The population around the Savuti channel and "swamp" evidently built up while there was water between 1959 and early 1965, but then experienced a considerable die-off. By October the animals were all very thin and there were very few calves. In the following October the animals were again thin and not one in more than 100 was found to be better than poor condition; the calves, although more numerous than the previous year and representing 20 to 25 per 100 females, were noticeably small compared with those along the Chobe. This may have been related to a later calving season, although rutting was also evident in this area during the second week in April 1966.

There were reports of impala having increased in and around the southern and eastern fringe of the Okavango swamps, during the 10 years before this assignment began. This was evident from the analysis of tsetse hunting records from near Maun (Child *et al.*, 1967) and was reported from Chief's Island, the Moremi Game Reserve and down the Kwaai river into the southern Mababe. Over 1,000 impala were observed at close quarters along the Kwaai in August 1965, and all were in very poor condition. The situation was even more critical by October when the majority of adults had staring coats and drooping ears. A ram shot at random had no fat deposits, the bone marrow was red and watery, and the utilization of protein tissue was obviously well advanced.

The animals were still very thin in February 1966, at the height of the rains and not one in over 100 adults was in anything but very poor condition. Calving took place around the second half of December which was later than usual and later than the season on the Chobe. Many calves died before they were six months old, and in June there were 26 calves in a sample with 97 adult females, when on account of the harsh conditions a large proportion of the yearling females were still visibly smaller than adults.

It is evident that the populations in and around the Okavango swamps are approaching the crest of an eruptive phase, but that the depression of their essential requirements as the result of several dry years had a marked effect on the herds in a number of areas. These, and the impala along the Chobe, appear to be increasing as the result of the general deterioration of habitats, which at this stage are favouring the species, which in turn is further suppressing the vegetation. Experience in 1965 and 1966, however, suggests that the populations around the swamps will soon decline, unless appropriate measures can be taken. These should include the controlled removal of a significant proportion of the animals.

#### SPRINGBOK

#### Antidorcas marsupialis

The geographical range of springbok includes the Makarikari plains in the south of the area covered by this survey, but ends very abruptly with no records north of about 19° 45' S.

Springbok have suffered a reduction in habitat due to the bush encroachment in large areas on these plains and recent increase in the prices offered for their skins has intensified hunting pressure against them. This should be rigidly controlled. The species has been incorporated into the farming program on many farms and ranches in South Africa, and the possibility of its being similarly used in Botswana should be considered when planning development of areas within its range.

#### GEMSBOK

#### Oryx gazella

Child and Savory (1964) received one report of gemsbok in 1725-C-4 in Rhodesia, although this species does not normally penetrate north of the 19th parallel in that territory. In Botswana it is regularly hunted on the Kakulwani plain in 1825-A-2, 3 and 4, but elsewhere is not common north of 20°S in the northeast. There are records and/or reports of two individuals north of the sand ridge in 1824-A-2 and another on the ridge in 1824-A-4. Several have been noted in mopane woodland in 1924-A-1 and 3, in Kalahari woodland in 1925-A-1, and the species is common south from Nyai pan in 1924-D-4.

#### ROAN

#### Hippotragus equinus

Roan were recorded in numbers in 1724-D-4 and 1725-C-3 and in small numbers in 1824-A-1, 2 and 3; B-2 and 4; C-1, 2 and 4 and 1825-A-1 and 3. They were also reported from 1923-D-1 and 2; are said to be plentiful in the western Makarikari, and to have survived in fair numbers around the southwestern fringe of the Okavango, although few were shot in the last 10 years of tsetse control hunting on the southern fringe.

In the northeast of the Chobe Game Reserve they are subject to seasonal movement with numbers building up along the river during the dry season (figure 11). As with several other species this appears to be influenced by the availability of surface water away from the river, which would explain the difference between the 1965 and 1966 peaks.

TABLE 17

Sex and age class breakdown of Impala on eastern  
fringe of Chobe population

Month	Adults		Yearling	Calves	Total
	♂♂ oo	♀♀ ++			
May		8		5	13
June	1	1	7	14	23
July	5	8	1	25	39
August	3	5		23	31
September	9	18	4	42	73
October	9	11		8	28
November	6	20	11	13	50
December	4	27	3	23	57
January	8	43	8	36	95
Total	45	141	34	189	409

Roan are sensitive grazers, favouring open grassland or plains in northeastern Botswana. Reports from old people point to a very marked decline in numbers in the past 10 to 40 years throughout the region, with the possible exception of the western Makarikari. Residents of Kasane claim that even during the last five years there has been a significant drop in the dry season concentrations along the Chobe.

Much of the Makarikari is waterless and it includes some of the healthiest multi-species grassland found on the present assignment. Further west, however, the species has declined drastically in the area between Kanyu and Maun.

Roan favour open country, but remarkably few were contacted during the present assignment, considering some 30,000 miles were driven in the study area. All 30 adults whose physical condition was assessed were classed as poor, and most were in the extreme, even during the most favourable months of the year.

The species should be considered as in danger of disappearing from much of its range and should receive special protection. This is probably mainly due to habitat deterioration, but in several areas numbers are now approaching a critical level so that any hunting of the species should be very strictly controlled. It might even be limited to holders of the package licences issued to the clients of the safari companies, except where careful investigation shows that more general hunting can be allowed. It is also most desirable that surviving areas of good roan habitat should be conserved and that the management of such areas in the Chobe Game Reserve should be given a high priority.

#### SABLE

#### Hippotragus niger

Sable are widespread in the northeast of Botswana, where they are subject to some seasonal movement. The species has been recorded along the Linyanti and Chobe in 1823-B-3 and 4; 1824-A-1 and 2; 1724-D-3 and 4 and 1725-C-3, and in the Mababe depression in 1824-C-1, 2 and 4 and 1924-A-2. Elsewhere in the Chobe Game Reserve they were noted in 1824-B-4 and D-2; and in 1825-A-1 and 3 and this range extends outside the Reserve in 1825-A-2, B-3 and D-1; C-2 and 4; 1823-D-1; 1923-B-1 and 3; 1925-B-2 and 1926-A-1.

The species is now reported to be rare on the western side of the Okavango swamps, where a generation ago it was still fairly plentiful, and very few have been shot on tsetse control on the Maun Front on the southern fringe of the swamps. The species' effective range is therefore the eastern fringe of these swamps and adjacent parts of the Mababe, the Chobe/Linyanti area and Kalahari woodland in the northeast and east of the region.

The regular counts along the Chobe river indicated the seasonal nature of sable usage of the Chobe flats (figure 11). Numbers were high around Kwikampa pan and the Ngwezumba pools in June 1965 and circumstantial evidence indicated most moved north to the Chobe when the pan dried. There was little water away from the river during 1965 and sable numbers were higher there during the dry season than in 1966, when many pans held water throughout the year.

Sable were strictly seasonal breeders which dropped their calves early in the year. The first calves in 1966 were noted on 5 February, 20 miles south of Dodo Crossroads, but they were not seen on the Chobe flats until the 26th of the month. The first record in 1967 was in the first week in April, but these were fairly well grown and were estimated to be two to three months of age. These dates comply with the observations of bushmen in the Ngwezumba-Nunga area, who gave the peak in calving as January or early February.

In several parts of northeastern Botswana old residents volunteered that there had been a noticeable decline in sable numbers during the last 20 or more years, and in some of these areas, notably around Tamafupi and Nunga, several skulls were found in the veld. These included seven adult males with moderately to well-worn permanent teeth, one adult female with heavily worn teeth and a juvenile just cutting its third lower molars. In addition Hepburn located six adult males which had recently died along the Chobe in 1962. Four of these had all permanent moderately worn teeth, but the other two skulls could not be located in 1965.

A total of 278 head were classified between September and November along the Chobe River. These included 69 adult males, 114 adult females, 30 yearlings and 65 calves. The proportion of males may be high as bulls tended to space themselves singly along the edge of the flats, where they were more or less resident during the dry season. The females and juveniles on the other hand, spent much of the day in woodland away from the river and tended to water in the late morning or early afternoon.

The survival rate of 57, eight to 10 month old calves per 100 adult females indicated by the above figures, was fairly satisfactory as was the number of 20 to 22 month old yearlings. But the physical condition of 71 adults along the Chobe river was judged as poor for 42 females and 27 males. Only two males, which remained on the flats after the 1965/66 rains had set in, were classed as fair.

The animals along the Chobe were generally in much better condition than those observed near Tamafupi in October 1965, and in or near the Moremi Game Reserve in August 1965 through June 1966.

Sable are fairly sensitive grazers, which appear to be entirely dependent on the availability of open water, as they have not been observed in waterless areas. The deterioration of the perennial grasses near permanent water through trampling or grazing by other species may therefore affect the species adversely. Together with the general decline in perennial grasses, this suggests that the range of sable will continue to decrease, unless adequate protection can be provided for its habitat.

The species is popular in national parks and game reserves, and is prized as a trophy so that, although numbers are still reasonably high in some areas, it should receive as much protection as possible from other forms of hunting.

#### TSESSEBE

#### Damaliscus lunatus

Special attention was paid to this little known species during the present survey, and the following discussion is based on the results of this work which is to be published elsewhere (Child and Hepburn, Ms).

There are records of tsessebe from 1724-D-4; 1725-C-3; 1823-A-4; C-2 and D-1; 1824-A-2 and 3; B-4; C-; , 2, 3 and 4; 1825-A-1 and 3; C-1 and D-1; 1923-B-1, 2 and 3, and from the Maun Front tsetse area, where it has been shot in decreasing numbers over the past 24 years (Child et al, Ms).

The species is subject to some seasonal movement, particularly in the north where numbers build up along the Chobe in years when the pans dry up (figure 12). There is also some dispersal away from permanent water in the southwest of the Chobe Game Reserve, although a proportion remained in the dry season range and tsessebe can apparently do without surface water for several months at a time.

Tsessebe are plentiful in some areas, but old people report a definite decline in numbers. Tsessebe are exclusively grazers and physical condition and the proportion of juveniles showed a close parallel with the status of perennial grasses, so that this decline was probably at least partially due to deteriorating habitats. The species is, however, also very susceptible to hunting. Skins now fetch reasonably high prices and it would appear advisable to control hunting and to limit the off-take from much of its range.

#### RED HARTEBEEST

Alcelaphus buselaphus

Hartebeest occur in the Makarikari area in the south of northeastern Botswana and have been seen or reported from 1925-D-2; 2026-A-1; 2024-B-3; D-1 and 3. They probably never enter the Chobe Game Reserve, as has been suggested, as none of these areas are within 70 miles of its borders and there does not appear to be suitable intervening habitat.

#### WILDEBEEST

Connochaetes taurinus

Wildebeest are subject to considerable movement in central Botswana and this extends into the northeast of the territory where they have been noted in 1724-D-4; 1725-C-3; 1823-B-3 and 4; D-1 and 2; 1824-A-1, 2 and 3; B-4; C-1, 3 and 4; 1825-A-3; B-3 and D-1; 1923-B-1, 2 and 3; 1924-A-1 and 3; D-4; 1925-A-3; 1926-A-3, and they have been shot in declining numbers on the Maun Front during the past 24 years (Child et al, Ms). The species also occurs, at least seasonally, throughout most of the Makarikari.

The decline in the Makarikari population between about 1960 and the spectacular crash in 1964 is being traced in the above manuscript. This appears to have been a classical example of a population eruption, followed by the expected heavy mortality as the species exceeds its habitat resources. Early writers do not mention herds of wildebeest "numbering thousands", or "blacking out the horizon" and the first such accounts appear to be from about 1920 to 1930. From then until 1962 most visitors to the area were impressed with the numbers of wildebeest they saw and Riney and Hill (1963) describe driving for over an hour without outflanking a herd.

The heavy mortality coincided with several dry years which followed a number of wet years. Survivors in the southwestern Makarikari appeared to favour a band of grassland with light to moderate bush encroachment, but still supporting a reasonable cover of Cenchrus ciliaris and Schmidtia bulbosa which together with Odysssea paucinervis were grazed in April, 1966.

Perennial grasses had virtually disappeared between this area and the Botletle river and this was a recent phenomenon as charred stumps and tufts were found in sandy soils where wildebeest and cattle were numerous until 1964. The collapse in the grasses was probably fairly sudden, judging from the uniform stands of scrub. On the other hand there was healthy stable multi-species grassland away from water between Kamaga and Gweta.

This evidence led to the hypothesis that wildebeest had increased as the result of land-use practices which had changed the species' composition of grasses near water, favouring such species as C. ciliaris and S. bulbosa, which are obviously palatable. Once the trend was in motion the increasing numbers of wildebeest would have accentuated it until this species alone or in combination with livestock, which were also numerous, overtaxed the simplified grassland and promoted bush encroachment, or, in areas unsuitable for bush, sand-dune formation. The wildebeest died in large numbers in 1964 and the cattle a year later.

This hypothesis suggests that the decline in wildebeest was due to some extent to changes in the habitat and not solely to the construction of veterinary disease control fences, as has been claimed. There is no denying that many animals died on these fences, but many also died in severely impoverished habitat many miles from them, and there is no evidence to hand to suggest that this resulted from the fences cutting a migration route.

Wildebeest appear to move into the southern Mababe from the edge of the Okavango swamps during the wet season as they are then more common in the depression than during the dry months. There is also a buildup along the Chobe in most years, (figure 12), apparently associated with the drying up of the pans in the Ngwezumba/Kakulwani area, but this has been very much less significant in recent years. Large herds have not been seen in the Kasane area for some years and old residents agree that wildebeest have become much less plentiful in the Kasane/Panda ma Tenga area during the last decade.

Wildebeest have a high reproductive potential and numbers can recover rapidly, although it seems unlikely that this will happen where the habitats have been seriously modified, as they are reported to have virtually disappeared from the Bushman Pits area before the general die-off in the rest of the Makarikari.

The species requires careful conservation and the protection of its habitats, so that moves to create a sanctuary in the Nyai Pan area should be encouraged. The disease control fences have killed many wildebeest and may have restricted their geographical range in Botswana so that the closest possible cooperation should be sought between the Game and Veterinary Departments over the siting of any future fences, and in the general management of the species where it occurs together with livestock.

#### BUSHBUCK

#### Tragelaphus scriptus

Bushbuck are common along the Chobe and Botletle rivers and, according to reports, this applies along the edge of the Linyanti, although the species appears to be less common in the Okavango delta. It has been recorded or reported in reasonable numbers from 1724-D-4; 1725-C-3; 1823-B-3 (?) and 4; 1824-A-1; 2023-B-2 and 4; 2024-A-1 (?) and 4; B-3 and a single juvenile was observed in 1824-A-2 at Kasinka, well away from the Linyanti. Tinley (1966) reports them from riparian vegetation in the Moremi and they have been shot in small numbers on the Maun Front, particularly toward the lower end of the Nxaragha valley near the western limit of 2023-A-3.

Bushbuck have not been recorded over three miles from the Chobe river, but within this narrow band there is a seasonal difference in the intensity of use. During the dry season they are closely confined to the riparian fringe with individuals feeding a short distance out on the Chobe flats. The most important browse is then Capparis tomentosa, Gardenia spathulifolia and Acacia sp., and the first two bear very distinct bushbuck browse lines by the end of the season. Bushbuck become less conspicuous in the riparian fringe and a portion of the population moves further from the river as soon as the vegetation begins to come into leaf just before the rains. Species particularly favoured at this time include Baphia obovata and Acacia nigrescens. These movements, and decreasing visibility from about January, account for the low numbers recorded on the standardized counts described in detail later in the report (figure 13).

During the 1965 dry season bushbuck were active in the early mornings, but activity declined during the morning before building up to a peak just before sunset. After sun-down most were observed lying down in thickets in the riparian fringe and relatively few were observed on night counts, using a powerful spot lamp, until about 23.00 hours, after

which they became more active and could be found in fair numbers in areas where a few hours before none were seen. This activity continued until about 01.30 hrs, but whether it extended until dawn was not determined.

Bushbuck were frequently associated with baboons and derived some food from fragments of plants dropped from the trees by the baboons, but were also recorded eating baboon droppings which may provide a significant element in their diet, particularly during the dry season when this association is most pronounced.

Small calves were observed throughout the year even when there was rutting behaviour in this more or less solitary species. The sex and ages were determined in a sample of 622, between June and January 1965/66 and 1966/67 (table 18). The social structure of these groups is summarized in table 19, which indicates that lone adults or a female and her calf were the most usual social units, amounting to 55.9 percent of the observations, followed by single or, occasionally, pairs of juveniles, which made up another 23.4 percent of the contacts.

Old residents of Kasane are agreed that bushbuck are now more common along the river than 10 years ago, and this is borne out by the high proportion of juveniles in table 18. These animals were estimated to be 18 months old or younger as judged against a known aged 19 month old female reported by Wilson and Child (1964). The population may, however, be approaching the crest of an eruptive peak judging from the heavy use of the most favoured dry season browse plants and the poor physical condition of most adults. In a sample of 60 adult males and 75 full-grown females, all but three males and five females were classed as in poor condition and many noted during the dry season were very thin. Six of the eight exceptions were in the vicinity of the Game Reserve headquarters, where they are sheltered from competition from other species, and even at the height of the dry season a male and two females were noted as fair.

It is therefore probable that environmental resistance to the expanding population has been intensified through the general increase of game along the Chobe, particularly during the dry months. An important factor may be the increase in elephant, although they have not been noted using either C. tomentosa or G. spathulifolia. The former grows rapidly, and at this stage the control of bushbuck numbers is probably a fairly low priority, although it would be prudent to maintain a close check on population trends.

#### SITATUNGA

#### Tragelaphus spekei

Sitatunga are limited to swamp habitats and occur in the Okavango delta and on the Botswana side of the Linyanti swamps as far east as Lake Liambezi in 1923-B and 1824-A-1. There are reports of occasional members of the species along the Chobe river east of this limit, within the Kachikau Enclave, and von Richter found an old skull at Kabulabula in 1724-D-4 in early 1967. They also occur in the eastern Caprivi in permanent swamps near Kasane.

Suitable habitat stretches in a belt averaging about two miles wide for over 50 miles west of Lake Liambezi, on the Botswana side of the border, but the best available maps indicate that less than three square miles is within the Chobe Game Reserve, whose north-western corner does not quite reach to the main channel of the Linyanti. Little is known of the species' biology, but it is an important trophy animal and can readily be viewed from prominent trees along the edge of the swamp.

It is therefore recommended that consideration should be given to protecting more of this species' specialized habitat. This is related to the question of changing the status of land tenure of some parts of this region, discussed later. It would also be

TABLE 18Sex and age of bushbuck along the Chobe river  
by months

Month	Total	Adults		Juveniles	Juveniles: 100 adult ♀♀
		♂♂	♀♀		
June	51	17	14	20	143
July	51	20	19	12	63
August	52	7	20	25	125
September	166	38	74	54	73
October	115	35	42	38	90
November	129	23	37	69	187
December	28	5	9	14	155
January	30	8	11	11	100
Total	622	153	226	243	
Average					107.5

TABLE 19

Group structure of Bushbuck

Group Structure	Frequency of occurrence	
	No. of observations (%)	No. of individuals (%)
Single ad. ♂	95 (22.7)	95 (15.2)
Single ad. ♀	90 (21.6)	90 (14.4)
ad. ♂♂	10 ( 2.4)	21 ( 3.3)
ad. ♀♀	12 ( 2.9)	25 ( 4.0)
Single ad. ♂ and Single ad. ♀	12 ( 2.9)	24 ( 3.8)
Ad. ♂♂ + ad. ♀♀	2 ( 0.5)	6 ( 0.9)
Ad. ♂ + Juvenile(s)	11 ( 2.6)	23 ( 3.6)
Ad. ♂ + ad. ♀ + Juveniles	14 ( 3.4)	49 ( 7.8)
Ad. ♂ + Juvenile	49 (11.7)	98 (15.7)
Ad. ♀♀ + Juvenile(s)	21 ( 5.0)	54 ( 8.6)
Juvenile(s)	102 (24.4)	137 (22.0)
Total	418	622
Average No./group		1.49

advisable to discourage large-scale burning of the swamp until the effects of these frequent fires on sitatunga habitat can be gauged.

## KUDU

### Tragelaphus strepsiceros

Kudu were recorded in 1724-D-4 and 1725-C-3 where numbers were high, and in smaller numbers in 1823-B-1 and 2; 1824-A-1; B-2 and 4; C-2 and D-2; 1825-A-3; and near Tsoi on the east bank of the Botletle at about the center point of 2024. They have also been shot in numbers on the Maun Front during tsetse control operations along the southern fringe of the Okavango swamps.

Although kudu occur away from the Chobe in the northeast of the game reserve, most are found within a short distance of the river. Here, like bushbuck, there is a local seasonal shift in the intensity of use. More activity near the river during the dry months leads to a virtual absence of kudu from the riparian strip and surrounding vegetation, as soon as browse on the sand ridge begins to come into leaf in November (figure 13). This is not related to visibility along the count route, as the drop occurs while it is good and numbers showed a clear increase while many bushes were still in leaf in 1966.

Juvenile skulls from the Maun Front and observations along the Chobe river support Simpson (1966) who describes a marked peak in calving early in the year in Rhodesia and Zambia. Animals were classified into sex and age classes according to ageing criteria developed by this author (tables 20 and 21). Entire groups of kudu were difficult to classify because of their preference for dense bush and only those where it was reasonably certain that the whole group could be observed are included in the tables.

The first table gives an indication of the composition of these groups and demonstrates the obvious prevalence of groups of females and juveniles, or of smaller groups of adult males. There is a general consensus of opinion that kudu have increased along the Chobe and this is substantiated by the high numbers of immature animals in the second table. The ratios should, however, be used with considerable caution as there is obvious social segregation between different classes and adult females appear to be more secretive than groups containing juveniles.

The kudu population is beginning to encounter considerable environmental resistance and without exception 41 adult males and 80 full-grown females were classed as in poor physical condition, and during the 1965 and 1966 dry seasons many were very thin. In 1965, in particular, the adults became very lethargic in the presence of danger and several had rough coats and drooping ears. These assessments of physical condition were confirmed by the poorly developed fat deposits in five specimens with fully adult dentition.

Kudu also made extensive use of Capparis tomentosa and Gardenia spathulifolia during the 1965 dry season, but generally fed at a higher level than bushbuck, thus avoiding undue competition with them.

The species is reported to be declining in the Okavango delta area and this is supported by lower kills over recent years in the Maun Front tsetse control hunting area, as the species is usually resilient to this type of hunting (Child et al, Ms). It is not common away from the Chobe or Linyanti and, as a valuable trophy animal, should be protected against undue persecution. A careful check should be maintained of population trends near the Chobe and more information is needed of its general biology in this area. Together with a study of bushbuck this could provide an attractive project for a visiting research worker and thus lead to a better understanding for the management of these two important tourist species.



TABLE 21

Group structure of Kudu along the Chobe river

Group Structure	Frequency of occurrence	
	No. of observations (%)	No. of individuals (%)
Ad ♂ (♂)	29 (33.3)	52 (15.2)
Ad ♀ (♀)	4 ( 4.6)	6 ( 1.7)
Single Ad ♂ and Ad ♀	1 ( 1.1)	2 ( 0.5)
Ad ♂ (♂) and ad ♀ (♀) with calves and/or Sub-ad	8 ( 9.2)	52 (15.2)
Ad ♀ (♀) with calves and/or yearlings of both sexes	30 (34.5)	181 (53.0)
Ad ♂ (♂) + Juvenile(s) of one or both sex	4 ( 4.6)	15 ( 4.3)
Juvenile(s)	11 (12.5)	33 ( 9.7)
Total	87	341
Average size of all groups		3.9

ELANDTaurotragus oryx

Eland are widely distributed in northeastern Botswana where they are subject to considerable movement, but they are only occasional visitors to the Chobe flats east of Kachikau. They have been recorded from 1724-D-4; 1725-C-3 and 4; 1824-A-1, 2 and 3; B-2 and 4; C-1 and 2; D-2; 1825-A-1 and 3; D-1 and 3; 1924-D-4; 1925-C-2 and 1926-C-2.

Eland are of special significance to the bushmen and the following account of their behaviour is based on these people's intimate knowledge of the species, augmented and confirmed by field observations during the present assignment.

The female herds which usually number 10 to 30 individuals break up temporarily to calve from July to September, but then reunite and several such groups coalesce and are joined by males which gives rise to large herds. Rutting begins while some calves are still being born and reaches a peak around October. The large herds persist into the rains but break up between January and May and from then on the males remain in small groups of from one to six or eight individuals. The calves leave the female herds about June and run in herds on their own, which may remain together until the animals reach adulthood, although young animals are sometimes associated with the large herds during the rains.

Fairly small calves were recorded from September, although Hepburn (Pers. comm.) noted young calves in July in both 1962 and 1963, and calves were generally well represented. No animals were classified as in poor condition and most adults which could be approached close enough were rated as "good". A male with all permanent teeth, killed by a lion at Ngwezumba pools late in August 1965, had over 23 mm of subcutaneous fat on the back, a kidney fat index of 329 and good fat reserves in the femur bone marrow.

Eland are not numerous in and around the Chobe Game Reserve but, the population appears to be healthy and may be expanding, as modifications to the habitat probably favour this browsing species and several old people considered numbers higher now than twenty years ago, although others had noticed no change. No particular management is recommended at this stage, although hunting should be regulated to ensure a safe off-take.

BUFFALOSyncerus caffer

Buffalo are locally very numerous in parts of northeastern Botswana where they are subject to considerable dispersal away from permanent water during the wet season. They have been recorded in 1724-D-3 and 4; 1725-C-3 and 4; 1823-B-2, 3 and 4; D-1 and 2; 1824-A-1 and 3; B-1, 2, 3 and 4; C-1, 2, 3 and 4; D-2; 1825-A-1 and 3; C-1, 2 and 3; D-1, 3 and 4; 1923-B-1, 2 and 3; 1924-A-1 and 2; 1925-B-2 and 1926-A-1 and 3. Buffalo are reported plentiful throughout the Okavango swamps and were one of the more numerous species shot on tsetse control on the Maun Front. They also move in a southerly direction toward the Botletle east of the Makalamabedi fence from the general direction of the southern Mababe.

The movements of buffalo require further investigation, on account of the species' possible implication in the spread of foot and mouth disease. The veterinary authorities in Botswana seem generally agreed that it is the only wild ungulate which is likely to transmit the disease over long distances, the significance of other species being in the local dissemination of the virus in an outbreak area.

The species is very nocturnal and secretive along the Chobe river, but becomes more conspicuous during the dry season (figure 7), possibly as the result of an influx of animals from waterless areas. Groups that had grazed on the flats during the night were followed and led two observers over 14 miles in an easterly direction one day and more than 10 miles in a southwesterly direction, from approximately the same starting point, two days later, without either group of cows and calves being seen. Similar tracking of bachelor herds was more rewarding as these moved only three to six miles from the flats.

#### History of Buffalo Population

Buffalo appear to have been reasonably common along the Chobe in 1874 when Selous (1881) shot several. They were unknown to the bushmen of the Ngwezumba area for several generations until about 1944 to 1946 when they began to be seen in small numbers over a fairly wide area, but are now common in this region. The bushmen at Nunga reported a similar sequence of events, although it was not possible to date the reappearance of the species there. A buildup in numbers is also reported along the Chobe. Stigand (1923) gives a brief account of the game in the Okavango swamps and on a journey from Toten, along the Thamalakane, across the western Mababe and up to the Linyanti near the present Ngamiland border but, significantly, does not even mention buffalo.

These and other reports indicate buffalo were fairly widespread but not especially common during the latter half of the 19th century, and that numbers were low and their range restricted for the first three or four decades of this century. By the early forties buffalo were being shot in large numbers on tsetse control on the Maun Front along the southern fringe of the Okavango swamps but, in spite of some reduction in the area hunted, the number shot per year showed a steady upward trend until 1965, when the pattern of hunting was changed (Child *et al*, Ms).

There was a marked die-off of buffalo in the Savuti area after the channel ceased flowing early in 1965. The skulls of 39 of the first to die around the swamp included 20 adult females with moderately to well worn permanent teeth; 2 unsexed adults with moderately worn teeth; nine adult males with moderately worn teeth; three young adults with the premolars exchanging, and four juveniles with the first or second molar erupting. The second wave of deaths was represented by 11 skulls of which 10 were adult males with moderately or heavily worn teeth and one was a female with lightly worn permanent teeth. Mr. Eric Rungren also observed the early stages of this die-off among animals along the Linyanti and of 11 carcasses, nine were old females. These samples suggest a mortality pattern, affecting first juveniles, then old females, old males and finally young adult females, similar to that observed by Child (1965) during the die-off of a herd of over 200 buffalo compressed onto an island during the formation of Lake Kariba.

Hepburn (pers. comm.) reports many thin and dying buffalo in the Enclave and south to the Ngwezumba river in 1962 when a number shot by local villagers were abandoned as too thin to eat.

The author inspected 16 lower jaws of buffalo collected in the Jari pan area on behalf of Riney and Hill (1963). Three had a complete set of teeth but the remainder were well grown juveniles. Some 2,000 buffalo were estimated to have died in this area of 48 square miles in 1962. There was a further heavy die-off in 1965 and considerable numbers are reported to have died during the intervening two years. The dentition and femur bone marrow were examined from 42 carcasses in October 1965, as well as the extent to which each carcass had been eaten by predators or scavengers. These included 21 adult males of which four had well worn permanent teeth, 13 moderately worn teeth and four lightly worn teeth. The only carcass in this group which had been extensively eaten was one with lightly worn teeth, although several of the others were known to have been killed by lion, which had abandoned the meat after very little feeding. It was also noticeable

that very few of the adult males had oily femur bones. On the other hand most of the 12 females with moderately or lightly worn permanent teeth had oily femur bones and had been extensively eaten. Two males with exchanging incisors 2 and 3, and a female with erupting adult canines were intermediate in the oiliness of their bones and the amount of meat removed, between the adult females and males, but a slightly younger male with the third molar erupting was hardly touched. Three small calves with the first molar erupting or in, were, however, extensively eaten, but these carcasses were older than most others.

A herd of 70 to 75 buffalo observed at Jari pan contained no small calves, and only five individuals which were not almost full grown. All the animals in this herd were very thin.

Here the pattern of mortality appeared to have proceeded further than near the Savuti. Adult males, after three years of generally heavy die-offs, were dying in greater numbers than the females, most of which were probably killed by lion, as their carcasses had better fat reserves than those of the males and they were generally more extensively eaten.

#### Trends in Buffalo Populations

As already noted, the population sampled by tsetse hunting on the southern fringe of the Okavango swamps is still apparently expanding. Reports indicate the same from several other areas around the swamps. The population along the borders of the Wankie National Park, near Jari pan, received a severe setback between 1962 and 1965, and habitat conditions are such as to suggest that animals will continue to die in this area in dry years unless appropriate action can be taken.

The die-off around the Savuti was probably precipitated by the exceptional habitat changes associated with the drying up of the channel. Buffalo are, however, very numerous seasonally along the Linyanti where several died in 1965. This population may be reaching a peak in an eruptive phase as conservation values in the area are generally low.

The buffalo along the Chobe near Kasane are still apparently increasing and juveniles are numerous. Many were in poor condition in October 1965, but some of these may have been animals which moved to the river from elsewhere as fat reserves were generally satisfactory in 15 buffalo shot for rations, between October 1965 and October 1966, and in four juveniles which drowned in the Chobe during a stampede in August 1966. With the exception of the juveniles, most had some subcutaneous fat at the base of the tail, and this reached 25 mm in depth in a female shot in October 1966. Most adults had reasonable kidney fat indices (see Child, 1965), ranging between 14 in a November female to 51 in the above October female. Only one of the young calves and an adult female shot in August 1966 had poor fat reserves in the femur marrow.

The perennial grasses on the Chobe flats were heavily grazed by buffalo at night, particularly during the dry season, and most of those shot had stomach contents with a significant proportion of this grass. The stomachs of the four juveniles drowned in August 1966 were full of green grass from the flats. The species also make extensive use of browse such as Baphia obovata, Dichrostachys cinerea, Pterocarpus stevensonii and Combretum spp.

#### Conclusion

There has been a marked increase in the number of buffalo in most of northeastern Botswana since the turn of the century, when numbers were low, possibly due to the great rinderpest which swept through this part of Africa between 1896 and 1898. The recovery

was assisted by changes in the habitats, including an increase in browse plants and cover, but in several areas the species is becoming overpopulated and a number of populations are at, or approaching, the crest of an eruptive peak, and can therefore be expected to begin to decline. Their activities are also damaging to the habitats of other species.

The species is much sought after as meat by many of the local people and the controlled hunting of buffalo should be encouraged, as a source of local protein and as a distraction from the hunting of several other species. An investigation into the possibilities for harvesting buffalo on a commercial scale in one or more of the concentration areas would also be desirable. Little is, however, known of the biology of this species, and every opportunity should be taken to accumulate basic information on its movements, habitat requirements, breeding, growth patterns, etc.

### DISCUSSION

The changing trends in many wild populations, in which the sensitive grazers are declining numerically and the species favoured by bush are increasing, coupled with the widespread bush encroachment and general deterioration of perennial grasses, especially on sensitive soils or where there has been the most intensive detrimental land use, causes concern for the future productivity of the region. The pattern of deteriorating conservation values occurs throughout much of Africa, but is particularly critical where the vegetation is sensitive to abuse, as the result of climatic factors or the geology or geomorphology of an area. The habitats in northeastern Botswana are subject to a low erratic effective rainfall and are mostly on unstable sandy soils.

Veld management, whether for wild or domestic species, should aim at achieving the long-term stability of the habitats and at halting the distressing decline in conservation values over large areas. At the same time it is necessary to seek to increase yields from these marginal lands and it is suggested that the controlled utilization of wildlife, in its varied forms, should receive full consideration in this respect. This does not imply that wildlife should replace existing forms of land use, but that it should be integrated with them on a carefully planned basis.

The remainder of this report is devoted primarily to suggestions for the management of the wildlife industry in northeastern Botswana. These suggestions include what appear to be appropriate measures for the control of the industry under prevailing circumstances and at the present level of understanding of the various species' biology and the utilization of wildlife in Botswana. A strong plea is made for incorporating the accumulation of useful information in any biological management or administrative control program, as this will provide a basis for more efficient coordination of the industry in the future.

### AVIFAUNA OF THE CHOBE GAME RESERVE

The varied birdlife of the Chobe Game Reserve is already a popular attraction with many visitors, and its significance as an added tourist attraction should increase. This prompted a survey of the species known in the reserve, which is included as appendix A of this report.

PART IISANCTUARIES AND GENERAL TOURISM BASED ON WILDLIFECHOBE GAME RESERVEHistory

The Chobe Game Reserve came into existence under the Bechuanaland Government Proclamation No.22 of 1961, better known as the Fauna Conservation Proclamation, after an alternative area along the Rhodesian border and adjacent to the Wankie National Park had been considered and rejected. The original description of the game reserve included a larger area, extending further south and east, but the boundaries were altered several times until in 1965 they were as shown in the figure 14.

Previous to the setting aside of the game reserve, various government officials in authority had enacted local regulations for the protection of several species, in addition to royal game, in this area, and in particular had attempted to restrict hunting along the Chobe river. In April 1962, a warden was appointed to the reserve and was stationed at Kasane and from then onwards policing activities were intensified, within the limits imposed by a meagre staff of from two to seven game scouts. These activities were further restricted during 1963 and 1964 when for 18 months the warden was required to act as district administrative officer, in the absence of a district commissioner.

The 27 miles of main road along the Chobe river from Kasane to Simwanza was built in 1962 with a R20,000 Colonial Welfare and Development grant to the game reserve. At the same time, a series of game-viewing tracks providing loops from this road onto the Chobe flood plain were opened up for tourist traffic, giving a total of some 60 miles of game-view routes.

The Chobe River Hotel was built in 1961, by private enterprise, to serve the game reserve. This company installed a pontoon across the Zambezi river at Kazungula in order to allow the area access from the Zambian road network, as at this stage there was only a primitive track to the Victoria Falls along the south bank of the river.

The Chobe Game Reserve was officially opened to the public on August 1, 1964, and the numbers of visitors making use of the amenity are summarized in table 23. A satisfactory growth in the volume of tourism was evident in the first year, but by 1966 tourist accommodation was saturated at peak periods, particularly during long holiday weekends in Rhodesia and Zambia in July, and during Rhodesian and South African school holidays.

Changes in the Status and Limits of the Reserve

The regulations governing the Chobe Game Reserve were similar to those applying in national parks in several neighbouring states and clearly indicated the Government's

intention that the area should be managed as a national park. The official status as a game reserve tended, however, to result in recommendations for conflicting forms of land use within the reserve and a division of the responsibility for game and its habitats between two Government Departments with diverging interests. Further it denied the area the prestige of a fully proclaimed national park.

It was therefore recommended to the Government that the status of the reserve should be elevated to that of a national park, to be run on established internationally accepted principles, and the necessary legislation is now before Parliament where it has been read for the first time. It was also evident that the prevailing arbitrary map-line limits of the reserve needed revision. They cut across ecological units and are difficult to administer as they ignore existing physical features. The author was requested to investigate possible changes.

The six areas considered are indicated as A to F in figure 14. Definite recommendations have been made for four of the areas while, in the remainder, suggestions in this report may require modification in the light of future developments.

#### Area A - Eastern Extension

The Kakulwani plains and adjacent libalas are attractive game-viewing country which only just penetrated the eastern border of the reserve. This was the only protected oribi habitat in Botswana and, as already noted, the area is probably important alternative habitat for the dry season concentrations along the Chobe river of such species as sable, roan, tsessebe, wildebeest and zebra. Further there was only a restricted area suitable for tourist development in conjunction with the pilot water-manipulation project situated around the head waters of the Ngwezumba river.

According to old people who used to live in the area, the plains were not much used by cattle, even when livestock was plentiful, as the coarse grasses are unpalatable in the dry season and the black "cotton" soils too adhesive during the wet season. A further disadvantage was the presence in neighbouring sandveld of "mohau" *Dichapetalum cymosum*, a toxic weed dangerous to livestock. No objections were raised by the Directors of Agriculture or Veterinary Services to an extension of the eastern limits of the game reserve, and the latter went so far as to agree that a slight deflection of the stock route between bore holes No. 2 and 3 could be justified. In fact the nearest point on the proposed boundary, drawn up in consultation with the Forest Department so as to exclude as much saleable timber as possible, was about  $3\frac{1}{2}$  miles from the stock route.

This extension of an additional 100 square miles of unoccupied state land has been incorporated into the schedules defining the national park.

#### Area B - Southeastern Corner of Reserve

The Forest Department is presently surveying the extent of timber resources in this area. Should they be worth exploiting, then consideration should be given to excluding some of the better wooded areas to the south of the Shinamba Hills and east of the Mababe Depression from the national park, retaining them as game reserve. It would then be desirable to compensate this loss by the addition of more of the libala country to the northeast of the hills and to ensure that the hills are well within the park. According to the surveyors carrying out the ground checks for the preparation of the maps of Botswana by the Directorate of Overseas Surveys, these hills are just within the present eastern boundary of the reserve.

TABLE 23

Visitors to the Chobe Game Reserve since it was opened  
to the Public in August 1964 expressed as daily,  
weekly and annual tickets purchased

Month	1964/65			1965/66			1966/67		
	Daily	Week	Ann.	Daily	Week	Ann.	Daily	Week.	Ann.
August	210	19	-	427	52	3	407	86	2
September	202	64	-	259	25	-	267	38	1
October	136	11	-	191	18	-	188	13	-
November	133	62	-	117	17	-	72	2	-
December	91	7	-	117	25	-	277	17	1
January	79	17	-	122	-	-	212	9	-
February	65	-	-	63	2	-	107	-	-
March	127	-	-	97	4	-	255	20	-
April	337	19	-	262	23	-	282	21	-
May	237	16	-	325	17	-	347	103	-
June	176	-	-	166	7	1			
July	514	46	-	551	43	1			
Total	2 307	261	-	2 757	233	5	2 414	309	4

Total to May

Under no circumstances should areas north of an east-west line some five miles south of the Ghautumbi molapo be excised from the park, as has been requested by the Forest Department.

#### Area C - Southern Extension

The Mababe depression is a natural ecological unit bisected by the southern boundary of the reserve which is arbitrarily sited along the 19th parallel. It was therefore suggested that the southern part of the Mababe should be added to the reserve, as the area was unoccupied state land in which the hunting rights were divided between two safari companies. The area was also hunted over by the 80 odd residents of Mababe Village, who moved north to this area from Mokoba in 1954.

The proposed line would have been as follows: south along the Magwikwe sand ridge from the 19th parallel to a point due east of the southern limit of the Kwaai airfield of Ker, Downey and Selby Ltd; thence by the shortest distance to the Kwaai river; east along this river to where it divides in the southern Mababe, just north of Mababe village; thence along the eastern watercourse, until it is no longer clearly defined; thence in a straight line south of east to the sixth pan south of the mopane limit, going south along Riley's road from Jovorega to Rakuku (i.e. about  $17\frac{1}{2}$  miles south of Jovorega on this road); then north along the road, including the pans in the game reserve, to the first pan south of the mopane limit; thence due east eight or ten miles to a track running more or less parallel to Riley's road; thence north along this road to the 19th parallel.

This additional area has large wet season concentrations of game, such as wildebeest and zebra, as well as large more or less resident populations of impala, kudu, tsessebe and giraffe, and would appear to be of considerable importance to game moving from the vicinity of the Moremi Game Reserve, during the rains. The country varies from open grassland to open bush or tree savannah with occasional closed forest. The ground is hard so that, providing there is underground water, the area could easily be opened up for tourism.

There is tsetse fly; an attempt to introduce large scale agriculture in the south was a costly failure, and neither the Directors of Agriculture nor Veterinary Services could visualize any objections to its inclusion in the game reserve. This was in fact recommended in general terms in "A Land Use Survey of the Northern Statelands Botswana" by Blair Rains et al (1967).

It is, however, a long way from Kasane so that it would be some years before it could be developed, while in the meantime it is earning valuable revenue from safari hunting. For these reasons it has not been included in the national park. Nevertheless, the area should be declared a game reserve (or controlled hunting area) until such time as it is required in the park, as this would allow the management of the habitats and wildlife populations in the Mababe as a whole and would facilitate better control of tribal hunting.

#### Area D

The southwestern corner of the game reserve is not to be included in the national park, the limits of which follow the Magwikwe sand ridge south of the Tsantsara molapo. The area will, however, retain the status of game reserve in which safari hunting will be permitted.

#### Area E

The Linyanti swamps and their environs provide an interesting contrast with the Chobe river east of Ngoma. The area has plentiful game, at least during the dry season,

and should be sampled by a tourist circuit. At present there is, however, very little of it within the game reserve for, as already noted when discussing sitatunga, the reserve includes only  $2\frac{1}{2}$ -3 square miles of swamp and, according to the best available maps, does not impinge on the international boundary, along the main channel of the Linyanti.

It would therefore seem highly desirable that more of this habitat should be brought within the park. The only way this can be achieved at present is by including part of the west of the Kachikau Enclave within the reserve, as this is unoccupied state land, but any serious inroads on the enclave would prejudice its usefulness as a hunting concession. A more desirable alternative would be the incorporation of the triangle between the Savuti and Linyanti, but this would require the consent of the North-West-District Council, as being in Ngamiland, it is Batawana Tribal Territory.

#### Area F

An area of particularly good Kalahari woodland adjacent to the southern border of the Kachikau Enclave has been excluded from the definition of the national park in order to allow the exploitation of the timber. It retains its status as game reserve and in addition will become, in terms of new forestry legislation, part of the forest reserve including most of the present Kachikau Enclave south of the Chobe flats.

For obvious practical reasons it is seldom possible to achieve the ideal within a national park, so that it contains only complete ecosystems, all the year round natural habitat requirements of the species recorded in it, and is therefore independent of surrounding areas. This is especially difficult where mobile populations, subject to more or less extensive movements of a seasonal nature, are involved in an area which is not geographically isolated in any way. The suggested changes in the game reserve or national park boundaries seek to alleviate some of these difficulties, but it is nevertheless desirable, wherever possible, that a national park for the protection of wildlife should be surrounded by a buffer zone in which the exploitation of the wildlife is strictly controlled.

In effect this is the case in the hunting concessions around the Chobe Game Reserve. Generally these areas are sparsely if at all populated, and hunting is mostly limited to the activities of the safari companies. There are, however, indications that the status quo is not always being maintained and the situation can be expected to deteriorate further, unless there are adequate safeguards, particularly as the commercial value of wildlife products becomes more generally known. Immediate steps should include a severe limitation on the issue of pot licences in the Chobe district and adjacent parts of the northern state lands, especially along the cattle export route, and the strict control of all hunting by residents of the Kasane-Kazungula-Lesuma area, the Kachikau Enclave and the southern Mababe.

If possible, the zone around the national park, or any other sanctuaries, should receive the designation of game reserve or controlled hunting area, which would not preclude other forms of extensive land use, with which wildlife management should be coordinated. It is particularly desirable that productive forest reserves and game reserves (as opposed to national parks) should be combined in order to obtain most effective utilization of the wild populations.

#### Kachikau Enclave

This enclave, which has already been mentioned on several occasions in this report, separates most of the game reserve from the Chobe - Linyanti river system, and is itself isolated from the rest of Botswana by the reserve (figure 14). It has already been agreed

that the rational use for this land would be to have it in the game reserve - national park system, but approximately 110 square miles are occupied by some 3,000 people. The area primarily under consideration is roughly that portion of the Chobe flats east of a line passing through Kachikau and Parakarungu which is free of tsetse fly, and is not to be incorporated in a forest reserve.

This area is scenically attractive and could be developed easily and cheaply for tourism. Its inclusion in the national park would increase the tourist-holding potential by over 60 percent and it provides essential habitats for several species, which may otherwise disappear from the Chobe District. The only year-round lechwe habitat is in this region, to the north of Kachikau and, as already stressed, the species is in a precarious position within the game reserve. Sitatunga do not occur in the reserve east of Ngoma, the enclave contains some of the limited oribi habitat which could be protected in Botswana and reedbeek are plentiful, although virtually absent from the present reserve.

These species are associated with attractive vegetation types which are disappearing and which would be worthy of protection, in their own right, if this were not also ensuring that Botswana would continue to have a game sanctuary with a record number of large mammal species. This argument could be countered as purely idealistic, but for the fact that the tourist industry has already proved its value and, with encouragement, could expand rapidly.

The area was first occupied by the present inhabitants around the turn of the century. These people belong to two tribes, the Masubia, which is the tribe of the eastern Caprivi, and an offshoot of the Batawana from Ngamiland. As already noted, their agricultural history has not been a happy one and the area has been subjected to periodic flooding. The first suggestion that people should be moved from parts of the area was made by the Forest Department in 1937. The District Administration reinforced this request in 1945, as by then large areas were completely denuded of all vegetation and wind erosion was widespread. By the early fifties, tsetse was advancing and reached Kasinka in 1952. At about the same time the best croplands in the east began to be submerged and the heavy die-off of cattle precipitated a voluntary exodus of some of the people. For those who remain in this remote part of Botswana expansion is now limited to a relatively small area surrounded by forest and game reserves and by tsetse fly, while there is no shortage of land for human occupation in the east of the Chobe District. Here there appear to be better prospects for crop and livestock production, nearer the District Headquarters and with better communications.

The enclave certainly has some potential for crop production, although it is doubtful if the cliché describing it as the "granary of the north" is applicable in view of the fact that almost 15 percent of the population received famine relief through the World Food Program in 1965. Livestock are estimated to number 1,600 head, but most were in poor condition in 1965 and 1966, judging from a sample of 109 allocated a grading. While the status of the grasses is generally fairly high, conservation values are not being maintained even at this low stocking rate, due to the necessity for early burning in order to render most of the grasses edible.

The restrictions on expansion imposed on these people are bound to come into increasing conflict with forestry and wildlife interests. Fire control and policing operations will remain more difficult and expensive, and the conflict between wildlife and agricultural pursuits will intensify. It is especially pertinent to consider the role of hippo in the regulation of the flow of the Chobe system and their effects on flooding, against their incompatibility with crops and the seasonal demand for their destruction by river bank cultivators. Three very old men, interviewed separately, mentioned an interesting phenomenon in this respect. They could detect no change in the numerical strength of the hippo population over the past 40-60 years, although garden raiding has

increased. Whereas in their youth the hippo used to walk right through their crops growing along the river bank, without causing damage, to graze beyond, this is no longer the case. This suggests that the hippo have only recently learnt to eat cultivated crops or that the grassland has been modified so as to be less attractive to them.

Few nations are better placed than Botswana to plan the long-term development of an area as large as the Chobe District along sound lines, and the Government is aware of this.

A technical meeting was called between members of the Agriculture, Veterinary, Forest, Tsetse and Game Departments and the District Administration to discuss this question. It was generally agreed that good areas for agricultural development appeared to exist in the east of the District, where communications are better, and that these should be further investigated with a view to development, which it was hoped, would attract people from the enclave.

The implied intention toward rational land use planning on a regional basis is to be commended. It is hoped that the necessary preliminary survey work can be implemented in the not too distant future, as continued uncertainty is bound to retard development or to channel it along less productive lines.

### Policy

The administration of a national park is greatly facilitated if there is a clearly defined policy setting out the aims and objectives for its management and development. Such a policy should be within the framework of the internationally accepted principles embodied in the "Draft African Convention for the Conservation and Management of Wildlife", taking into account local conditions. It must also bridge the gap between the need to conserve the natural beauty of, in this case, the wildlife populations and their habitats, and the need to exploit these resources for the maximum long-term benefit of the people of Botswana. Above all it must be realistic.

Once a policy has been drawn up and accepted, then it allows the delegation of authority to Field Staff without the danger of ad hoc decisions or individual preferences, which might be temporary, distorting the long-term objectives. In other words, it ensures continuity as and when there are changes in staff and obviates the need for the park warden constantly to have to refer back to his superiors.

This has obvious advantages in reducing time spent on purely administrative functions, but can be equally useful when dealing with biological problems. Management cannot begin until the end product required of such management is known, as this will determine the techniques which may be tried. If, for example, it were policy to have as many elephant in the park as possible, irrespective of the numbers of other species, this would require a different approach than if it were policy to have as many animals from as wide a variety of species as possible. It also focuses the attention of research toward specific problems and so avoids lengthy studies which, although interesting in themselves, may be of very low priority to the overall well-being of the park. This may be important where trained manpower is limited.

The need for a carefully laid out plan for coordinating the development of the amenities within a national park is fairly obvious, but what is perhaps less often realized is the need to integrate this development within an overall policy. A striking example of this need occurs in the drier parts of the Chobe Game Reserve where tourist facilities have to be developed in conjunction with water manipulation projects. The several factors which must then be taken into account include: the availability of underground water habitats which are not over sensitive to trampling by the animals which will use the water; the availability of sufficient sites the right distance apart to allow a system of rotation

in the use of the bore holes so that habitats have time to recover between successive seasons in which the holes are used; there must be reasonably attractive country for game viewing and the siting of accommodation; the presence of hard ground reduces the costs of roads and tracks and, last but not least, there must be adequate game of a sufficient variety to attract and hold tourists at the seasons in which the area is open to the public.

The definition of policy is obviously the prerogative of the Government and the following tentative suggestions are included purely as a framework for the management and development plans outlined below.

#### Suggested Policy for the Chobe National Park

The Chobe National Park is set aside for posterity for the enjoyment of mankind, in particular for the enjoyment and benefit of the people of Botswana, and for the protection of the animals, plants and natural features within its limits. Recognizing that the aesthetic justifications for the park will be fortified if it is as economically self-sufficient as possible, it is the intention that certain areas of the park should be developed in order to attract and hold visitors, provided this does not conflict unduly with the maintenance of the essential natural beauty of the area. Recognizing also that the area has been modified from its pristine state by past land use and is influenced by current land use in neighbouring areas, it is the intention that the park should be managed in such a way as to safeguard the conservation values of the habitats and the future existence of the fauna native to the area.

The park will be administered in terms of the National Park Proclamation of 1967, by Central Government, through a park warden and subsidiary staff, who will be responsible for: 1) ensuring its proper administration, management and development, in accordance with the principles and the spirit of the "Draft African Convention for the Conservation and Management of Wildlife" of 1967, and 2) for keeping such records of these activities as may be necessary to ensure continuity and facilitate future planning.

The biological management program will be based on a management plan and will aim at providing the greatest number of animals, particularly large mammals, of the widest possible variety commensurate with ecological stability. Where habitat manipulation is necessary, it will be done in such a way as to appear as natural as possible. Scientific research by bona fide research workers will be encouraged, but unless granted written permission to the contrary, it is the responsibility of such workers to obey all park regulations. Buildings, roads and other constructions should be harmonized with the landscape and will be sited only after detailed planning within an overall general development plan. Tourist amenities will aim to attract and hold as many visitors as possible without destroying the essential wilderness qualities of the park. Accommodation should range from primitive camp sites to high-class hotel-type accommodation and private enterprise, under strict government control, will be invited to participate in its development and management.

#### Biological Management

The Chobe Game Reserve is a large area of some four and a half thousand square miles of dry marginal country which has been considerably modified by past land use. The changes in the habitats are reflected by changing trends in the wildlife populations, some of which are expanding while others recede. The knowledge of the area and the mechanisms affecting these changes is still far from complete, in points of detail, and any management toward countering them will have to be carried out by a small staff, with many other duties, and with limited funds.

It therefore seemed advisable to try to define the priorities for stabilising the habitats and then gradually reclaiming those which are essential to endangered species, although additional desirable measures are mentioned in the discussion on individual species in Part I of this report. The priorities appeared to include the recording of the history of land use, area by area by area; the detailed exploration of these areas with a view to describing the fauna and flora and determining conservation trends, and the establishment of a system of routine recording for measuring the changing trends in wildlife populations. This work should continue, together with the evaluation and, if possible, rectification of possible overpopulations of game, and water manipulation.

### Exploration

The exploration of the reserve, using aerial photograph print laydowns as a basis, should continue as opportunity affords. In addition to mapping the vegetation and recording the seasonal abundance of game, gaps in the detailed history of the area should be filled by the careful questioning of old people whenever possible, and repeated checks should be made of conservation trends. The latter should be based on step-point transects and photography and should include a critical assessment of the physical condition of individual adult animals.

The information thus assembled should be filed in an accessible form and should be compiled into area reports, with appropriate maps etc., at periodic intervals. These reports may seldom be complete but would ensure that valuable information is not lost.

### Fire Control

The proper control of fire is probably the greatest single challenge to the management of large areas of the Chobe Game Reserve. There are considerable practical difficulties in the controlling of unwanted burns as fires enter from outside or are started by careless travellers within the reserve, and early burning is official Forest Department policy.

The theoretical basis for needing to control fires and for using burning as a management tool, and the effects of different burning regimes on the type of vegetation occurring in the reserve have been outlined briefly in Part I. It is evident that unless the present burning pattern can be altered and unless the trends induced by it can be halted or reversed, certain species, whose essential habitat requirements are declining, will continue to diminish in numbers and may disappear.

Fire control is a difficult and expensive operation so that severe penalties for negligent burning are desirable. These will not prevent all fires, but they will deter a portion of the wrong-doers and so reduce the incidence of fires. It is also necessary to control the movements of people using the main roads through the reserve and to designate limited areas where they may camp and light fires, so that these areas can be specially protected.

Negotiation is called for between the Game and Forest Departments in order to arrive at a policy which is less damaging to the natural resources of the country than one dependent on regular early burns. This is especially pertinent to areas which are both forest and game reserves and around the perimeter of the national park, as obviously the question will not arise within the park.

It should be the Game Department's policy to prevent all unwanted fires in the national park, although it will be some years before this is possible. In the meantime through traffic should be controlled and all available effort should be concentrated in a few critical areas, which could be expanded as opportunity afforded.

The first of these areas should be the strip of highly modified Kalahari woodland backing up the Chobe flats between Kasane and Ngoma (figure 5). The area is already enclosed by fire traces, which should be widened and graded early each season. It might also be necessary to cut a second fireguard parallel to this, particularly along the eastern border of the park. The proposed diversion of the main road through the park to Ngoma bisects this block lengthwise and would be a useful second break if maintained as such, and this would also apply for the transverse road cutting across the area from Kalwizikankanga or Serondellas to Mandabuzi and Ngwezumba.

If built with this purpose in mind, the road could be made effective against fires from the east penetrating deep into the northern arm of the park. It should be noted, however, that where tourist roads are to act as firebreaks this precludes the early burning of an adjacent strip, to increase their effectiveness, as such fires will promote bush encroachment and so reduce visibility for tourists.

The second area which requires special attention is that around the head waters of the Ngwezumba river where the pilot water-manipulation project is situated. The proposed network of game-viewing tracks should be graded annually and their effectiveness against fires increased by moving the verges to a depth of some 20 yards. This would, incidentally facilitate game viewing. This system of tracks will not enclose the area entirely so that to be effective it would need to be supplemented by a series of firebreaks, particularly along the eastern border of the park.

This area will be linked to the strip along the Chobe by the aforementioned road and, consequently, about half the eastern border of the park would be protected in the direction from which most fires originate. It would, however, be an advantage to have an additional break linking the two areas along the eastern boundary.

The system would be of real benefit to the Forest Department's interests in the forest and forest game reserve to the west and fire prevention here would protect the northern arm of the park from fires from the west. This protection would be increased if the two systems were linked along the 13 miles of road from Ngwezumba toward Kachikau.

The third area deserving special consideration is the Mababe depression, most of which was burned out in 1963, 1965 and 1966 by fires started along the main road between Kachikau and Maun. It might be some time before this area is developed for tourism and until then, the cutting of firebreaks would be unduly expensive. However, the area is protected from settlement in the north by the forest reserve and there is only light settlement to the south, by non stock-owning people, so that the most economic way of limiting fires in the whole Mababe would be through the policing of the southern settlements and through restricting the use of the roads through it to permit holders.

A high priority, which does not fall strictly within the terms of management, is the prevention of the frequent damaging fires on the Chobe flats, started by people crossing over the river in dugouts from the Caprivi. The terrain renders policing extremely difficult, as these people can easily recross the river, which in many places is narrow, while a law enforcement officer has to negotiate several hundred yards of open grassland. The apprehension of poachers becomes virtually impossible when this grass is short after a burn. Poaching is blatant and is carried on in full view of tourists and Game Department staff alike, and is directed mainly against lechwe. Dogs are landed on the Botswana side to chase the lechwe towards the river, where they are dispatched on the bank or in the water.

This is the only serious poaching in the Chobe Game Reserve and calls for close collaboration with the South African authorities in the Caprivi. Not only is the poaching

to be deplored, but the fires started to facilitate it are causing considerable harm to the pastures along the Chobe river in the main game viewing area in the reserve.

### Erosion Control

There is very little accelerated erosion in the Chobe Game Reserve which could not be counteracted by the protection of the perennial grasses from the harmful effects of fire. An important exception is the face of the sand ridge overlooking the Chobe flats between Kasane and Ngoma.

Perennial grasses have almost disappeared and recovery from past land use is prevented by the seasonal concentration of game. Large herds of ungulates, including elephant, pour down the sand ridge towards water, shifting considerable quantities of soil and destroying most of the herbaceous layer early in the dry season. This is accentuated by the grubbing activities of baboons, especially in stony areas which might otherwise receive more protection.

Some attempt to stabilize this sensitive portion of the habitat is called for. Fallen trees, of which there are many due to elephant damage, could be laid along the contour in an attempt to deflect the downward rush of animals from the most affected areas. These would also tend to hold soil washed during the rains and could be arranged so as to enhance their protection of patches of grass from undue use.

### Habitat Manipulation

It will be necessary to manipulate habitats to some extent, in order to offset some of the harmful effects resulting from past land use. This should be directed toward improving the habitats of endangered species, the diversification of the already highly modified habitats adjacent to the Chobe flats and, to a limited extent, to improving visibility along important game-viewing tracks.

These objectives may often be catered for simultaneously and an opportunistic approach would ensure the most economic use of labour, or the most efficient use of fire. A simple example would be where habitats consisting of uniform thickets were to be diversified by hand clearing. This could be expensive if undertaken as a special operation, but costs would be reduced if it were done when a road maintenance gang were in the area and, by promoting grassy glades where there were none before, it would favour grazers and improve visibility.

Burning, carried out correctly, is a useful management tool and can be used to promote either woody species at the expense of grass, or *vice versa*, or to improve the nature of grassland. In the Chobe Game Reserve its use should probably be restricted for some years to combating the scrub which is invading grassland areas thus impoverishing the habitats of several grazing species whose numbers are declining. In most areas burning should be limited to fires late in the dry season, preferably after the grass has dried out after an early shower of rain. Neither should such fires take place at too frequent intervals for, as already discussed, this can induce results similar to early burning, if there is not sufficient combustible material.

The correct interval between burns in the dry marginal habitats of the Chobe Game Reserve could be determined from experiment, but this would necessitate a long delay until such trials yielded results. It would seem preferable to limit burning, where it is desirable, to a frequency of not more than one late burn every five years. Even then, this regime should not be strictly adhered to, and an area should be burnt only if there is a good accumulation of combustible material. This might necessitate delaying the burn one or more years until the dry season following a particularly favourable growing season.

The Forest Department currently map all fires in areas of potentially marketable timber and these most valuable records should be augmented and extended to include the whole Chobe Game Reserve. It is especially important that all deliberate burns associated with management should be accurately mapped, and that the conditions before the fire and in the following dry season should be recorded with the aid of step-point transects and a series of fixed-point photographs.

Habitat manipulation should be concentrated along the strip adjacent to the Chobe flats in the northeast of the reserve and in one or two areas in the Mababe depression. In the first area the object would be to break up the thickets which have become established along the main road between Kasane and Ngoma. This will require the hand clearing of patches of bush where grasses are insufficiently developed to enable a hot burn, while judicious burning should be sufficient to thin out the bush at the eastern end of the Pookoo flats. Where hand clearing is necessary, felled scrub should be windrowed at the edge of the clearing to provide material for a hot fire in a later year. Chemical treatment of the stumps may also be needed in order to prevent coppicing.

One or more areas of grassland with moderate to light bush encroachment should be selected in the Mababe depression in order to establish the usefulness of burning for the elimination of such bush. These areas would, however, require absolute protection from fire for at least four years before the trials are started.

It may be necessary to burn small patches of the tall grassland of the Kakulwani plains adjacent to game-viewing tracks in order that tourists may see game. Such fires would have to be early to be of use and should not cause undue damage in this relatively resilient grassland, provided the areas involved are limited to a few acres away from water holes and are not burnt again for a number of years. This will necessitate the keeping of very detailed records.

#### Water Manipulation

There are a great many seasonal pans in the Chobe Game Reserve, several of which may hold water throughout the year, but there is very little truly permanent surface water. In dry years, such as 1965, it is limited to the Chobe river in the northeast, the Linyanti swamp in the northwest, the pools in the Ngwezumba river at Ngwezumba bridge and, in recent years, to water in the Savuti, although even this was limited to a small seep at the foot of the Gubatsa Hills, during the 1965 and 1966 dry seasons.

The augmentation of natural surface water is therefore one of several management techniques which can be used to raise the year-round holding capacity for several species of game in large areas of the reserve. These species disperse through the reserve during the rains and tend to coalesce towards larger and larger pans and eventually to permanent water, as the dry season progresses. The sequence in which pans dry up varies to some extent according to the local distribution of rain in a given season and this, in turn, influences the movements of the animals so that a secondary aim of water manipulation is to attempt to regulate these movements.

There are, however, several dangers inherent in any management program which alters but one aspect of an integrated ecosystem. It was, therefore, recommended that a pilot project should be tried in order to evaluate the uses and limitations of this type of management under local conditions in the Chobe Game Reserve and that the results of these trials, which should be carefully documented, should form a basis for the consideration of further schemes. Six bore holes have been sunk around the headwaters of the Ngwezumba river and are to be used in a rotational system.

Several factors were taken into account in the planning of this pilot scheme. The development of tourist amenities in this area is a logical step following expansion along the Chobe. Underground water was generally available and the Kakulwani plains and surrounding libala country was relatively stable grassland. The trampling effects of game using the Ngwezumba pools diminished rapidly away from the water and were insignificant a mile from it, in spite of the general deterioration in conservation values due to too frequent burning around the pools. Consequently the bore holes were sited approximately three miles apart. Nevertheless, populations of elephant and buffalo, at least, may require to be controlled in this area for, as already noted, they have built up rapidly from nothing, since the early forties, and damage is widespread.

There are two methods of rotating the use of the six bore holes. Each hole could be pumped in succession for one dry season, so that the vegetation around it would be spelled from intensified use for five years. After several cycles it should be possible to judge whether this degree of use was safe. However, as this is a pilot project, it is desirable that the results of the trials should become available as soon as possible in order to facilitate the planning of water development elsewhere in the reserve, or in other game management areas. It is therefore suggested that the holes should be spelled for differing periods. The initial cost of equipping the holes would be increased, but should be justified by the greater efficiency of the trials and the difference in cost would be reduced by staggering the years in which the holes were used initially. This would, in any case, be necessary to ensure that there was at least one hole in the system in use for the first 26 years.

A schematic program for the use of each of the six holes is given in table 24, taking into account the relative stability of the habitats surrounding the holes and the need to limit the number of pumps required in any given year. There is a danger that a rest of only one or two years between successive pumpings will prove inadequate to allow the vegetation to recover around bore holes No. 1 and 2. As soon as this becomes obvious, pumping should be suspended at these holes and, if possible, others added to the system. If this cannot be done, then these holes should be used only in those years where they are the sole supply, as indicated at the base of the table. The same argument could be applied for bore hole No. 3, but if it is also true for No. 4, then the whole question of the economics of water manipulation will require to be reviewed.

Once safe limits have been determined for the use of each hole, say, after 20 years, then the pumping program should be revised on this basis, taking into consideration those areas which have been most recently used and those which may have deteriorated through too frequent use.

When the scheme is in operation it will be important to ensure that pumping begins early in the year, before most small pans dry up, and that any mechanical failures are attended to promptly. It might therefore be prudent to budget for a complete set of standby equipment. This would mean starting with three sets in 1968 and increasing this to four by 1972.

The importance of adequate records from which to judge the optimum rest period between successive pumpings and to safeguard against extensive damage to the habitats around the bore holes cannot be stressed too strongly. It should be a routine duty for the warden to undertake the following standard recordings at the end of every dry season at each water hole and in at least one control area with permanent natural surface water and one without. The minimum requirements at each site should include three point-line transects from fixed points at distances of 50, 100 and 500 yards from the water hole or control point. Ideally these should be in similar habitat and must proceed along a fixed

TABLE 24

Proposed program for trials with the spelled use of six bore holes in a water manipulation scheme in the proposed Chobe National Park

Bore hole No.	Name	Bore holes pumped in any given year.*																								
		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Regular Program	1 Tambico Pan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2 Sarlgho	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3 Tjinga Pan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	4 Poha	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	5 Namuchira Pan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	6 Mognatsau Pan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Revised program for 3 bore holes	Total holes in use	2	2	1	3	1	1	2	1	2	1	1	2	2	1	1	3	1	1	3	1	1	1	2	3	2
	1 Tambico Pan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2 Sarlgho	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3 Tjinga Pan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

\*If pumping cannot begin in 1968, the program should begin in 1968 and each bore hole will be used a year later than is shown in the table.

bearing, recording the status of the vegetation, the trend in the conservation values of the habitat and the relative use made of the area by game. This data should be supplemented by a series of panoramic photographs and pictures of the ground cover at the start of each line and at fixed points in different vegetation types within one mile of each water hole. In addition, there should be a detailed account of any management undertaken in the area over the past year and of any other points relative to water manipulation and its influence on wildlife or its habitats. Finally, this information should be compiled into an annual report.

This recording should have commenced prior to any pumping but sampling undertaken during the 1966 dry season was curtailed by an extensive fire and was, in any case, unsatisfactory as the sites of the bore holes had not then been finalized. The routine recording should, therefore, commence in 1967 when the fixed points for the photographs and transects should be chosen and marked in such a way that they can be located in subsequent years with certainty. The experience in 1966 demonstrated the desirability of adequate fire protection in this area as soon as possible.

Similar routine measurements should be planned for future water manipulation projects. The pilot scheme will act as a guide, but it should be borne in mind that habitats elsewhere in the reserve may be more sensitive than those around the headwaters of the Ngwezumba river.

The planning of development in parts of the reserve, which would depend upon the use of underground water, is hampered by the lack of knowledge of the quality and availability of such water, or of the use made of saline waters by most species of game. The former requires a proper geophysical survey in areas such as the Mababe depression, which are otherwise suitable for tourist development, and the latter an assessment of the drinking habits of game with access to saline waters. Work, which could be useful in this respect, is in progress in the Wankie National Park and highly mineralized water is used by game in the Kalahari Gemsbok National Park.

There are a number of artificial water holes in the Gemsbok Park in which the degree of mineralization varies, both as regards total dissolved salts and the constituents (table 25). All appear to be used fairly extensively by wildlife, including wildebeest, gemsbok and springbok. A detailed survey of the actual extent of this use in relation to varying salinities and the status and trends in the vegetation around the water holes would be valuable. The information would be of use in the Chobe Game Reserve, as well as elsewhere in Botswana where it is necessary to provide water for wildlife.

When in flood the Savuti channel and swamp provide water for large herds of game in easily developed country in the western Mababe, but the erratic behaviour of this water-course makes it inadvisable to base long-term development on its availability. It would be of considerable value to tourism in the reserve if the channel could be kept open permanently or if water were available in sufficient quantities from its bed, and both possibilities justify investigation. However, the habitats in the vicinity of this water have already been seriously downgraded, and this fact should be taken into account for any management of water in this region.

Thus water manipulation is necessary in order to try and hold animals in the drier parts of the reserve during the dry season, which is the only time of the year when visitors will be able to penetrate these areas. Provision should be made for these artificial water holes to be in clusters so that water can be provided on a rotational basis without destroying the habitat. Regular observations on the effects of water manipulation on animals and their habitats, augmented by information from elsewhere, should provide the basis for greater efficiency in the use of water as a management tool on a long-term basis.

### Overpopulations of wildlife

Several examples of wild populations endangering their habitats and those of other species through overpopulation are mentioned in the discussions of individual species. These include more or less resident species, as well as those subject to seasonal movements and the effects are generally most pronounced near permanent water at the end of the dry season. In years of poor rainfall, when pans dry early and the vegetation near the permanent water is least able to sustain the heavy concentrations of game, the damage to habitats can be extensive. The provision of artificial water holes is not likely greatly to reduce the effect and it could actually accentuate it by raising the overall carrying capacity of the region, with the net result of a tendency for overpopulation in the additional areas in which water is provided.

The disturbance of the delicate relationships between animals and their environment, with the possible exception of elephant along the Chobe is mainly attributable to trends induced through past land use or the effects of harmful burning. It would seem preferable, at this stage, to try to stabilize the habitats and, where possible, to reverse the undesirable trends through their protection or management. Where this fails, and the failure is due to the depressive effects of overpopulation, some control of numbers may be necessary in order to assist in reversing the trend beyond a critical threshold.

Such decisions should be based upon adequate information which can usually be obtained easily enough if the problem is acute. A simple syndrome, with evidence from different aspects of the ecosystem, will often specify the basic causes of a problem and so indicate the most appropriate remedial action.

There are three areas in the reserve where overpopulation should be carefully watched. These are: (1) the strip along the edge of the Chobe flats between Kasane and Ngoma, (2) as already indicated, the area in which artificial water holes are to be provided around the headwaters of the Ngwezumba river, including the vicinity of the existing permanent pools, and (3) the western Mababe around the Savuti.

Routine game counts should continue along the Chobe river between June and November, when there should be at least six counts in each month. The standard procedure already in use should be strictly adhered to. Counts should begin from the warden's house at 14.30 hrs. and should follow the following route: west along the main road to Ihaha, then east along the loop roads to where these rejoin the main road at Msikili, counting should then be suspended until the western entrance to the rice paddy field loop. Any game visible on this loop should be included until the main road is reached at Kalwizikankanga. From there counting is again suspended as far as the entrance to the Water-Cart road, but animals along this loop to Sidudu should be noted. Enumeration should be carried out by two observers in the cab of a land rover or a similar vehicle. Game scouts have been trained to undertake this recording on the standard forms illustrated in table 26.

The information gathered in two years was useful for drawing attention to problems needing further investigation and illustrated the seasonal nature of the concentrations of several species along the river. Even within this short period, important differences in the dry-season use of the area emerged and the rapid decline in the number of lechwe was confirmed.

The vegetation along the main road should be photographed periodically to illustrate any marked changes. Fixed-point photographs were taken of the vegetation on each side of the road every half mile for 12 miles, and then every mile for a further seven miles west from the warden's house during the last week in September and first week in October 1965 and 1966. This information should be augmented with step-point transects in critical areas.

TABLE 25

The Chemical Characteristics of Bore Holes used by Game  
along the Nossob riverbed, Kalahari Gemsbok  
National Park\*

	Bore Holes					
	Rookop	Kaspers- draai	Dikbaards- kolk	Kijkij	Kameel- sleep	Sekwats
pH.	8.45	8.19	8.40	8.50	8.70	8.80
CO <sub>3</sub> <sup>-</sup>	123	123	184	123	123	215
HCO <sub>3</sub> <sup>-</sup>	2059	998	811	811	1123	998
Cl <sup>-</sup>	1292	3300	4296	4428	10652	14599
SO <sub>4</sub> <sup>-</sup>	1094	1872	2016	2064	4608	7008
F <sup>-</sup>	4	5	6	4	7	10
NO <sub>3</sub> <sup>-</sup>	-	-	-	-	-	-
Total Anions	4572	6298	7313	7430	16513	22830
K <sup>+</sup> + Na <sup>+</sup>	2205	3350	4135	4175	9595	13344
Ca <sup>++</sup>	-	33	16	27	-	-
Mg <sup>++</sup>	17	66	27	31	24	16
Fe <sup>+++</sup>	-	-	-	-	-	-
Total Cations	2222	3449	4178	4233	9619	13360
TOTAL	6794	9747	11491	11663	26132	36190

\*Data kindly supplied by Department Geophysical Surveys, Botswana.

The large increase in elephant in this part of the reserve over the past few years requires urgent attention as already indicated in the discussion on this species.

Wildlife populations built up to a spectacular level when the Savuti channel filled and gave rise to swamp conditions in the west of the Mababe between 1958 and early 1965. Elephant caused extensive damage to woody vegetation and the effects of trampling and overgrazing were widespread in an area which may have been sensitive, due to past use by livestock, as there are several old kraal sites and areas of well grown scrub.

Much of the game died after the water dried up; but numbers are already increasing now that the channel has filled again. Appropriate management will depend upon the future behaviour of the channel, but neighbouring habitats should be checked with the aid of step-point transects at the end of each dry season while there is water. If conditions continue to deteriorate, some form of control might become necessary.

### Conclusion

The habitats in the Chobe Game Reserve are still in a fairly healthy state, although signs of early deterioration are widespread, and several game species are already declining numerically. In suggesting a management program the limitations of manpower and funds are recognized. However, unless some action is taken to stabilize the habitats (and to improve those where this can be achieved easily), conditions will continue to deteriorate accentuating the problems and the cost of remedial action.

Considerable emphasis has been placed on recording changes in the ecosystem with the aid of rapid techniques, as this allows trouble to be detected at an early stage when correction is least difficult. It is, for example, a simple matter to extend the intervals between pumpings from a bore hole, when the habitat begins to show signs of deterioration, but much more difficult to reclaim habitats that are seriously downgraded. A decline in conservation values may not always be obvious to begin with, unless the appropriate signs are sought, but vegetation may then collapse suddenly as the deterioration accelerates past critical thresholds, after which it is difficult to reverse the processes.

Fire is undoubtedly an important factor retarding the recovery of the veld from the effects of past land use, and the early protection of the primary tourist areas is suggested along with the modification and management of habitats in these areas. As more staff and funds become available, management should be intensified and spread into other parts of the reserve, by which time the results of observation and management techniques already tested, should provide a basis for ever-improving efficiency.

### THE MOREMI GAME RESERVE

This tribal game reserve is a credit to the people of Ngamiland. It is a triangular-shaped area situated in attractive country along the edge of the Okavango swamps between two of the major distributaries of the Okavango delta and has been described in some detail by Tinley (1966). The vegetation ranges from dry deciduous woodland through grassland, subject to seasonal inundation, to true swamp.

The reserve is administered by the Fauna Conservation Society of Ngamiland whose policy is to retain the area in as natural a state as possible, with no buildings inside the proclaimed 700 square miles or so, where development is to be limited to a few crude tracks. It is planned that these should consist of a road following the Kwaai and Mogogelo rivers, above high water, and linked across the base of the triangle by the road



along the eastern boundary of the reserve. Loop roads will lead from these on to molapos, which are not currently flooded in any given year, and to places of interest in the drier woodland in the center of the reserve. Development of the reserve may be complicated by the inconvenience and possible dangers associated with the tsetse fly.

Tourists are allowed to drive, walk or camp where they please, but each party is obliged to hire an armed game scout, so that this reserve has much in common with the wilderness concept, in so far as it can be applied under local conditions.

The reserve is gaining in popularity, in spite of its remoteness and the density of tsetse fly in some parts, and is much more accessible now that there is a good all-weather gravel road from Francistown to Maun. The day-to-day administration of the reserve and the control of visitors is undertaken by the members of the Fauna Conservation Society, who have in addition done some useful development work in their spare time. The increase in tourism will place an ever-increasing burden on these public-spirited people and their resignation from the society, which could be necessitated for reasons beyond their control, would lead to a disruption in the supervision of the small staff of paid game scouts. The recent moves to entrust the day-to-day supervision of these scouts to the Game Department is therefore to be welcomed, especially as the Game Department plan to build accommodation and to station an assistant warden on the border of the reserve.

Tinley (1966) confirmed Riney and Hill's (1963) warning that the area now forming the Moremi Game Reserve might need careful management. The area was used for livestock production prior to the reinvasion of tsetse fly and until 1963 was frequently burnt. Two point-line transects run at random along the edge of the Mogogelo molapo in August 1965 demonstrated the low level of the vegetation and the deterioration of conservation values in some parts of the area. This is especially noticeable along the Kwaai river in the northeast of the reserve. Over 2,000 lechwe and 1,000 impala were examined and not one animal was classed as in other than poor condition. This also applied in smaller groups of kudu, waterbuck and wildebeest and in subsequent more detailed assessments of the condition of the adults of several species the majority were very thin, even during the growing season.

Impala, lechwe, warthog and, to a lesser extent, tsessebe and wildebeest, are very numerous and there is extensive elephant damage in some areas. Impala calves were notably small and numbers of these, lechwe and tsessebe young were lower than to be expected in a healthy population.

It is clear that more detailed surveys are needed in this and surrounding areas to examine the apparent overpopulation and the various alternative management techniques which could be tried in order to stabilize the reserve ecologically. Research into tsetse fly suggested by the Tsetse Fly Control Department should be welcomed provided it does not conflict with the objectives for the reserve.

#### NYAI PAN

Nyai or Paradise pan is situated in the northwestern corner of the Makarikari system. It is about six miles long and four miles wide and is apparently the flat bed of an extinct lake, separated by a series of sand ridges, around the southern perimeter, from the more typically Makarikari element of the Kanyu flats.

The ground is hard and supports open parkland with scattered groups of Terminalia prunioides and occasional baobabs around the western margin and groups of stunted Acacia