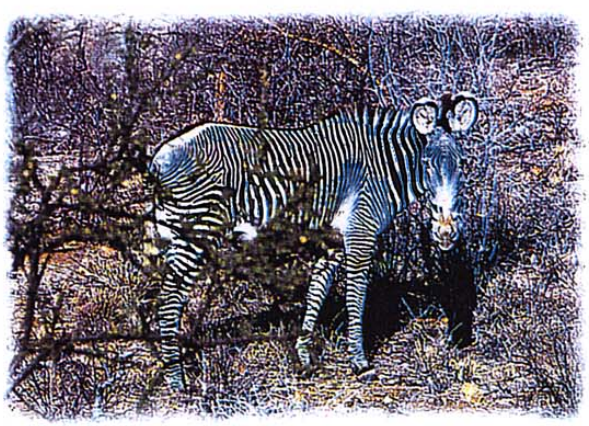
IUCN
The World Conservation Union

REPORT TO IUCN/SSC
Equid Specialist Group

CURRENT STATUS OF BURCHELL'S ZEBRA IN AFRICA

With additional information on Grevy's Zebra and Cape Mountain Zebra



Compiled By Rod East
July 1997

CONTENTS

Cover photos: upper - Burchell's zebra, Kruger National Park, South Africa
lower left - Grevy's zebra, Samburu National Reserve, Kenya
lower right - Cape mountain zebra, Mountain Zebra National Park, South Africa
(photos: Rod East)

1. COMPILER'S INTRODUCTION

The IUCN/SSC Antelope Specialist Group (ASG) conducted an extensive survey of the distribution, abundance and conservation status of antelopes in all countries of sub-Saharan Africa during the mid to late 1980s. The results were published by IUCN in three parts (East 1988, 1989, 1990). In 1994, the ASG embarked on a country by country update of the Antelope Survey, by obtaining new information from ASG members and contacts on the status of antelopes and significant developments affecting their conservation. These results are made available to ASG members and others in the form of *Antelope Survey Updates*, five of which have been produced in the last 2 years (East 1995, 1996a, b, 1997a, b).

The *Antelope Survey Updates* include four "miscellaneous" ungulate species which were not included in parts 1 to 3 of the Antelope Survey but are now the responsibility of the ASG within IUCN/SSC, viz., giraffe, okapi, water chevrotain and African buffalo. In addition, it seemed logical to include zebras, particularly Burchell's or plains zebra *Equus burchelli* (Gray, 1824). Many of the ASG's sources of antelope data also have information on zebras, which would obviously be useful to the Equid Specialist Group (ESG), particularly as continent-wide monitoring of widespread, abundant species such as Burchell's zebra requires an extensive network of informants. In 1995, in correspondence with Patrick Duncan, then ESG Chair, Rod East (ASG Co-Chair and ESG member) offered to compile a report for the ESG summarising information on the status of Burchell's zebra, when sufficient data had been gathered for the major range countries. This report is the result.

Information on Burchell's zebra obtained during the course of the antelope updates is presented for each country in sections 2 to 18. This aims to update the information on this species which was included in the Action Plan for the Conservation of Wild Equids (Duncan 1992), in order to provide the ESG with an information base on which to build during the 1997-2000 IUCN triennium. Subspecies of Burchell's zebra are treated as in Fig. 6 of Duncan (1992). Information which was obtained on Grevy's zebra (*Equus grevyi* Oustalet, 1882) and mountain zebra (*Equus zebra* Linnaeus, 1758) is also included in the country sections. While the ESG's coordinators for these two restricted-distribution species will no doubt have additional and more recent information, the data obtained on Grevy's and mountain zebras is included here for the interest of ASG members.

This report does not repeat the more detailed accounts of conservation issues and protected areas for each country given in the *Antelope Survey Updates*. Sources of information are indicated in each section. All references to "in litt." and "pers. comm." refer to correspondence and communication with Rod East unless otherwise indicated. The information is summarised in section 19.

Two current or former zebra range states are excluded from this report, viz., Burundi, where Burchell's zebra was reportedly extirpated in 1961 (Duncan 1992), and Lesotho, where any naturally occurring zebras are extinct but there may now be a few introduced individuals of *E. burchelli antiquorum*.

The checksheets used in the antelope updates are designed to obtain quantitative data on each species' numbers, population trend and distribution, in accordance with the quantitative criteria which IUCN has adopted for evaluating risks of extinction (IUCN 1994). In this report, tables on zebra abundance within specific areas use the following symbols for

population trend:

I: increasing
S: stable
D: decreasing
?: unknown

If any reader would like clarification of any aspect of this report, please contact Rod East, c/o NIWA, P.O. Box 11-115, Hamilton, New Zealand (email: r.east@niwa.cri.nz).

Acknowledgements: Provision of information on zebra populations in the form of checksheets and reports by ASG members and contacts (sources are given in the country sections) is gratefully acknowledged. Jeremy Anderson, Tom Butynski, James Culverwell, Brendan Dooley, John Fryxell, Alistair Graham, Richard Jeffery, Mike Knight, Richard Kock, Peter Lloyd, Rapelang Masogo, Simon Mduma, Francis Mkanda, Bihini Won Wa Musiti, Delia and Mark Owens, Brian Reilly, Karen Ross, David Rowe-Rowe, Cathy Schloeder, Fekadu Shiferaw, Chris Thouless, P.T. van der Walt, Petri Viljoen, Wolfgang von Richter and Savvas Vrahimis are thanked particularly for the additional information they provided on zebras.

2. SUDAN

In the early 1980s, southern Sudan had a greater abundance of wildlife than almost any other part of Africa (East 1988). Since 1983, this region has been embroiled in an ongoing civil war. Substantial remnants of its wildlife are known to survive, and there are now opportunities to initiate conservation action (East 1997b).

Burchell's zebra occurs in the southeast, to the east of the Nile. No information on zebra populations in this region was included in Duncan (1992), but it was present in substantial numbers prior to the outbreak of the current civil war (Table I). No information is available on the current status of Burchell's zebra in southern Sudan, beyond the likelihood that meat-hunting to feed the combatants in the civil war has caused a major reduction in its numbers.

TABLE I. Estimated Populations of Burchell's Zebra (*E. b. boehmi*) in Southern Sudan in the early 1980s.

Area		Size (sq km)	Popn.	Source
Boma National Park	late dry season late wet season	22,800	29,160 23,630	aerial surveys (J. Fryxell, in litt. September 1995)
Jonglei canal survey area	late dry season mid-wet season	68,000	3,890 0	aerial surveys (Mefit-Babtie 1983)

Note: Standard errors of these estimates are of the order 30% of the estimated populations.

3. ETHIOPIA

Significant wildlife populations persist in the lowlands and in some highland areas of Ethiopia. Many of the country's protected areas are understaffed or have only a minimal presence of Ethiopian Wildlife Conservation Organisation (EWCO) staff, as a result of lack of trained manpower, funds and other resources. These problems are compounded by a general lack of public awareness of the value of the country's unique wildlife resources. Attempts to raise the generally low levels of wildlife protection and management are now receiving substantial external support, e.g., an EU-funded project which aims to rehabilitate Omo, Mago and Nechisar National Parks in the southwestern lowlands.

Burchell's Zebra

This species occurs in southwestern Ethiopia, where the main surviving populations occur in Omo, Mago and Nechisar National Parks, and Yabelo Wildlife Sanctuary (Bolton

TABLE II. Estimated Populations and Population Trend of Zebras in Ethiopia.

Area	Size (sq km)	Year	Popn.	Trend	Source
Burchell's Zebra (*E. b. boehmi*)					
Omo NP	4,033	1994	40	S/D	total aerial count (Lamprey 1994)
Mago NP	2,098	1994	130	S/D	total aerial count (Lamprey 1994)
Nechisar NP	700	1995	<3,000	I	Chemere Zewdie & Getenet Wondimu, EWCO
Yabelo WS	2,496	1993	>3,000	I	Kahsay Tensae & Abate Tekle, EWCO
		1995	2,840	S/I	aerial survey (Thouless 1995a)
Total			about 6,000	S/I	
Grevy's Zebra					
Chew Bahir WR	2,000	1995	370	D	aerial survey (Thouless 1995a)
Borana CHA	40,000	1995	36	?	aerial survey (Thouless 1995a)
Alledeghi plains	880	1995	177	S	total aerial count (Thouless 1995b)
Total			583	S/D	

Note: The estimates from Thouless (1995a) are from aerial surveys using systematic reconnaissance flight techniques, and have standard errors from 27% (Chew Bahir) to >70% (Yabelo, Borana) of the estimate. Information for Nechisar and Yabelo from EWCO was provided by Fekadu Shiferaw (in litt. November 1995) and is based on observations and "guestimates" by local EWCO staff in these areas, not on quantitative surveys.

1973). Recent estimates of these populations (Table II) suggest that numbers may have increased since the period 1986-90, when total numbers in these four protected areas were estimated to be about 2,000 and decreasing (Duncan 1992). Estimates by EWCO staff indicate substantial population increases since 1988-90 at both Nechisar and Yabelo. The suggested increase at Yabelo tends to be substantiated by the aerial survey results of Thouless (1995a). Despite these recorded increases, the levels of protection at Yabelo and Nechisar are relatively low. Yabelo Wildlife Sanctuary has never received effective protection and management, and was taken over for a livestock project in the late 1980s. Nechisar National Park is affected by encroachment of settlement (C. Schloeder, in litt. August 1996).

The populations of Omo and Mago National Parks are at similarly low levels to those recorded in 1986-90, well below the estimated 4,000-6,000 Burchell's zebras for these two parks in the late 1970s (Lamprey 1994). However, it is not clear to what extent the apparent population decline reflects movements of zebras in and out of these parks (Graham et al. 1996). Zebra herds were observed on the adjacent Tama plains by both Lamprey (1994) and Graham et al. (1996); the latter observed no zebras within Omo and Mago National Parks during an aerial survey in 1996. These parks have received no effective protection since the mid-1970s and are heavily poached (C. Schloeder, in litt. August 1996; Graham et al. 1996).

Grevy's Zebra

By the early 1990s, Grevy's zebra survived in only three areas of Ethiopia, the Alledeghi plains (estimated population 175), Yabelo Wildlife Sanctuary and surrounding areas (maximum of 150), and Lake Chew Bahir (numbers unknown, but had been about 1,500 in the late 1970s) (Duncan 1992). The surveys conducted by Thouless (1995a, b) indicate that the isolated Alledeghi population has remained stable, but suggest that numbers may have decreased at Yabelo and Chew Bahir (Table II). The estimate for Borana Controlled Hunting Area in Table II is based on a sighting of a single animal to the west of Yabelo Wildlife Sanctuary; no Grevy's zebras were observed within this sanctuary (Thouless 1995a). At Chew Bahir Wildlife Reserve, Grevy's zebra was observed only at the southern edge of the salt flats, to the south of the lake, where it occurred in relatively good numbers.

4. SOMALIA

Interclan strife has had a catastrophic effect on much of Somalia during the 1990s, and little is known about the current status of its wildlife. Grevy's zebra is believed to be extinct in Somalia, but a decreasing population of perhaps 1,000 Burchell's zebras (*E. b. boehmi*) survived within this species' range in the extreme south of the country in 1991 (Duncan 1992). Recent information obtained by the ASG indicates that good populations of wildlife survive in southern Somalia and that conservation action is in progress in this region (Estes 1995; T. Butynski, in litt. April 1997), but we do not yet have any information on the current status of individual species.

5. UGANDA

An effective system of conservation areas was established in Uganda in the 1950s and 1960s, and formed the basis of a substantial tourism industry at that time. The civil strife and breakdown in law and order which occurred during the 1970s and early 1980s had severe consequences for the country's wildlife and protected areas. Political stability has returned to Uganda since the Museveni government came to power in 1986, and wildlife conservation and the tourism industry have been revitalised. In 1996 the government established a new institution, the Uganda Wildlife Authority (UWA), which is responsible for the conservation and management of wildlife within and outside protected areas. A wildlife conservation policy is being formulated and adopted by UWA which stresses both the fundamental importance of preserving Uganda's rich biodiversity, and the need for local communities to become involved in and benefit from wildlife conservation. Relatively high levels of external support have been provided to Uganda's conservation efforts in recent years. These developments offer the realistic prospect that many of the daunting challenges which still face wildlife conservation in Uganda will be met and overcome (East 1997b).

In the 1970s and early 1980s, Burchell's zebra occurred in reasonably good numbers in two separate areas of Uganda, in and around Lake Mburo National Park in the Ankole grasslands in the southwest, and in the semi-arid savanna grasslands of Kidepo Valley National Park and the Karamoja region in the northeast. In 1991, >3,000 zebras occurred at Lake Mburo, but the Kidepo population was assessed as small and decreasing (Duncan 1992).

The Lake Mburo ecosystem includes the national park and the adjoining Ankole Ranching Scheme. The size of the national park was reduced from 650 sq km to 260 sq km in 1989. As a result of these boundary changes, Lake Mburo National Park has become only a dry season concentration area for most wildlife. During the wet season, species such as zebra and impala move into the adjacent ranchland, where they are hunted intensively by local people (Lamprey & Michelmore 1996). A wet season aerial survey in 1995 revealed a substantial

TABLE III. Estimated Populations and Population Trend of Burchell's Zebra (*E. b. boehmi*) in Uganda.

Area	Size (sq km)	Year	Popn.	Trend	Source
Lake Mburo NP	260	1995	1,290	S	aerial survey (Lamprey & Michelmore 1996)
Ankole ranches	1,303		1,140	S/D	
L. Mburo ecosystem	1,563		2,430	S/D	
Kidepo Valley NP	1,575	1995	450	S	aerial survey (Lamprey & Michelmore 1996)
Pian-Upe GR	3,250	1995	400	D	aerial survey (Lamprey & Michelmore 1996)
Total			3,280	D	

Note: Standard errors of the estimated populations are generally in the range 25-40% of the estimate.

decline in the area's wildlife populations since the most recent previous survey in 1992. The estimated zebra population of the Lake Mburo ecosystem (Table III) decreased by 29% during this period. While this decrease was not statistically significant at the 95% probability level, Lamprey & Michelmore (1996) suggested that the zebra population has in fact decreased with the other wildlife populations, as a result of illegal hunting on the Ankole ranches. A stable wet season population of about 1,300 zebras remained within the national park, where the level of protection has been improved substantially since 1991 with assistance from USAID, SIDA and AWF. If present trends continue, Lake Mburo National Park may become an island remnant of Ankole's natural ecosystem, with wildlife populations reduced to lower levels and restricted to the park. In addition, the park's grazing resources are likely to be threatened by encroachment of livestock during future droughts, with the estimated number of cattle in the ecosystem increasing from 65,000 in 1992 to 110,000 in 1995 (Lamprey & Michelmore 1996).

During the last 10 years, most of the wildlife of Kidepo Valley National Park in northeastern Uganda has been destroyed by poaching to provide meat for camps of the Sudan People's Liberation Army across the border in the adjoining southern Sudan. An aerial survey in 1995 found that Kidepo's zebra population appeared to have been affected less severely than most other wildlife species. Whereas elephant, giraffe, buffalo and antelope populations had been reduced by up to 98% or eliminated, the estimated zebra population (Table III) was similar to the estimates of 450-500 obtained in the 1970s and early 1980s (Lamprey & Michelmore 1996). The future of this park looks more promising than its recent past, with vigorous rehabilitation efforts now being made by UWA.

The Karamoja region, situated to the south of Kidepo Valley National Park in northeastern Uganda, was formerly one of the country's finest wildlife areas. In the 1960s and 1970s, Burchell's zebra occurred in good numbers in parts of this region, e.g., Bokora Corridor and Pian-Upe Game Reserves. Aerial surveys conducted in 1995 revealed that most of Karamoja is now devoid of large wildlife species, as a result of intense hunting pressure over the last 15-20 years (Lamprey & Michelmore 1996). Protected areas such as Bokora Corridor Game Reserve have also been encroached by settlement and large numbers of livestock. The only surviving zebra population observed in Karamoja was in Pian-Upe Game Reserve (Table III), where numbers have decreased from an estimated 2,340 in 1968 and 800 in 1983. The southern section of Pian-Upe is largely free of agricultural encroachment and cattle, and retains viable remnants of most of Karamoja's other wildlife species as well as zebras.

6. KENYA

Kenya has one of the highest international profiles for wildlife preservation in Africa. Wildlife-based tourism has been a major foreign exchange earner for more than 30 years, and the country's protected areas (Fig. I) include many world-famous national parks and reserves. Protection and management of these areas declined during the 1970s and 1980s. By the late 1980s, the deterioration of Kenya's wildlife sector had reached crisis proportions, with widespread poaching and rampant corruption. This situation was swiftly reversed in the early 1990s, following the establishment of the Kenya Wildlife Service (KWS) in 1989 and the initiation of major external support to KWS through the Protected Areas Wildlife Service project, which commenced in 1992 with funding by the World Bank and other donors. By 1994, generally effective control of poaching and improvement of security was in place within most of Kenya's major protected areas.

The wildlife management policies of KWS have subsequently shifted away from strict protection of parks and reserves towards attempting to improve the co-existence of wildlife and rural communities. This has included greater tolerance of domestic livestock within protected areas. The country's relatively small private game-ranching sector, which comprises about 25 ranches, is playing an increasingly important role in wildlife management in Kenya, e.g., wildlife now generally receives higher levels of protection and management on private game ranches and sanctuaries than in most of the national parks and reserves. In Laikipia district, which is predominantly ranchland and retains substantial wildlife populations including zebras, local landowners and residents recently formed the Laikipia Wildlife Forum, to promote sustainable management of the district's wildlife through game cropping and ecotourism.

In southern Kenya, pressures on wildlife from the expansion of agriculture and livestock grazing are increasing in and around some of the country's major wildlife areas, e.g., the Mara and Tsavo regions. Pressures on natural habitats are much lower in northern and eastern Kenya, where human population densities are generally very low and most wildlife species still occur widely. Northern Kenya, which has most of the world's remaining Grevy's zebras, has good potential for long-term survival of wildlife, if the region's security problems can be overcome. Continuing good investment, stable policies and political backing will be essential for Kenya to make further progress in wildlife conservation and to retain its position as one of Africa's leading wildlife countries (East 1997b).

The Department of Resource Surveys and Remote Sensing (DRSRS) conducts regular systematic reconnaissance flight surveys of wildlife and livestock distribution and abundance in Kenya's rangeland districts (Fig. I). Great emphasis has been placed on the use of standardised procedures in these surveys. Results are now available for the period 1977-94 (Grunblatt et al. 1996), and provide a valuable source of information on the population trends of wildlife and livestock within Kenya's rangelands.

<u>Burchell's Zebra</u>

DRSRS aerial surveys indicate a stable total population of about 146,000 Burchell's zebras in Kenya's rangeland districts. The bulk of the population occurs in Laikipia, Narok, Kajiado and Taita Taveta. Burchell's zebra is widespread in these four districts, and occurs more locally in nine other districts (Table IV). While the total population is stable, numbers have changed substantially within some districts since the 1970s, with increases in Laikipia,

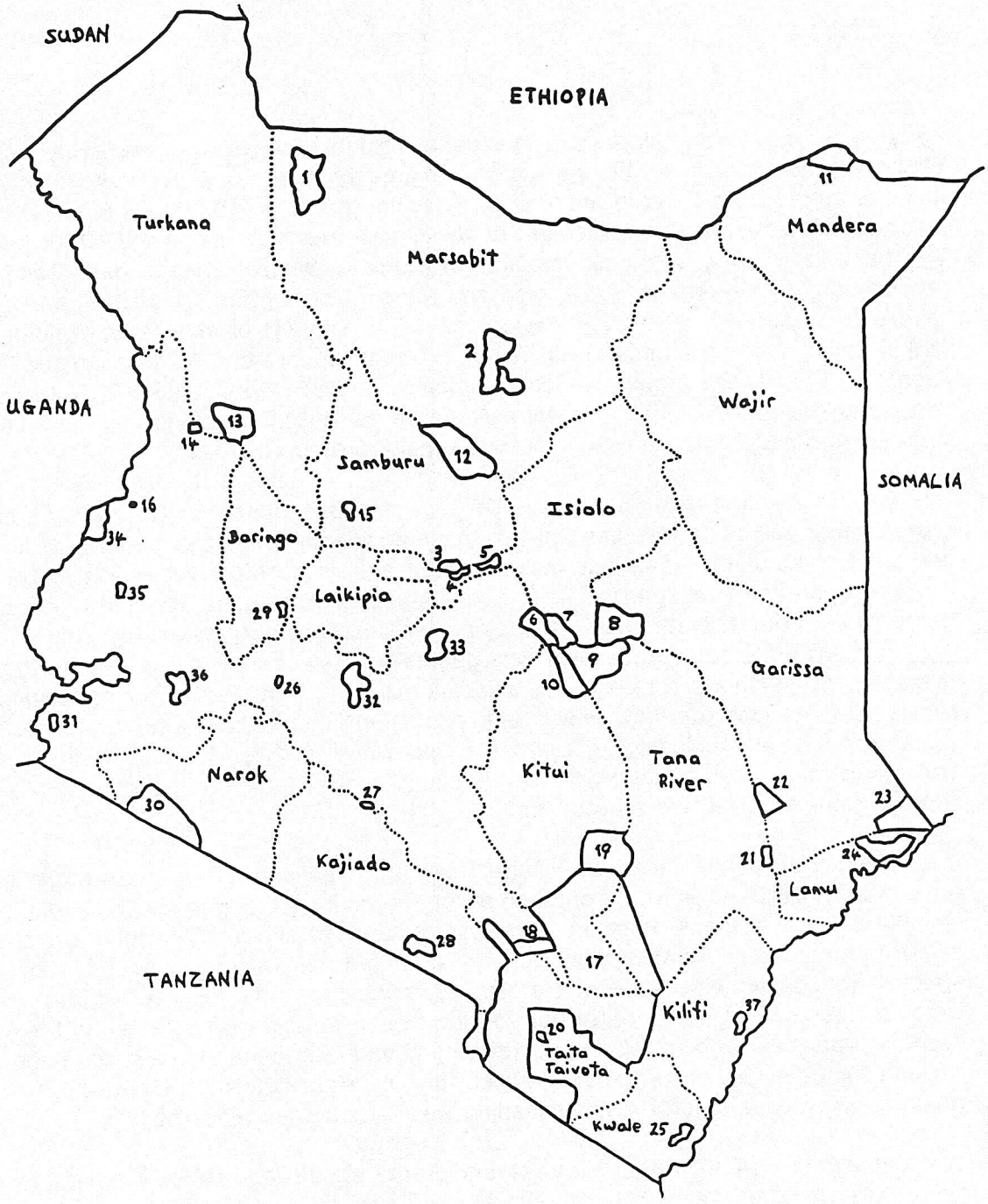


Fig. I. Rangeland districts (dotted outlines) and protected areas of Kenya. Protected areas - 1: Sibiloi National Park. 2: Marsabit National Park and National Reserve. 3: Samburu National Reserve. 4: Buffalo Springs National Reserve. 5: Shaba National Reserve. 6: Meru National Park. 7: Bisanadi National Reserve. 8: Rahole National Reserve. 9: Kora National Reserve. 10: North Kitui National Reserve. 11: Malka Mari National Park. 12: Losai National Reserve. 13: South Turkana National Reserve. 14: Nasolot National Reserve. 15: Maralal Game Sanctuary. 16: Saiwa Swamp National Park. 17: Tsavo National Park. 18: Ngai Ndeithia National Reserve. 19: South Kitui National Reserve. 20: Taita Hills Wildlife Sanctuary. 21: Tana River Primate National Reserve. 22: Arawale National Reserve. 23: Boni National Reserve. 24: Dodori National Reserve. 25: Shimba Hills National Reserve. 26: Lake Nakuru National Park. 27: Nairobi National Park. 28: Amboseli National Park. 29: Lake Bogoria National Reserve. 30: Masai Mara National Reserve. 31: Ruma National Park. 32: Aberdare National Park and Forest Reserve. 33: Mount Kenya National Park and Forest Reserve. 34: Mount Elgon National Park and Forest Reserve. 35: Kakamega Forest National Park. 36: Mau Forest Reserve complex. 37: Arabuko-Sokoke Forest Reserve.

TABLE IV. Average Estimated Populations for the Period 1991-94 and Population Trend of Zebras in Rangeland Districts of Kenya, from aerial surveys conducted by DRSRS (Source: Grunblatt et al. 1996).

	Burchell's Zebra (*E. b. boehmi*)		Grevy's Zebra	
District	Popn.	Trend	Popn.	Trend
Turkana	-	D	-	-
Marsabit	-	D	1,970	D
Samburu	6,140	S	1,110	S/D
Baringo	370	S	-	-
Laikipia	34,070	I	320	S
Isiolo	360	S/D	980	D*
Mandera	-	-	-	-
Wajir	-	-	70	S/D
Garissa	1,240	D	370	S/D
Kitui	1,170	S/D	-	-
Tana River	2,650	D	30	S/D
Narok	42,670	S	-	-
Kajiado	40,510	I	-	-
Taita Taveta	10,290	D*	-	-
Lamu	930	S	-	-
Kilifi	2,390	I	-	-
Kwale	3,240	I	-	-
Total	146,030	S	4,850	D*

Note: Standard errors of the larger estimated district populations are generally less than 25% of the estimate. Population trends are based on comparison with estimates from the 1970s; increasing and decreasing populations are those which changed significantly at the 90% probability level (Grunblatt et al. 1996). "S/D" refers to estimated populations which decreased by more than 50%, but for which the decrease was not statistically significant at the 90% probability level. Asterisks denote populations which decreased significantly between the 1970s and 1980s, but were stable between the 1980s and 1990s (Grunblatt et al. 1996). Data for Narok exclude the Serengeti migrants.

TABLE V. Estimated Size and Trend of Major Populations of Burchell's Zebra in and around Protected Areas of Kenya.

Area	Size (sq km)	Year	Popn.	Trend	Source
Masai Mara NR	1,670	1989-94	6,630	S	aerial surveys (Broten & Said 1995; Grunblatt et al. 1995)
Mara ranches	3,890		19,260	S	
Mara Total	5,560		25,890	S	
Tsavo ecosystem	40,572	1997	11,950	D	aerial survey (DRSRS 1997)
Nairobi NP	117	1993-94	1,260	S	ground counts, KWS (R. Kock, in litt. March 1996)
Amboseli NP	392	1992-94	1,840	S	aerial surveys (Grunblatt et al. 1995)

Note: Population estimates for the Mara refer to resident zebras only; an additional 10,000-50,000 migratory zebras enter the Masai Mara National Reserve seasonally from the Serengeti (Broten & Said 1995). Population estimates for Nairobi and Amboseli National Parks are averages of dry and wet season estimates.

TABLE VI. Estimates of Zebra Population Densities (no. per sq km) in and around (within 20 km of) Protected Areas (Source: DRSRS aerial surveys, Grunblatt et al. 1995).

Area	Size of Census Strip (sq km)	Year	Burchell's Zebra		Grevy's Zebra	
			No. seen	Density	No. seen	Density
Lake Bogoria NR	135	1994	17	0.13	-	-
Meru NP - Bisanadi-N. Kitui-Kora-Rahole	677	1988	2	<0.01	16	0.02
Losai NR	382	1994	-	-	78	0.20
Maralal GS	137	1994	194	1.42	2	0.01
Marsabit NP & NR	364	1994	-	-	15	0.04
Lake Nakuru NP	92	1990	45	0.49	-	-
Samburu-Buffalo Springs-Shaba NRs	207	1994	17	0.08	56	0.27
Sibiloi NP	261	1994	-	-	36	0.14
Tana River - Arawale NRs	348	1988	91	0.26	3	0.01

Kajiado, Kilifi and Kwale, and decreases in Taita Taveta, Garissa and Tana River. Estimated populations of a few hundred Burchell's zebras occurred in each of Turkana and Marsabit districts in northern Kenya in the 1970s, but this species was not reported in the results of aerial surveys of these two districts in the early to mid-1990s (Grunblatt et al. 1996).

Approximately 50% of Kenya's resident Burchell's zebras occur outside protected areas (Grunblatt et al. 1996). Whereas protected areas harbour significant populations in Narok (Masai Mara National Reserve), Kajiado (Amboseli and Nairobi National Parks) and Taita Taveta (Tsavo National Park), at least seasonally, the important population of Laikipia district occurs predominantly on ranchland.

The largest protected -area populations occur in and around Masai Mara National Reserve and Tsavo National Park (Table V). The population of approximately 25,000 resident Burchell's zebras in the Mara region occurs mainly on the Mara ranches to the north of the reserve. While there is an overall trend for the wildlife populations of the Mara ranches to decrease as traditional pastoralism gives way to agriculture (Broten & Said 1995), zebra numbers on the ranches have remained stable. There is also a stable resident population of several thousand zebras within Masai Mara National Reserve. The population of the reserve swells during the dry season, when about 10,000-50,000 Burchell's zebras migrate northwards from the Serengeti. These migratory animals, which spend about 6 months in the Mara before returning south across the Tanzania border during the rains, do not appear to enter the Mara ranches in significant numbers (Broten & Said 1995).

The Tsavo ecosystem comprises about 40,000 sq km, including Tsavo National Park (20,821 sq km), South Kitui and Ngai Ndeithia National Reserves (1,302 sq km) and adjoining areas. Tsavo's wildlife has declined markedly during the 1990s, as a result of factors such as increasing pressures from agricultural settlement and competition with domestic livestock, rinderpest, and the droughts of 1991-93 and 1996-97. The estimated numbers of Burchell's zebra within the Tsavo ecosystem decreased by 50% from 23,710 in 1991 to just under 12,000 in early 1997. The protection and management of this important area may require special attention if the marked reduction of its wildlife resources is to be arrested and reversed (East 1997b).

Nairobi and Amboseli National Parks act as dry season concentration areas for migratory Burchell's zebra populations in northern and eastern Kajiado, respectively. The average zebra populations of these two small parks are about 1,000-2,000, but numbers within the parks are much higher in the dry season. Amboseli, for example, supports >3,000 zebras in some dry seasons compared to only a few hundred or less in the wet season (Grunblatt et al. 1995). These populations are dependent on continued seasonal access to communal pastoral land and group ranches outside the national parks.

Burchell's zebra also occurs in several other protected areas. Estimates of population density in and around protected areas from DRSRS aerial surveys (Table VI) indicate that small populations (generally <100) occur in protected areas such as Lake Bogoria National Reserve (107 sq km), Meru National Park and the adjoining Bisanadi, North Kitui, Kora and Rahole National Reserves (total area 5,273 sq km), Maralal Game Sanctuary, Lake Nakuru National Park (139 sq km), Samburu-Buffalo Springs-Shaba National Reserves (743 sq km) and Tana River National Reserve (171 sq km). Burchell's zebra is absent from protected areas such as South Turkana, Nasolot, Ruma, Losai, Marsabit, Malka Mari, Boni-Dodori, Shimba Hills and most of the mountain and forest parks (Grunblatt et al. 1995; R. Kock, pers. comm. 1996).

Grevy's Zebra

The population of Grevy's zebra in northern Kenya estimated from DRSRS aerial surveys decreased from >13,000 in 1977 to 4,280 in 1988 (Duncan 1992). Subsequent DRSRS estimates indicate that the Kenyan population of this species has remained stable since the late 1980s, but has shown no significant recovery from the 1970s-1980s decline (Table IV). The largest numbers remain in Marsabit, Isiolo and Samburu districts. Grevy's zebra still occurs widely at low densities in these three districts, and in Laikipia. It also occurs in a few isolated areas of Wajir, Garissa and Tana River districts. The distribution map for 1987-94 (Grunblatt et al. 1996) has similar limits to that in Duncan (1992).

Grunblatt et al. (1996) estimated that less than 10% of Kenya's population of Grevy's zebra occurs within protected areas. Estimates of population density from DRSRS aerial surveys (Table VI) suggest populations of the order 100-400 in Losai National Reserve (1,806 sq km), Sibiloi National Park (1,571 sq km), Samburu-Buffalo Springs National Reserves, and Meru National Park and the adjoining reserves, and <100 in Maralal Game Sanctuary, Marsabit National Park and National Reserve (2,090 sq km) and Tana River-Arawale National Reserves. More recent observations indicate that the wildlife of the Meru National Park area is now very scarce, as a result of persistent poaching and incursion of cattle (East 1997b). Only 2 Grevy's zebras were seen during an aerial survey of Meru and the Bisanadi and Rahole reserves by KWS in 1995 (R. Kock, in litt. March 1996). Conversely, Marsabit National Reserve and National Park may support larger numbers than suggested by extrapolation of the density estimate in Table VI, with recent KWS observations indicating that >400 Grevy's zebras utilise the grazing and water resources of these protected areas (R. Kock, in litt. March 1996). Grevy's zebra is not known to occur in South Turkana-Nasolot National Reserves, Boni-Dodori National Reserves or Malka Mari National Park, and is probably now only a rare vagrant in the Arawale and Tana River National Reserves. A viable population may have been established outside the species' natural range by the introductions to Tsavo National Park in the 1960s and 1970s. DRSRS surveys of the Tsavo ecosystem in 1991 and 1994 produced population estimates of 60-90 Grevy's zebras (DRSRS 1997).

Most of the global population of Grevy's zebra occurs outside protected areas in northern Kenya, where the security situation precludes widespread conservation action. Parks and reserves such as Samburu-Buffalo Springs, Marsabit, Losai and Sibiloi may be increasingly vital to this species' survival. A population of 1,500 Grevy's zebras is known to use the Samburu, Buffalo Springs and Shaba National Reserves (Duncan 1992), for example, but the future of these reserves is under threat from irrigation projects which would remove their dry season water supply. Breeding populations within fenced sanctuaries may also play an important role in the long-term protection of Grevy's zebra. As an example, the privately owned Lewa Downs Wildlife Conservancy in the northern foothills of Mount Kenya comprises a fenced area of 158 sq km which was formerly ranched for cattle. As well as providing an important breeding sanctuary for species such as rhinos, this conservancy is reported to have a healthy population of Grevy's zebra which comprises >10% of the species' global population (Lockwood 1996).

7. RWANDA

Rwanda is one of the most densely populated countries in Africa, and wildlife is largely restricted to Volcanoes and Akagera National Parks. The latter formerly occupied about 10% of the country's land area. With assistance from WWF and other international donors, relatively good levels of protection were maintained in both of these national parks during the 1970s and 1980s. Wildlife inevitably suffered during the civil war and genocide which occurred in Rwanda in the early-mid 1990s. Whereas the wildlife of the montane habitats of Volcanoes National Park has come through this period reasonably intact (East 1997b), the wildlife populations of the savanna grasslands and swamps of Akagera National Park and the adjoining Mutara Hunting Reserve, including Burchell's zebra (*E. b. boehmi*), have been badly affected (East 1995).

Protection of Akagera National Park was abandoned in 1990 because of the guerilla war then raging in northern Rwanda. A CCE-ORTPN-CIFCD project was initiated in 1992 to evaluate the status of the park and re-establish protection and management. An aerial census (total count) of the park's zebra, buffalo and topi populations was conducted in March 1994, just before the project was abruptly terminated by the catastrophic events which engulfed Rwanda in April 1994. This census revealed that Akagera's zebra population, which was concentrated on the grasslands in the northern part of the park with one large herd in the adjoining Mutara Hunting Reserve, had decreased by about 70% from 3,800 in 1990 to 1,000-1,280 in 1994 (Fourniret 1994). The decline of Akagera's wildlife during this period was caused by a massive increase in poaching by local people, and the presence of a military encampment in the Mutara reserve.

During late 1994 and early 1995, the Mutara reserve and the northwestern half of Akagera National Park were occupied by large numbers of cattle and their owners who had moved from Uganda. These people are ethnic Tutsi who had lived in exile in Uganda for 35 years since fleeing massacres in Rwanda in 1959. Their mass return to Rwanda occurred after the Tutsi-dominated Rwandan Patriotic Front came to power in 1994. By mid-1995, the former protected areas had been encroached by several hundred thousand cattle and large numbers of associated people. The Mutara reserve had effectively ceased to be a conservation area, and only the southeastern part of Akagera National Park, where the prevalence of tsetse flies was a partial barrier to cattle, appeared to have any prospect of rehabilitation (East 1995). The northern part of the protected areas has subsequently been degazetted.

8. TANZANIA

Tanzania has retained extraordinarily rich wildlife resources which are now without parallel in Africa (East 1997a). National parks, game reserves, game controlled areas and other protected areas cover about 25% of the country (Fig. II) and most wildlife occurs within and around these areas. The country suffered severe economic difficulties during the

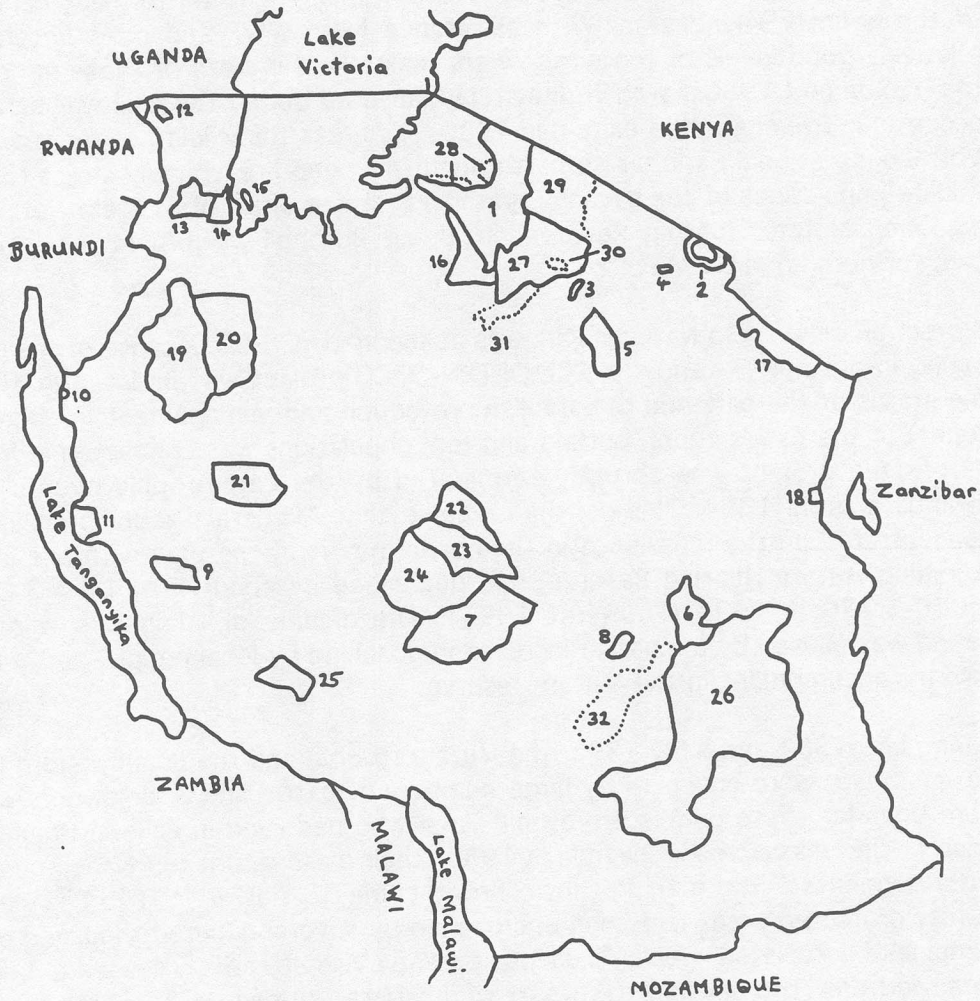


Fig. II. National parks and game reserves of Tanzania.
National parks - 1: Serengeti. 2: Kilimanjaro National Park and Forest Reserve. 3: Lake Manyara. 4: Arusha. 5: Tarangire. 6: Mikumi. 7: Ruaha. 8: Udzungwa Mountains. 9: Katavi. 10: Gombe. 11: Mahale Mountains. 15: Rubondo.
Game reserves - 12: Rumanyika Orugundu and Ibanda Arena. 13: Burigi. 14: Biharamulo. 16: Maswa. 17: Mkomazi. 18: Sadani. 19: Moyowosi. 20: Kigosi. 21: Ugalla. 22: Muhesi. 23: Kisigo. 24: Rungwa. 25: Uwanda. 26: Selous.
Other areas - 27: Ngorongoro Conservation Area. 28: Grumeti and Ikorongo Game Controlled Areas. 29: Loliondo Game Controlled Area. 30: Ngorongoro Crater. 31: Lake Eyasi. 32: Kilombero Game Controlled Area.

TABLE VII. Estimated Populations and Population Trend of Burchell's Zebra (*E. b. boehmi*) in Wildlife Areas of Tanzania.

Area	Size (sq km)	Year	Popn.	Trend	Source
Serengeti ecosystem (excluding Ngorongoro Crater & highlands)	25,000	1989-91	191,030	S/D	aerial surveys, TWCM (Campbell & Borner 1995)
Ngorongoro Crater	250	1992	4,185	S	ground counts (Runyoro et al. 1995)
Tarangire ecosystem	12,600	1994	41,340	S	aerial survey (TWCM 1995a)
Mkomazi GR	3,100	1991	1,200	S	aerial survey (TWCM 1993a)
Lake Manyara NP	110	1984	225	S/I	ground count (Prins & Douglas-Hamilton 1990)
Sadani GR & surrounds	1,537	1992	5	S/D	aerial survey (TWCM 1993b)
Biharamulo-Burigi GRs & surrounds	6,530	1990	5,160	S	aerial survey (TWCM 1991)
Moyowosi-Kigosi GRs	21,870	1994	3,970	S	aerial survey (TWCM 1995b)
Ugalla GR & surrounds	6,900	1991	15	S/D	aerial survey (TWCM 1992a)
Katavi-Rukwa	12,640	1991	20,860	I	aerial survey (TWCM 1992b)
Ruaha ecosystem	42,344	1993	30,070	S	aerial survey (TWCM 1994)
Selous GR & surrounds	81,840	1994	36,150	I	aerial survey (TWCM 1995c)
Mikumi NP	3,215	1994	1,000	D	aerial survey (TWCM 1995c)
Kilombero GCA	6,928	1994	570	S	aerial survey (TWCM 1995c)
Total			335,780	S/D	

Note: TWCM estimates are based on standardised systematic reconnaissance flight methodology and, for the major zebra populations, generally have standard errors of <15% of the estimated population; population trends are based on statistical comparisons with previous surveys at the 95% probability level.

late 1970s and early 1980s, and during this period there was a marked decline in infrastructure and staff morale within protected areas. Since the mid-1980s, there has been substantial economic recovery and a return to relative economic stability. In 1989-91, the government conducted a major anti-poaching effort, Operation Uhai. This was a carefully planned and implemented one-off attempt to bring illegal killing of elephants and other wildlife by commercial poachers to a halt. Since the mid-late 1980s, wildlife-based tourism in the northern protected areas has grown substantially and is now an important source of Tanzania's external revenue. The extensive tracts of wildlife habitat which remain in the west and south are remote and not easily accessible, and a thriving trophy hunting industry is the main form of revenue generation from wildlife in these areas.

While Tanzania retains spectacular concentrations of wildlife, the expansion of human settlement, livestock grazing and agriculture are increasing the pressures on natural ecosystems. Recognition of the global importance of the country's wildlife and the government's demonstrated commitment to wildlife conservation have attracted significant international support for many protected areas, including both bi-lateral and non-government donors, but more could be done. Ultimately, the maintenance of Tanzania's major wildlife concentrations in perpetuity may depend on the willingness of donor agencies and governments to make a long-term commitment to assisting the country's protected areas, in recognition of their aesthetic, scientific and other values (Sinclair & Arcese 1995).

Tanzania Wildlife Conservation Monitoring (TWCM), which is a cooperative venture between the Frankfurt Zoological Society, Tanzania National Parks, the Wildlife Division, Ngorongoro Conservation Area Authority and Serengeti Wildlife Research Institute, conducts regular aerial surveys of Tanzania's protected areas. TWCM's systematic surveys are building up a database on Tanzania's wildlife areas which is valuable for detecting population trends of wildlife species. In 1989-91, the Tanzanian population of Burchell's zebra was estimated to number 390,000 (Duncan 1992). More recent population estimates are now available for most of the major populations (Table VII) and indicate a total population of about 336,000. Numbers are stable in and around most of the key protected areas, but may be decreasing in the Serengeti. The Selous population is increasing. Tanzania's overall population of Burchell's zebra represents more than 50% of this species' estimated global population (Duncan 1992, and see section 19 of this report). Tanzania also has a high percentage of Africa's giraffe, buffalo and savanna antelope populations (East 1997a).

The migratory zebras of the Serengeti ecosystem continue to comprise the largest existing population of Burchell's zebra, but the long-term viability of this world-famous natural area is now under severe threat from human encroachment and overexploitation of its wildlife resources (Sinclair & Arcese 1995). Poachers are estimated to remove 160,000-200,000 animals per annum, in order to satisfy the demand for wildlife meat by the large and rapidly increasing human population living to the west of Serengeti National Park (Campbell & Hofer 1995). Zebras comprised 9% of the estimated offtake, representing an estimated annual removal of 18,600. Further, although Campbell & Borner (1995) presented a merged estimate of the Serengeti zebra population (191,030; standard error 11,550) from systematic reconnaissance flight surveys conducted in 1989 and 1991, the individual estimates show a possible decrease from 1989 (256,560; standard error 18,470, as reported in Duncan 1992) to 1991 (148,940; standard error 14,800). Campbell & Hofer (1995) used the 1991 estimate of zebra numbers and calculated an annual offtake of 12.7% of the population, which is unlikely to be sustainable. The future of this important zebra population, along with the rest of the region's spectacular wildlife, is

dependent on the success of current attempts to improve the protection and management of Serengeti National Park and the adjoining protected areas.

The Tarangire ecosystem also supports an important migratory zebra population, which concentrates around the permanent water sources in the north of Tarangire National Park (2,600 sq km) during the dry season. Zebras and wildebeest are virtually absent from the park during the wet season, when they migrate to the north and east of the ecosystem, well outside the park. Effective protection of Tarangire's migratory zebra and wildebeest populations therefore requires preservation of their seasonal migration routes and wet season grazing areas (TWCM 1995a).

Major populations of Burchell's zebra also occur in the Selous, Ruaha and Katavi-Rukwa regions. Protection and management of the vast Selous Game Reserve (43,000 sq km) have improved to relatively high levels since 1988, as a result of German development aid to this protected area. The zebra population of the Selous ecosystem reached a low in 1986, when poaching was rampant in the area, but has since increased at an average rate of 6.3% per annum and can be expected to return to the levels of 45,000-52,000 recorded in the mid-1970s (TWCM 1995c). Zebras occur across most of the Selous woodlands, but with few in the southwest and an increasing density towards the northeast. There is no indication of major seasonal movements by this population (TWCM 1995c).

The zebra population of the Ruaha ecosystem is stable at about 30,000. This population shows a distinct seasonal migration pattern within the protected areas (TWCM 1994), concentrating in the eastern half of Ruaha National Park and Rungwa-Kisigo Game Reserves during the wet season, and moving to the west in the dry season. In the Katavi-Rukwa region, zebras occur mainly in the 2,000 sq km Katavi National Park (estimated population 7,250) and in the Mulele foothills to the east of the park (estimated population 11,830) (TWCM 1992b). It was considered that the population increase observed in 1991 may have resulted from immigration into the Katavi/Mulele area.

Significant populations of Burchell's zebra also occur in several other protected areas of Tanzania, e.g., Ngorongoro Crater, Biharamulo-Burigi, Moyowosi-Kigosi, Mkomazi and Mikumi. The status of the Biharamulo-Burigi population appeared to be good in 1990, but this population's seasonal reliance on access to areas outside the game reserves makes it potentially susceptible to loss of habitat caused by agricultural expansion (TWCM 1991). The Moyowosi-Kigosi population occurs mainly to the west of the Moyowosi River, within Moyowosi Game Reserve. Small numbers were observed in 1994 on the east side of the river, within Kigosi Game Reserve, where this species had apparently been absent for more than 20 years (TWCM 1995b). The estimated zebra population of Mikumi National Park decreased significantly from 5,570 in 1991 to 1,000 in 1994 (TWCM 1995c). This population change could reflect movement of animals out of this park, which is contiguous with the Selous Game Reserve, but the 1994 survey also recorded significant encroachment of settlement, agriculture and timber extraction on to Mikumi National Park.

9. ANGOLA

Large areas of Angola were affected by civil war between the mid-1970s and the early 1990s, and little information is available on the current status of wildlife. Burchell's zebra (*E. b. zambeziensis*) occurred widely in the protected areas of the southern regions of the country in the 1970s and early 1980s, with a few Hartmann's mountain zebras in the extreme southwest (Duncan 1992). The only more recent information available to the ASG is that gathered by an EU-funded IUCN team which travelled extensively within Angola in 1992 to gather information for an assessment of the state of the country's renewable natural resources (IUCN/ROSA 1992). These surveys revealed that most of Angola's populations of larger wildlife species had been annihilated during the prolonged civil war, and the national parks had been devastated by uncontrolled hunting, troop movements and the collapse of the former national parks administration and infrastructure. Populations of all large mammals have been severely reduced or eliminated in all former protected areas. Qualitative information obtained on the status of individual species suggested that Burchell's zebra "has been severely diminished if not eliminated in Angola", with Hartmann's mountain zebra "probably close to extinction" (IUCN/ROSA 1992).

10. ZAMBIA

Zambia's 19 national parks cover 8% of the country, with an additional 21% designated as game management areas (Fig. III). These protected areas were formerly among the best administered and managed in Africa, but during the last 15-20 years their general integrity has become threatened by poaching, encroachment of settlement and incursions by domestic livestock. The National Parks & Wildlife Service (NPWS) has lacked sufficient trained staff, equipment and resources to counter these threats. In the absence of adequate government funds, external support has been largely responsible for providing the resources to keep key protected areas at least moderately well staffed and managed, e.g., from donors such as Frankfurt Zoological Society to North Luangwa National Park, NORAD (Norway)/DGIS (Netherlands) to South Luangwa National Park and Lupande Game Management Area, ODA (UK)/EU/DANIDA (Denmark)/WWF to Lochinvar National Park and Bangweulu, and JICA (Japan) to Kafue National Park. In some other protected areas, e.g., Lavushi Manda, Lusenga Plain, Isangano and Mweru Wantipa National Parks, and many of the game management areas, protection and management are poor or non-existent and wildlife populations are severely depleted. Recovery of at least some of these depleted areas is a realistic prospect, since extensive areas of Zambia have relatively few people or livestock, natural habitats often remain intact, and there is increasing external support for protected areas and growing private sector involvement in the country's wildlife industry (East 1996a).

The Equid Action Plan (Duncan 1992) estimated a total population of about 23,000 Burchell's zebras in Zambia in 1979-89, with the upper Zambezi zebra (*E. b. zambeziensis*) in the west and Crawshay's zebra (*E. b. crawshayi*) in the east. More recent

information indicates substantially larger numbers, with an estimated national population of about 40,000 (Table VIII), mainly because of more extensive coverage, e.g., Kafue and Liuwa Plain National Parks and substantial parts of the Luangwa Valley were not included in Duncan (1992).

The country's three largest populations of the upper Zambezi zebra occur on the Kafue flats and in Kafue and Liuwa Plain National Parks. Duncan (1992) treated the 1989 Kafue flats population estimate of 7,700 as "Kafue NP & flats", but in fact this population occurs outside and to the east of Kafue National Park, within Lochinvar and Blue Lagoon National Parks and in adjoining parts of Kafue Flats Game Management Area (Jeffery et al. 1989) (see Fig. III). Lochinvar National Park has benefitted in recent years from the WWF-Zambia Wetlands Project, and recent observations (B. Dooley, in litt. March 1995) indicate that the Kafue flats population is at least maintaining its numbers.

Kafue National Park is one of the largest national parks in Africa. It contains extensive areas of miombo woodland, with open grassland in areas such as the Busanga floodplain in the northwest. Zebra densities are highest at Busanga and in the southern region of the park (Table VIII). Poaching continues to be a major problem in the central region of Kafue National Park, but the habitat is generally in good shape. As management improves, this park is expected to support substantially larger wildlife populations than occur at present (Yoneda & Mwima 1995). Zebras also occur, in unknown but probably greatly depleted numbers, in the extensive game management areas which surround Kafue National Park.

The remote Liuwa Plain National Park in western Zambia retains spectacular wildlife populations, with Burchell's (upper Zambezi) zebra one of the most abundant species. Herds of 20 to 300 zebras were seen frequently during a traverse of this vast flat plain of treeless grassland in June/July 1994 by Brendan Dooley (in litt. March 1995). The estimated population of 6,000 is based on Dooley's observations, his discussions with local game scouts, and information provided to him by NPWS headquarters. Quantitative surveys are needed to confirm the population levels of the wildlife of Liuwa Plain, and improved protection and management is required urgently to control poaching by Zambian and Angolan meat-hunters in this area.

The estimated population of about 20,000 Crawshay's zebras in the Luangwa Valley is larger than the 15,300 reported in 1979 (Duncan 1992), but this difference is at least partly due to the inclusion of additional parts of the valley in Table VIII. Overall zebra densities in the central Luangwa Valley were assessed as stable over the period 1979-94 by Jachmann & Kalyocha (1994). However, there is likely to have been some population increase further to the north, in North Luangwa National Park, during this period, since the North Luangwa Conservation Project has developed rigorous protection against poaching since 1986. The overall status of Crawshay's zebra in the Luangwa Valley is similar to that of antelopes (East 1996a), viz., relatively high densities and generally stable populations in the better protected national parks (North Luangwa, South Luangwa and Luambe), relatively good numbers in a few game management areas, and depleted populations elsewhere.

There has been an upsurge in game ranching in Zambia in recent years, with the number of registered game ranches increasing to 20 in 1994 (NPWS, in litt. June 1995). Both the number of ranches and their wildlife populations, which currently include several hundred zebras, are expected to continue to increase.

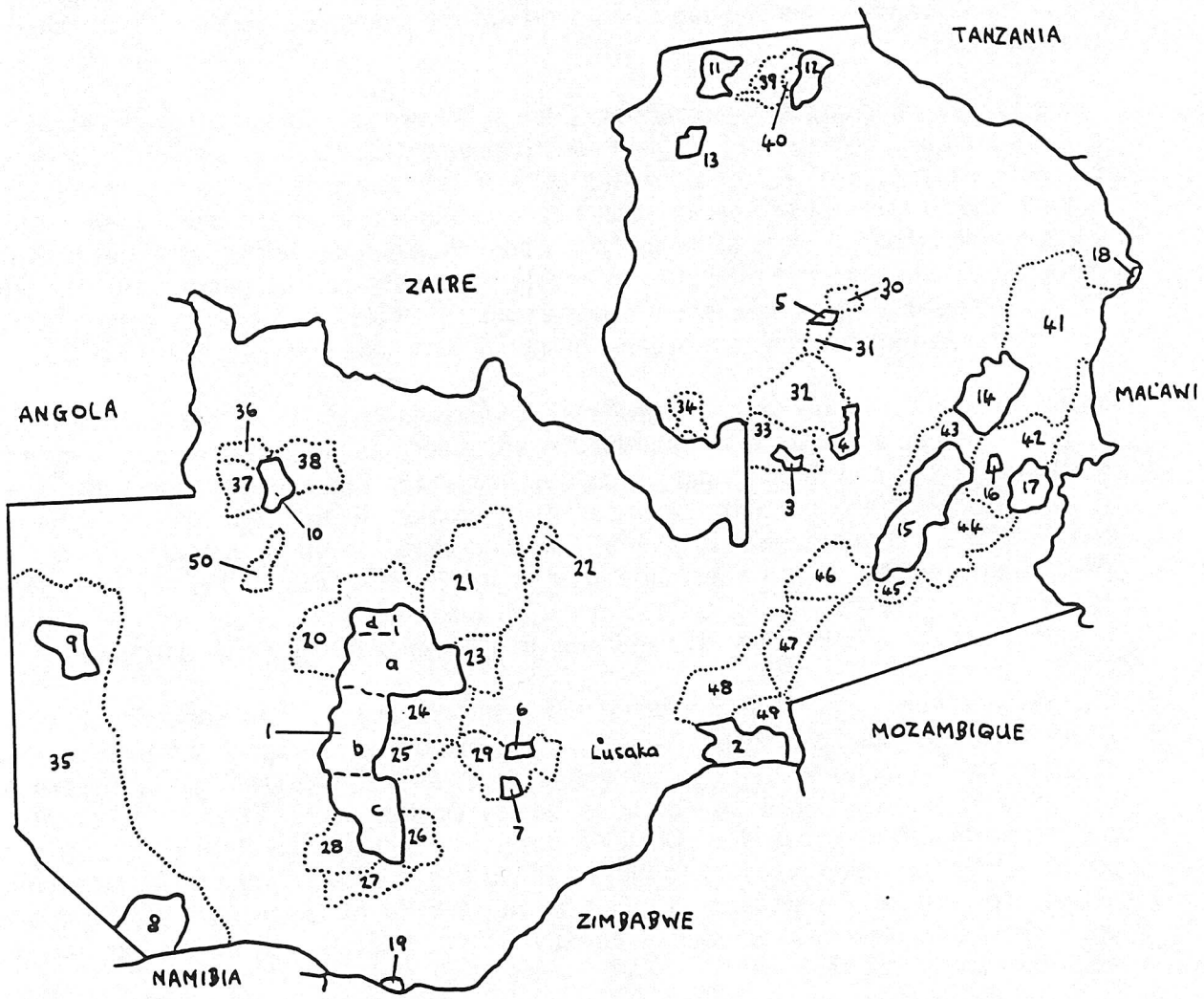


Fig. III. National parks and game management areas of Zambia. National parks - 1: Kafue [including northern region (a), central region (b), southern region (c), and Busanga Plain (d)]. 2: Lower Zambezi. 3: Kasanka. 4: Lavushi Manda. 5: Isangano. 6: Blue Lagoon. 7: Lochinvar. 8: Sioma Ngwezi. 9: Liuwa Plain. 10: West Lunga. 11: Mweru Wantipa. 12: Nsumbu. 13: Lusenga Plain. 14: North Luangwa. 15: South Luangwa. 16: Luambe. 17: Lukusuzi. 18: Nyika. 19: Mosi Oa Tunya.
Game management areas - 20: Kasonso-Busanga. 21: Lunga-Luswishi. 22: Machiya-Fungulwe. 23: Kaluanyembe. 24: Mumbwa. 25: Namwala. 26: Bilili Springs. 27: Sichifulo. 28: Mulobezi. 29: Kafue Flats. 30: Luwingu. 31: Chambeshi. 32: Bangweulu. 33: Kafinda. 34: Mansa. 35: West Zambezi. 36: Chibwika-Ntambu. 37: Lukwakwa. 38: Musele-Matebo. 39: Kaputa. 40: Tondwa. 41: Musalangu. 42: Lumimba. 43: Munyamadzi. 44: Lupande. 45: Sandwe. 46: Chisomo. 47: West Petauke. 48: Luano. 49: Rufunsa. 50: Chizela.

TABLE VIII. Estimated Populations and Population Trend of Burchell's Zebra in Wildlife Areas of Zambia.

Area	Size (sq km)	Year	Popn.	Trend	Source
E. b. zambeziensis					
Kafue National Park:					
northern region	10,130	1994	340		aerial survey (Yoneda & Mwima 1995)
central region	7,471		135		
southern region	3,796		1,250		
Busanga plain	960		1,105		
Kafue NP Total	22,357		2,830	S	
Liuwa Plain NP	3,660	1994	6,000	D	B. Dooley (in litt. March 1995)
Sioma Ngwezi NP	5,240	1991	390	?	aerial survey (Tembo 1995)
Kafue flats	6,000	1994	9,000	S	B. Dooley (in litt, March 1995)
Subspecies Total			18,220	D	
E. b. crawshayi					
Lower Zambezi NP	4,132	1995	410	D	aerial survey (Mwima & Yoneda 1995)
Mweru Wantipa NP	3,134	1994	present	D	B. Dooley (in litt. July 1995)
Lusenga Plain NP	880	1994	present	D	B. Dooley (in litt. July 1995)
Luangwa Valley:					
Musalangu GMA (part)	5,183	1994	230	D	aerial survey (Kapungwe 1994)
North Luangwa NP	4,636	1995	9,050	S	aerial survey (D. & M. Owens, in litt. June 1995)
Lumimba GMA	2,700	1994	2,710	S	
Munyamadzi GMA	2,500	1994	340	D	
Luambe NP	320	1994	320	S	for other parts of Luangwa
Lukusuzi NP	1,920	1994	450	D	Valley, aerial survey by
South Luangwa NP	9,050	1994	5,100	S	Jachmann & Kalyocha
Lupande GMA	4,500	1994	1,490	S/D	(1994) (ground survey in
Sandwe GMA	1,500	1994	140	?	Lupande GMA)
Chisomo GMA	3,450	1994	-	-	
West Petauke GMA	3,842	1994	660	?	
Luangwa Valley Total	39,601		20,490	D	
Subspecies Total			20,900	D	
Subspecies indet.					
Zambian game ranches		1994	350	S/I	NPWS (in litt. June 1995)
Species Total			39,470	D	

Note: Standard errors of estimates from aerial surveys of the larger zebra populations in Zambia reported above are generally of the order 16-30% of the estimate.

11. CONGO-ZAIRE*

Between 1960, when Zaire gained independence, and 1997, a history of internal conflicts and corruption up to the highest levels of government seriously weakened the country's infrastructure, and large regions were cut off from government control. Throughout this period, the Institut Zairois pour la Conservation de Nature (IZCN), which is responsible for managing national parks and hunting areas, maintained the integrity of most of the country's national parks and extended the protected area system. IZCN's operations became more difficult than usual during occasional periods of civil disturbance, and more frequently suffered from lack of resources. Support to IZCN and key protected areas from external donors such as the World Bank, EU, Germany, WWF, WCS, FZS, UNESCO and others has played a key role in assisting IZCN to continue to function.

Burchell's zebra (*E. b. zambeziensis*) formerly occurred in the savanna grasslands and woodlands of Upemba and Kundelungu National Parks in the Shaba/Katanga region of southeastern Zaire. In the early 1970s, the total population was probably less than 1,000, with most of these in the northern sector of the Upemba park (Verschuren 1975). The species became extinct in Kundelungu National Park during the 1980s, but was still present in Upemba in 1991 (Duncan 1992).

Unlike most of the country's other national parks, for which formal arrangements of ownership were signed when they were gazetted, Upemba and Kundelungu National Parks were simply ceded for use as conservation areas and still belong to the local people. Apparently there has never been hard-line control of poaching in Upemba and Kundelungu, where IZCN could not shoot poachers following warnings as they were permitted to in other parks. During political disturbances in Shaba/Katanga in the early 1990s, local politicians and regional authorities declared that people could move back into these two parks and hunt and cut firewood. IZCN staff had to more or less abandon the parks, and the wildlife populations of Upemba and Kundelungu have decreased dramatically (East 1996b).

Information on the current status of wildlife in Upemba and Kundelungu National Parks was provided to the ASG through a questionnaire reply by Omari, IZCN, through Bihini Won Wa Musiti (in litt. February 1996). This confirmed that Burchell's zebra no longer occurs in Kundelungu, and indicated that while this species is still common in Upemba, this population is decreasing.

[* Following the takeover of the country by the forces led by Laurent Kabila during 1996-97, its name has been changed from Zaire to Congo.]

12. MALAWI

Malawi is a small, densely populated country, and wildlife is now largely confined to protected areas. National parks and game reserves cover 11% of Malawi's land area and are administered by the Department of National Parks & Wildlife (DNPW). Malawi has consistently shown strong commitment to wildlife conservation. Its protected areas are relatively well staffed, but morale of DNPW field staff has waned to some extent, perhaps because of declining protected-area budgets, and poaching pressures are high in some of the most important parks and reserves (Dublin et al. 1994).

Burchell's zebra occurs in Nyika and Kasungu National Parks, and Nkhotakota and Vwaza Marsh Game Reserves, but is absent from other protected areas, viz., Liwonde and Lengwe National Parks and Majete and Mwabvi Game Reserves (F.X. Mkanda, in litt. March 1997). The combined population for the four protected areas in which zebras occur was estimated to be about 720 in 1989 (Duncan 1992) and 670 in 1997 (Table IX). While total numbers altered relatively slightly between 1989 and 1997, there were substantial changes in the populations of individual parks and reserves. Estimated numbers increased by 28% in Nyika National Park and 250% in Nkhotakota Game Reserve, but decreased by 72% in Kasungu National Park and 78% in Vwaza Marsh Game Reserve. These differences may at least partly reflect differing levels of illegal offtake, with Kasungu and Vwaza Marsh known to suffer from relatively high poaching pressure (Mkanda 1993; Dublin et al. 1994). The country's largest zebra population, in Nyika National Park, occurs mainly in this park's central plateau grasslands and northern woodlands, where poaching pressures are relatively low (Munthali & Banda 1992).

TABLE IX. Estimated Populations and Population Trend of Burchell's Zebra (*E. b. crawshayi*) in Protected Areas of Malawi (source: ground and aerial surveys by DNPW, F.X. Mkanda, in litt. March 1997).

Area	Size (sq km)	Year	Popn.	Trend
Nyika NP	3,132	1997	320	I
Kasungu NP	2,316	1997	85	D
Nkhotakota GR	1,802	1997	250	I
Vwaza Marsh GR	986	1997	15	D
Total			670	S/D

13. MOZAMBIQUE

Mozambique's wildlife has suffered from more than 75 years of largely uncontrolled slaughter (East 1989). By the early 1980s, substantial wildlife populations were confined to a few protected areas, most notably Gorongosa National Park at the southern end of the Rift Valley and the adjoining Zambezi Valley Wildlife Utilisation Unit and Marromeu Game Reserve. Increasing guerilla hostilities and civil conflict resulted in the government's abandonment of the Gorongosa-Marromeu area from 1981 to 1995. Following the end of the country's civil war in 1992, IUCN in conjunction with Mozambique's National Directorate of Forestry & Wildlife (DNFFB) undertook a 4-month EU-funded project to conduct an aerial survey of the wildlife of Gorongosa-Marromeu and prepare a plan for the park's rehabilitation. The survey revealed that most of the area's wildlife had been shot out during the civil war. In 1968, for example, Gorongosa National Park supported Mozambique's largest remaining population of Burchell's zebra (*E. b. chapmani*), estimated to number 3,000, with an additional 670 zebras within Marromeu Game Reserve, but in 1994 the estimated zebra population of the Gorongosa park had decreased by 98% to a mere 65 animals and no zebras were seen in Marromeu (Dutton 1994). Similar reductions were observed in the populations of all other wildlife species.

Relatively little encroachment of settlement occurred in Gorongosa-Marromeu during the civil war, and the area's natural habitats are generally in good shape (Dutton 1994). Based on the results of the 1994 project, an EU-funded DNFFB/IUCN emergency rehabilitation project operated in Gorongosa-Marromeu in 1995-96, aimed at controlling illegal harvesting of wildlife and timber, re-establishing the park's basic infrastructure, removing land mines and initiating integrated management with the local community. Oglethorpe & Oglethorpe (1996) reported that at the completion of the emergency rehabilitation programme, Gorongosa's populations of large mammal species were increasing, although still at low levels, and the park was to reopen for tourism.

Burchell's zebra may also survive in small numbers in some of Mozambique's other protected areas, which generally suffered similarly to Gorongosa during the civil war, e.g., *E. b. crawshayi* in the Niassa/Rovuma reserve on the Tanzania border in the north. At present, the country's total zebra population is unlikely to exceed a few hundred, but it can be expected to increase as the rehabilitation of key protected areas such as Gorongosa proceeds.

14. NAMIBIA

Namibia retains extensive areas of relatively unmodified natural habitats, has a well developed system of protected areas and a strong wildlife utilisation industry, and consequently supports internationally important wildlife populations (East 1989). This includes significant numbers of Burchell's zebras in the less arid savannas of the north and

northeast, and the bulk of the world's population of Hartmann's mountain zebra (*E. zebra hartmannae*) which was estimated to number about 7,000 in 1989-91 (Duncan 1992). The ASG has not yet updated its information on Namibia's antelopes, and consequently has gathered no information on the current status of zebras. However, the status of the major population of Burchell's zebra (*E. b. antiquorum*) in Etosha National Park (22,700 sq km) was reviewed by Gasaway et al. (1996). This population decreased from >20,000 in the 1950s and early 1960s to <10,000 in the 1980s, and apparently stabilised at about the 1989 population level of 6,300 (as reported in Duncan 1992) in the late 1980s and early 1990s. Etosha's populations of other plains ungulates showed similar declines or remained at low levels during 1960-94. Gasaway et al. (1996) concluded that high adult and juvenile mortality caused by predation and anthrax were primarily responsible for holding Etosha's populations of Burchell's zebra, wildebeest, gemsbok and springbok well below the ceiling set by their food resources.

In 1989, in addition to the Etosha population, there were decreasing populations of about 1,700 Burchell's zebras on farms and communal land in Namibia, about 300 in the game reserves of the northeast, and a total national population of about 9,300 (Duncan 1992). For the purpose of this report, these estimates are used for Namibia in section 19.

15. BOTSWANA

As recently as the 1970s, Botswana retained migratory wildlife populations which rivalled those of countries such as Tanzania. The numbers of most of Botswana's wildlife species have decreased markedly over the last 20 years, as the expansion of human settlement and the cattle industry has placed increasing pressure on natural ecosystems (Crowe 1995). Access of wildlife to seasonal grazing areas and water supplies is becoming increasingly restricted or lost, and remaining wildlife habitats are increasingly reduced and/or degraded. National parks and reserves cover >17% of Botswana's land area, and wildlife is becoming increasingly restricted to these areas. The country's system of protected areas, although extensive and now the basis of a substantial tourism industry, was established with greater regard for the avoidance of major areas of human settlement and cattle ranching than for the ecological requirements of wildlife (Campbell 1973). Seasonal access by wildlife to forage and water outside protected areas is blocked increasingly by expanding human activities. Consequently, the parks and reserves cannot maintain the country's wildlife resources in their current or former abundance. In addition, the activities of the Department of Wildlife & National Parks (DWNP) are constrained by shortages of staff, funds and equipment. At present, the department lacks the capability and funding to implement progressive, comprehensive and innovative management strategies (Crowe 1995).

Botswana's wildlife is likely to lose more ground, unless there is a major reversal of the country's wildlife management and conservation policies. In 1996, in response to a request from a task force of conservation NGOs, the government agreed to establish a commission of enquiry to look into the decline of the country's wildlife, and acknowledged that influences such as demographic factors, livestock expansion and veterinary fences are threatening the

TABLE X. Estimated Populations and Population Trend of Burchell's Zebra (*E. b. antiquorum*) in Botswana (source: aerial surveys, DWNP 1995).

Area	Year	Popn.	Trend
Okavango-Chobe	1994	17,260	S/D
Makgadikgadi-Nxai Pan	1994	12,190	D
northeast border with Zimbabwe	1994	200	D
Tuli block	1994	810	S/I
Overall National Total	1994	34,300	D

Note: Standard errors of the population estimates range from 15 to 42% of the estimates.

future of wildlife.

Burchell's zebra remains widespread within and outside protected areas in northern Botswana during the wet season (Crowe 1995; DWNP 1995). The largest population, which occurs from the Okavango Delta northeast into Chobe National Park and adjoining parts of Chobe district, concentrates around the permanent water sources of the Okavango and the Chobe-Linyanti river system during the dry season. This population could be affected adversely by plans to extract water from the Okavango River, as proposed by the Namibian government in 1996. A second zebra concentration, in and around Makgadikgadi-Nxai Pan National Park, tends to move southwards towards the Boteti River at the southern end of the park during the dry season and disperses northwards and eastwards to the pans in the wet season (Kgathi & Kalikawe 1993). Some zebras may migrate from the Makgadikgadi-Nxai Pan area to the Okavango and the Chobe-Linyanti-Kwando river frontage in the dry season (Crowe 1995). The future of the migratory zebra populations of Okavango-Chobe and Makgadikgadi-Nxai Pan depends on continued availability of critical resources of forage and water, and maintenance of migration corridors which provide seasonal access for wildlife to these resources. A much smaller, fairly distinct zebra population occurs in the northeast, along the Zimbabwe border, with animals moving back and forth between Botswana and northwestern Matabeleland in Zimbabwe. There are also significant numbers of zebras on private farms in the Tuli block in eastern Botswana (Table X).

DWNP has conducted aerial surveys of Botswana's wildlife since the early 1970s. These estimates have shown a substantial decrease in the country's total zebra population, e.g., between the 1991 DWNP estimate of 47,000 quoted by Duncan (1992) and the 1994 estimate of 34,300 (Table X). Crowe (1995) gave higher estimates of the total zebra population, presumably through different interpretation and analysis of DWNP survey data, but showed a steady decrease from 64,800 in 1987 to >51,000 in 1991 and 46,780 in 1994. The most pronounced decrease was in the Makgadikgadi population, which decreased by 75% between 1979 and 1994.

16. ZIMBABWE

For more than 30 years, Zimbabwe has been among the leading countries in Africa in treating wildlife as a valuable economic resource. National parks and other wildlife areas administered by the Department of National Parks & Wild Life Management (DNPWLM) cover almost 12% of the country, and play an important role in the growing tourism industry. Most of this parks and wildlife land is in national parks and safari areas. Innovative approaches have been adopted to wildlife management on marginal lands outside protected areas, to enable landowners to benefit economically from the sustainable utilisation of wildlife on their land. Developments such as the rapid growth of private game ranches in commercial farming areas during the last 20 years, to more than 650 registered game ranches, and the well-known CAMPFIRE programme on communally held land, have established an additional wildlife estate which covers a total area almost as large as the country's parks and wildlife land (Child 1995).

While Zimbabwe has successfully expanded its wildlife and tourism industries during the last 20 years, the future trends for the wildlife sector are unclear. In recent years, chronic funding shortages have led to a noticeable decline in the infrastructure of protected areas, although poaching has generally remained at low levels (Dublin et al. 1994; Meldrum 1996). Levels of wildlife protection and management are now generally substantially higher on private game ranches than on parks and wildlife land. DNPWLM has gained permission to retain the revenues earned from parks and wildlife land, but the department continues to face funding uncertainties. There has recently been a major transition in the senior staff of DNPWLM, and the department's policy appears to be moving away from facilitation of the game ranching industry towards greater emphasis on regulation and government control. It is possible that these trends could result in a move by private ranches away from game animals and back to cattle.

The estimated national population of 6,000 Burchell's zebras in Zimbabwe in 1989 given by Duncan (1992) was probably an underestimate, since total numbers are currently estimated to be about 20,000 (Table XI). There has been an increase in the zebra population of private game ranches since 1989, but numbers on parks and wildlife land are generally stable.

The largest population is in Hwange National Park (14,651 sq km). Davies et al. (1996) estimated a population of 3,040 from an aerial survey of this park and the contiguous Deka Safari Area (568 sq km). On the basis of a year-long ground survey of Hwange National Park in 1996, Wilson (1997) estimated that the park's zebra population was between 3,000 and 4,000 animals. Zebras are most abundant in Hwange's open grasslands, but occur throughout this park in a variety of habitats. Burchell's zebra is also common in other areas of northwestern Matabeleland adjoining Hwange National Park, viz., the Matetsi complex (Matetsi Safari Area, Kazuma Pan National Park and contiguous forestry areas) and Zambezi National Park, with small numbers in the Ngamo and Sikumi Forestry areas.

Burchell's zebra is also reasonably common in Zimbabwe's other major areas of parks and wildlife land, viz., Sebungwe (Chizarira and Matusadona National Parks, Chete and Chirisa Safari Areas, and Sengwa Wildlife Research Area), the middle Zambezi Valley (Mana Pools National Park, Charara, Hurungwe, Sapi, Chewore and Dande Safari Areas), and Gonarezhou National Park and the adjoining Malipati Safari Area.

An overall breakdown of the estimates given by Davies et al. (1996) reveals estimated total populations of 4,300 in national parks, 4,930 in safari areas, 210 in Forestry areas and 215 on communal land. In addition, zebras occur in several smaller areas of parks and wildlife land which were not included in the surveys by Davies et al. (1996), e.g., Matobo National Park, Tuli Safari Area, McIlwaine and Kyle Recreational Parks. Zebras also occur at low densities in some communal lands not surveyed by Davies et al. (1996). The estimated total population on private game ranches, which comprises about half the national population (Table XI), is probably conservative (J.L. Anderson, in litt. October 1996).

TABLE XI. Estimated Populations and Population Trend of Burchell's Zebra (*E. b. chapmani* and *antiquorum* x *chapmani* intermediates) in Zimbabwe.

Area	Size (sq km)	Year	Popn.	Trend	Source
Hwange NP-Deka SA	15,219	1995	3,040	S	aerial survey, DNPWLM (Davies et al. 1996)
Matetsi complex	3,856	1995	2,290	S	aerial survey, DNPWLM (Davies et al. 1996)
Zambezi NP	543	1995	240	S	aerial survey, DNPWLM (Davies et al. 1996)
Ngamo & Sikumi Forestry areas	2,344	1995	140	S	aerial survey, DNPWLM (Davies et al. 1996)
Sebungwe	16,082	1995	1,250	S	aerial survey, DNPWLM (Davies et al. 1996)
Middle Zambezi Valley	11,020	1995	1,650	S	aerial survey, DNPWLM (Davies et al. 1996)
Dande SA & surrounds	3,822	1995	260	?	aerial survey, WWF (Davies et al. 1996)
Zambezi Valley Escarpment Communal Lands	1,283	1995	5	?	aerial survey, DNPWLM (Davies et al. 1996)
Gonarezhou NP - Malipati SA	5,377	1995	780	S	aerial survey, DNPWLM (Davies et al. 1996)
Private Game Ranches		1996	10,480	S/I	Wildlife Producers' Assn. Newsletter July 1996 (J. Anderson, in litt Oct. 1996)
Total			20,135	S/I	

Note: Standard errors of the larger population estimates from the 1995 DNPWLM aerial surveys are generally 30-45% of the estimate (these surveys were primarily designed to count elephants).

17. SOUTH AFRICA

During the last 50 years, South Africa has achieved the most advanced management of protected areas and wildlife in Africa. The existing 422 protected areas cover 6.7 million hectares, about 5.5% of the country's land area (Wahl & Naude 1996). These include world famous protected areas such as the parks administered by the Natal Parks Board and the National Parks Board of South Africa (Fig. IV), and numerous reserves controlled by provincial conservation agencies. The National Parks Board has modified its conservation ethic and practices to adjust to the country's recent, fundamental political changes. This includes a change in focus from protection of pristine natural areas from which local people are largely excluded, to more emphasis on a participative approach which gives local rural communities greater access to the economic benefits which arise from protected areas, while maintaining the overall objective of preserving the country's national parks in as natural a state as possible.

In addition to national parks and provincial reserves, the role of the private sector in wildlife conservation is becoming increasingly important. The country's total area of private reserves and game farms has grown more than 8-fold since 1979, and now almost matches the total size of the national and provincial conservation areas. South Africa has more than 10,000 privately owned game ranches and a growing number of privately owned wildlife conservancies, which utilise wildlife for sport hunting, meat production and/or tourism.

As a result of these developments, the wildlife sector is well placed to contribute strongly to the economic development of the new South Africa (East 1996b).

Burchell's Zebra

The estimated total population of Burchell's zebra in South Africa now exceeds 48,500 (Table XII), compared to an estimated 42,000 in 1989 (Duncan 1992). This increase is partly due to the inclusion of additional areas, e.g., private land in the Transvaal, but numbers are assessed as showing a real increase in several parts of the country.

The major protected population is in Kruger National Park. This population was not affected significantly by the severe drought of 1991-92, which caused substantial reductions in many of Kruger's ungulate populations. The decrease of some of the rarer antelope species e.g., roan, on the northern basalt plains of Kruger National Park is partly due to competition from zebras, which have increased steadily in numbers in this area since 1980, as a result of the introduction of artificial water points (East 1996b). Several new national parks have been established in South Africa since 1989, and existing parks such as Addo/Zuurberg and Karoo have been enlarged substantially. Marakele National Park, for example, is a newly established national park in the Waterberg mountain range. It comprises mainly sour bushveld, and was formerly utilised for cattle ranching. Many wildlife species, including Burchell's zebra, have been reintroduced into the area. In the longer term, it is planned to enlarge Marakele National Park to more than 1,500 sq km. This park has the potential to eventually rival Kruger National Park as a tourist destination for viewing game animals.

Burchell's zebra is also well represented in provincial reserves and on private land (Table XII). In Natal, the largest original population (1,700) occurs in Hluhluwe-Umfolozi Park, from which animals have been translocated to Mkuzi Game Reserve (population now

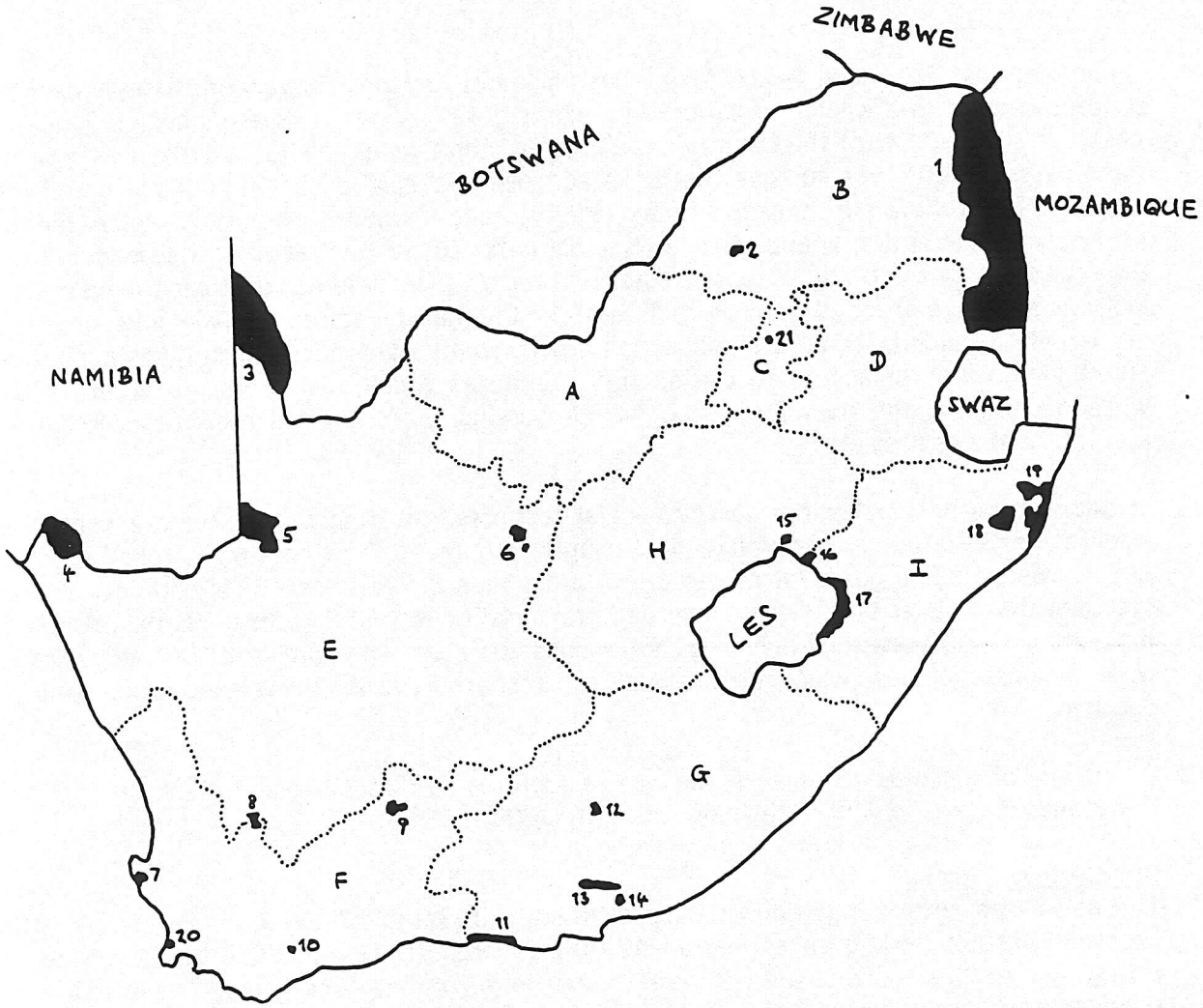


Fig. IV. National parks and provinces of South Africa.
Parks established by the National Parks Board - 1: Kruger National Park. 2: Marakele National Park. 3: Kalahari Gemsbok National Park. 4: Richtersveld National Park. 5: Augrabies Falls National Park. 6: Vaalbos National Park. 7: West Coast National Park. 8: Tankwa Karoo National Park. 9: Karoo National Park. 10: Bontebok National Park. 11: Tsitsikamma National Park. 12: Mountain Zebra National Park. 13: Zuurberg National Park. 14: Addo Elephant National Park. 15: Golden Gate Highlands National Park.
Parks established by the Natal Parks Board - 16: Royal Natal National Park. 17: Natal Drakensberg Park. 18: Hluhluwe-Umfolozi Park. 19: Greater St. Lucia Wetland Park.
Provinces - A: Northwest. B: Northern. C: Gauteng. D: Mpumalanga. E: Northern Cape. F: Western Cape. G: Eastern Cape. H: Free State. I: KwaZulu-Natal.
20: Cape Town. 21: Pretoria. LES: Lesotho. SWAZ: Swaziland.

TABLE XII. Estimated Populations and Population Trend of Zebras in South Africa.

Area	Size (sq km)	Year	Popn.	Trend	Source
Burchell's Zebra (*E. b. antiquorum*)					
Kruger NP	21,682	1993	29,500	I	total aerial count (P. Viljoen, NPB, in litt. Feb. 1995)
Marakele NP	399	1995	110	I	data for all national parks other than Kruger are from aerial/ground counts (P. T. van der Walt, NPB, in litt. Sept. 1995)
Golden Gate Hlds NP	116	1995	124	S	
West Coast NP	248	1995	10	?	
Vaalbos NP	227	1995	130	S/I	
Natal Parks Board protected areas		1994	>4,500	S/I	data for Natal from Rowe-Rowe (1994)
Natal private reserves & farms		1994	>500	I	
Transvaal provincial reserves		1995	5,000	S	data for Transvaal from B.K. Reilly, Gauteng Prov. Admin. (in litt. May 1995)
Transvaal private reserves & farms		1995	>5,000	I	
Free State provincial reserves		1995	600	S/I	data for Free State from S. Vrahimis, Free State Dept. of Env. Affairs & Tourism (in litt. May 1995)
Free State private reserves & farms		1995	2,000	I	
Cape provincial reserves		1995	>100	I	data for Cape from P. H. Lloyd, Western Cape Prov. Admin. (in litt. Oct. 1995)
Cape private reserves & farms		1995	>1,000	S/I	
Total			>48,570	I	
Cape Mountain Zebra (*E. z. zebra*)					
Mt. Zebra NP	67	1995	252	S	data for national parks from NPB aerial counts (P.T. van der Walt, in litt. Sept. 1995; M. H. Knight, in litt. June 1997)
Addo/Zuurberg NP	515	1995	90	I	
Bontebok NP	28	1993	12	I	
West Coast NP	248	1995	6	?	
Karoo NP	433	1997	200	I	
Cape prov. reserves		1995	340	I	P. H. Lloyd (in litt. Oct. 1995)
Other areas		1995	50-100	I	
Total			950-1,000	I	

Note: For the purpose of comparison with previous information, the ASG has gathered data from within the boundaries of South Africa's four former provinces. These equate to the nine new provinces (see Fig. IV) as follows: The former Natal Province and the former self-governing territories within its boundaries are now known as KwaZulu-Natal. The former Transvaal Province and adjoining self-governing territories now comprise the new Gauteng, Northern and Mpumalanga Provinces, and part of Northwest Province. The boundaries of the Free State (formerly the Orange Free State) are unchanged. The former Cape Province now comprises the Northern Cape, Eastern Cape and Western Cape Provinces, and part of Northwest Province.

1,400), Itala Game Reserve (700), Chelmsford Nature Reserve (180), Spioenkop Nature Reserve (200), Vernon Crookes Nature Reserve (100), Weenen Nature Reserve (180) and 11 other Natal Parks Board protected areas (Rowe-Rowe 1994). Itala and Mkuzi also received additional introductions of zebras from Swaziland. There are over 50 small, introduced populations on private land throughout KwaZulu-Natal Province.

In the former Transvaal Province, Burchell's zebra occurs widely, with populations exceeding 50 on about 60 provincial nature reserves and exceeding 300 on at least ten of these reserves (B.K. Reilly, in litt. May 1995). Zebras also occur widely, and in increasing numbers, on private land in the Transvaal. In Free State Province, Burchell's zebra occurs on seven provincial reserves, with the largest numbers in Tussen-die-Riviere Game Farm (270), Willem Pretorius Game Reserve (90) and Sandveld Nature Reserve (95), and in increasing numbers on private farms, where this species is sought after by landowners (S. Vrahimis, in litt. May 1995). In the former Cape Province, Burchell's zebra occurs on six provincial reserves (Amalinda, Rolfontein, Fort Fordyce, Oviston, Molopo and the "old Transkei" reserve Mkambati) (P.H. Lloyd, in litt. October 1995), and in larger numbers on private land.

The country's overall population of Burchell's zebra includes approximately 29,870 within national parks, >10,000 within provincial reserves (including Natal Parks Board parks), and >8,500 on private land.

Cape Mountain Zebra

Equus zebra zebra is endemic to South Africa. Its numbers have increased from 550-600 in 1990 (Duncan 1992) to just under 1,000 (Table XII). Mountain Zebra National Park continues to support the largest population. The reintroduced population in Zuurberg National Park has increased markedly since 1990. The size of this park has been increased substantially to link it with Addo Elephant National Park. With its scrub, grassland and mountain fynbos habitats, the enlarged Addo/Zuurberg park has high potential for re-establishing a large mammal community fully representative of the rugged mountains and steep river valleys of this part of the eastern Cape. The mountain zebra population of Karoo National Park has more than doubled since 1989.

The Cape mountain zebra occurs in increasing numbers in seven provincial nature reserves, viz., De Hoop (50; some animals move on to the adjoining Overberg Test Range, which is a Denel property), Gamka (24), Langkloof in the Kammanassie mountains (25), Baviaanskloof (16), Karoo (100), Tsolwana (75) and Commandodrift (50) (P. H. Lloyd, in litt. October 1995). Other areas where this zebra occurs include local authority nature reserves and private land.

18. SWAZILAND

Although it is a small, relatively densely populated country, Swaziland has established several well protected conservation areas which support substantial remnants of the country's wildlife (East 1995). These include two parastatal nature reserves, Malolotja (180 sq km) in the northwestern highveld and Mlawula/Ndzindza (175 sq km) in the northeastern lowveld and Lebombo uplands, the Royal-owned Hlane Game Reserve (163 sq km) in the northeastern lowveld, and several privately owned or entrusted reserves, such as Mlilwane Wildlife Sanctuary (45 sq km).

Information on the status of Burchell's zebra (*E. b. antiquorum*) in Swaziland was provided by James Culverwell (in litt. July 1994). This species was historically widespread in Swaziland, apart from the western highveld, but indigenous populations survive only in the lowveld and northern Lebombo mountains. This includes populations of about 200-300 in Hlane Game Reserve and 50-80 in Mlawula Nature Reserve. It is ubiquitous in the northeast of the country near Tshaneni on a cattle ranching area (IYSIS), which conducts regular removals under the auspices of the Natal Parks Board. It also survives in low numbers in the Big Bend area in eastern Swaziland. Burchell's zebra has been reintroduced to Mlilwane Wildlife Sanctuary, and introduced to Malolotja Nature Reserve. It is thriving in Malolotja, where it numbers about 200 head.

Total numbers of Burchell's zebra in protected areas of Swaziland currently exceed 500 and are stable or increasing. Numbers are probably similar on private land.

19. SUMMARY AND CONCLUSIONS

BURCHELL'S ZEBRA

As noted in Duncan (1992), Burchell's zebra is one of the most abundant ungulates in Africa. The total estimated population from the information included in this report exceeds 643,000 (Tables XIII and XIV), in comparison to an estimated 672,000 in Table 4 of Duncan (1992). These figures are likely to be underestimates of actual zebra numbers, since they are based largely on the results of aerial surveys which have not been corrected for undercounting bias. As with other savanna ungulates, an unknown proportion of zebra populations is missed during aerial counts. Factors which have been applied to correct for aerial undercounting of the more conspicuous savanna ungulates are often of the order 1.2-2.0, e.g., 1.5 for Burchell's zebra by Lamprey (1994). This suggests that the true total population of Burchell's zebra may be nearer 1,000,000 than the estimated 643,000+.

The general pattern of the status and trends of Burchell's zebra populations is stability in protected areas, increasing populations on privately owned land in countries with significant wildlife utilisation industries, e.g., South Africa and Zimbabwe, and decrease

TABLE XIII. Summary of Estimated National Populations and Population Trend of Zebras in Eastern and Central Africa.

	Burchell's Zebra									
	Grant's Zebra (*E. b. boehmi*)		Upper Zambezi Zebra (*E. b. zambeziensis*)		Crawshay's Zebra (*E. b. crawshayi*)		Species Total		Grevy's Zebra	
Country	Popn.	Trend	Popn.	Trend	Popn.	Trend	Popn.	Trend	Popn.	Trend
Sudan	?	?	-	-	-	-	?	?	-	-
Ethiopia	6,000	S/I	-	-	-	-	6,000	S/I	580	S/D
Somalia	?	?	-	-	-	-	?	?	-	-
Uganda	3,280	D	-	-	-	-	3,280	D	-	-
Kenya	146,030	S	-	-	-	-	146,030	S	4,850	S/D
Rwanda	<1,000	D	-	-	-	-	<1,000	D	-	-
Tanzania	335,780	S/D	-	-	-	-	335,780	S/D	-	-
Angola	-	-	?	?	-	-	?	?	-	-
Zambia*	-	-	18,220	D	20,900	D	39,470	D	-	-
Congo-Zaire	-	-	<1,000	D	-	-	<1,000	D	-	-
Malawi	-	-	-	-	670	S/D	670	S/D	-	-
northern Mozambique	-	-	-	-	?	?	?	?	-	-
Total	>490,000	S/D	>18,000	D	>21,500	D	>530,000	D	5,430	S/D

* total population includes zebras of indeterminate subspecies on game ranches

outside protected areas on communally owned land and in less developed countries (Duncan 1992). As for the other common, widespread ungulates of Africa's savanna woodlands and grasslands, Burchell's zebra faces gradual attrition as human populations expand and related pressures on natural ecosystems increase, except on land where effective conservation measures are implemented (East 1995). Attrition of wildlife populations often occurs more rapidly when civil conflict and the breakdown of law and order result in the cessation of even rudimentary protection, as exemplified by countries such as Rwanda, Angola and Mozambique.

TABLE XIV. Summary of Estimated National Populations and Population Trend of Zebras in Southern Africa.

Country	Chapman's Zebra (*E. b. chapmani*) Popn.	Trend	Burchell's Zebra Damara Zebra (*E. b. antiquorum*) Popn.	Trend	Species Total Popn.	Trend	Cape Mt. Zebra Popn.	Trend
Namibia	-	-	9,300	S/D	9,300	S/D	-	-
Botswana	-	-	34,300	D	34,300	D	-	-
Zimbabwe	20,135*	S/I	-	-	20,135	S/I	-	-
southern Mozambique	65	D	-	-	65	D	-	-
South Africa	-	-	>48,500	I	>48,500	I	950-1,000	I
Swaziland	-	-	1,000	S/I	1,000	S/I	-	-
Total	20,200	S/I	>93,000	?	>113,000	?	950-1,000	I
				from Table XIII:	>530,000	D		
				Burchell's zebra Grand Total	>643,000	S/D		

* includes intermediates between *chapmani* and *antiquorum*

Protected Areas

Most of the remaining free-ranging populations of Burchell's zebra occur in and around protected areas (Duncan 1992), and the future status of this species will be closely tied to the future of these areas. Most of the larger parks and reserves in Africa's savanna zones continue to support major populations of Burchell's zebra (Table XV). In addition, the lower numbers which occur in many of the smaller protected areas of Africa's rangelands are important for conserving the species' genetic diversity (Duncan 1992).

About half the major populations listed in Table XV are migratory, and most of these are dependent on seasonal access to unprotected rangeland adjoining protected areas. Successful conservation of these zebra populations will depend on maintenance of access to critical seasonal resources of forage and/or water on surrounding lands, as well as effective protection of parks and reserves.

Current levels of protection and management of Africa's national parks and other protected natural areas vary widely, e.g., among those listed in Table XV, levels range from low in areas such as Liuwa Plain to moderate in areas such as Serengeti, Kafue and Hwange and high

TABLE XV. Major Populations of Burchell's Zebra Subspecies in and around Protected Areas.

Country	Protected Area	Popn.	Trend
Grant's Zebra (*E. b. boehmi*)			
Kenya	Masai Mara NR	6,000 - >50,000*	S
	Tsavo NP & surrounds	11,950	D
Tanzania	Serengeti NP & surrounds	191,300*	S/D
	Tarangire NP & surrounds	41,340*	S
	Selous GR & surrounds	36,150	I
	Ruaha NP - Rungwa-Kisigo GRs	30,070*	S
	Katavi NP & surrounds	>20,000*	I
Upper Zambezi Zebra (*E. b. zambeziensis*)			
Zambia	Lochinvar-Blue Lagoon NPs-Kafue Flats GMA	9,000	S
	Liuwa Plain NP	6,000*	D
	Kafue NP	2,830	S
Crawshay's Zebra (*E. b. crawshayi*)			
Zambia	North & South Luangwa NPs & surrounds	>14,000	S
Chapman's Zebra (*E. b. chapmani*)			
Zimbabwe	Hwange NP (possibly intermediates with *antiquorum*)	>3,000	S
Damara Zebra (*E. b. antiquorum*)			
South Africa	Kruger NP	29,500	I
	Natal Parks Board areas	>4,500	S/I
	Transvaal prov. reserves	5,000	S
Botswana	Okavango (Moremi GR - Chobe NP & surrounds)	17,260*	S/D
	Makgadikgadi-Nxai Pan NP	12,190*	D
Namibia	Etosha NP	6,000	S

*migratory populations

in areas such as Selous, North Luangwa and Kruger. Most of Africa's parks and reserves face increasing pressures from poaching, agricultural encroachment and livestock incursion, as human population densities increase on surrounding lands, and the long-term future of many protected areas is not secure. In addition, government wildlife agencies' operating budgets for law enforcement have decreased in real terms (inflation-adjusted) throughout most of Africa (e.g., Dublin et al. 1994). The future of protected areas will depend on the development of conservation measures which are appropriate for Africa in the 21st century. These are likely to require both a strong commitment to wildlife conservation by African governments and long-term external support from international donors.

Status of Subspecies

Five extant subspecies of Burchell's zebra were recognised in Duncan (1992). These subspecies are useful indicators of genetic differences, although in reality they represent arbitrary categories in a continuously varying population (cline) (Duncan 1992). Substantial variation occurs within the supposed ranges of described subspecies. The zebra mare with foal on the cover of this report, for example, which was photographed in August 1991 near Orpen Dam in Kruger National Park, lacks the extent of "shadow striping" typical of the Damara zebra (*E. b. antiquorum*). This individual was part of a group of seven adult zebras (R. East, personal observations), in which the rest of the herd had stripe patterns more closely resembling Kingdon's illustration of this subspecies (see Fig. 4 in Duncan 1992).

Grant's zebra (*E. b. boehmi*) is by far the most abundant subspecies, with estimated total numbers of about half a million, mainly in Tanzania and Kenya (Table XIII). The numbers of Grant's zebra have decreased in Uganda and Rwanda, and may also be decreasing in Tanzania, where excessive illegal offtake by meat-hunters threatens the major population in the Serengeti. Numbers appear to be stable in Kenya and may have increased in Ethiopia. This subspecies may also survive in significant numbers in southeastern Sudan and southern Somalia. Most of the major protected populations of Grant's zebra are migratory (Table XV).

The upper Zambezi zebra (*E. b. zambeziensis*) has suffered from overhunting in Angola and southeastern Congo-Zaire. It survives in good numbers in western Zambia, where estimated numbers (Table XIII) are substantially higher than reported in Duncan (1992). The important population on the Kafue flats (Table XV) is reasonably well protected, especially in Lochinvar National Park, but the Liuwa Plain population requires enhanced protection. The vast Kafue National Park has the potential to support a larger population of this subspecies.

The major surviving population of Crawshay's zebra (*E. b. crawshayi*) is in the Luangwa Valley in eastern Zambia, where estimated numbers (Table XIII) are higher than reported in Duncan (1992). While overall numbers in the Luangwa Valley conservation areas are decreasing (Table VIII), the core populations are stable in the relatively well protected North and South Luangwa National Parks (Table XV). Significant populations of this subspecies also occur in protected areas of Malawi (Table XIII).

The former concentration of Chapman's zebra (*E. b. chapmani*) in Gorongosa National Park suffered a catastrophic reduction during Mozambique's civil war, but may now have the chance to recover as this park undergoes rehabilitation. This subspecies and intermediates with *antiquorum* occur in substantially larger numbers in Zimbabwe (Table XIV) than reported in Duncan (1992), with the largest numbers in protected areas such as Hwange National Park and on private game ranches (Tables XI and XV).

The Damara zebra (*E. b. antiquorum*), possibly including intermediates with *chapmani*, occurs in substantial numbers in South Africa, northern Botswana and Namibia (Table XIV). Major populations occur in Kruger, Makgadikgadi-Nxai Pan and Etosha National Parks, Okavango-Chobe, Hluhluwe-Umfolozi and other Natal Parks Board protected areas, and on private farmland and provincial reserves in South Africa (Tables XII and XV). The overall population trend of this subspecies is unclear, with numbers increasing in South Africa, decreasing in Botswana and greatly reduced in Namibia (Table XIV).

GREVY'S ZEBRA

The status of this species continues to be highly precarious, with an estimated total population of about 5,400 (Table XIII), no sign of recovery in the Kenyan population from the marked decrease which occurred between the 1970s and the late 1980s, and a relatively small proportion of the population occuring within protected areas such as Chew Bahir, Sibiloi, Marsabit, Losai and Samburu-Buffalo Springs-Shaba.

CAPE MOUNTAIN ZEBRA

As pointed out in Duncan (1992), the successful recovery of the Cape mountain zebra from not more than 100 individuals in the late 1940s is a valuable case-study in the conservation of rare ungulates, and its population is continuing to increase (Table XIV).

20. REFERENCES

Bolton, M. 1973. Notes on the current status and distribution of some large mammals in Ethiopia (excluding Eritrea). *Mammalia 37*: 562-586.

Broten, M.D.; Said, M. 1995. Population trends of ungulates in and around Kenya's Masai Mara Reserve. *In* Serengeti II: Dynamics, management, and conservation of an ecosystem; Sinclair, A.R.E.; Arcese, P. (Editors), pp. 169-193. University of Chicago Press, Chicago, U.S.A.

Campbell, A.C. 1973. The national park and reserve system in Botswana. *Biological Conservation 5*: 7-14.

Campbell, K.; Borner, M. 1995. Population trends and distribution of Serengeti herbivores: Implications for management. *In* Serengeti II: Dynamics, management, and conservation of an ecosystem; Sinclair, A.R.E.; Arcese, P. (Editors), pp. 117-145. University of Chicago Press, Chicago, U.S.A.

Campbell, K.; Hofer, H. 1995. People and wildlife: Spatial dynamics and zones of interaction. *In* Serengeti II: Dynamics, management, and conservation of an ecosystem; Sinclair, A.R.E.; Arcese, P. (Editors), pp. 534-570. University of Chicago Press, Chicago, U.S.A.

Child, G. 1995. Managing wildlife successfully in Zimbabwe. *Oryx 29*: 171-177.

Crowe, D. 1995. Status of selected wildlife resources in Botswana and recommendations for conservation actions. *In* The Present Status of Wildlife and its Future in Botswana. Proceedings of a Seminar/Workshop organised by the Kalahari Conservation Society & Chobe Wildlife Trust, 7-8 November 1995.

Davies, C.; Craig, C.; Mackie, C.; Chimuti, T.; Gibson, D. 1996. Aerial census of elephant and other large mammals in the Gonarezhou, Zambezi Valley, north-west Matabeleland, Sebungwe, Dande and communal land regions of Zimbabwe, July to November 1995. Department of National Parks & Wild Life Management, Harare, Zimbabwe.

DRSRS. 1997. Summary of aerial surveys for Tsavo ecosystem. Ministry of Planning & National Development, Department of Resource Surveys & Remote Sensing, P.O. Box 47146, Nairobi, Kenya.

Dublin, H.T.; Milliken, T.; Barnes, R.F.W. 1994. Four years after the CITES ban: Illegal killing of elephants, ivory trade and stockpiles. Report of IUCN/SSC African Elephant Specialist Group. IUCN, Gland, Switzerland.

Duncan, P. (Editor). 1992. Zebras, Asses, and Horses: An Action Plan for the Conservation of Wild Equids. IUCN, Gland, Switzerland.

Dutton, P. 1994. A dream becomes a nightmare. *African Wildlife 48* (6): 6-14.

DWNP. 1995. Status and trends of selected wildlife species in Botswana. Monitoring Unit, Research Division, Department of Wildlife & National Parks, Gaborone, Botswana.

East, R. (Compiler). 1988. Antelopes: Global Survey & Regional Action Plans, part 1: East & Northeast Africa. IUCN, Gland, Switzerland.

East, R. (Compiler). 1989. Antelopes: Global Survey & Regional Action Plans, part 2: Southern & South-central Africa. IUCN, Gland, Switzerland.

East, R. (Compiler). 1990. Antelopes: Global Survey & Regional Action Plans, part 3: West & Central Africa. IUCN, Gland, Switzerland.

East, R. (Compiler). 1995. *Antelope Survey Update No. 1* (Benin, Cameroon, Central African Republic, Rwanda: Akagera National Park, Swaziland, Togo, Zaire: Maiko National Park). IUCN/SSC Antelope Specialist Group Report.

East. R. (Compiler). 1996a. *Antelope Survey Update No. 2* (Burkina Faso, Ivory Coast: Comoe National Park, Chad, Gabon, Ghana, Zambia). IUCN/SSC Antelope Specialist Group Report.

East, R. (Compiler). 1996b. *Antelope Survey Update No. 3* (Senegal, South Africa, Sudan, Zaire). IUCN/SSC Antelope Specialist Group Report.

East, R. (Compiler). 1997a. *Antelope Survey Update No. 4* (Mali, Tanzania). IUCN/SSC Antelope Specialist Group Report.

East, R. (Compiler). 1997b. *Antelope Survey Update No. 5* (Kenya, Rwanda: Volcanoes National Park, Southern Sudan, Uganda). IUCN/SSC Antelope Specialist Group Report.

Estes, R.D. (Editor). 1995. Somalia: Bahadhe District wildlife gets a break. *Gnusletter 14* (2 & 3): 31-33.

Fourniret, Yves. 1994. Recensement de la faune du Parc National de l'Akagera et du Domaine

Chasse du Mutara (Rwanda). Report to CCE-ORTPN-CIFCD.

Gasaway, W.C.; Gasaway, K.T.; Berry, H.H. 1996. Persistent low densities of plains ungulates in Etosha National Park, Namibia: testing the food-regulating hypothesis. *Canadian Journal of Zoology 74*: 1556-1572.

Graham, A.; Netserab, B.; Enawgaw, C. 1996. Trends in large herbivore numbers of Omo and Mago National Parks. National Parks Rehabilitation in Southern Ethiopia Project, Technical Report No. 2.

Grunblatt, J.; Said, M.; Njuguna, E.; Ojwang, J. 1995. DRSRS protected and adjacent areas analysis. Ministry of Planning & National Development, Department of Resource Surveys & Remote Sensing, P.O. Box 47146, Nairobi, Kenya.

Grunblatt, J.; Said, M.; Wargute, P. 1996. DRSRS national rangelands report: Summary of population estimates for wildlife and livestock, Kenyan rangelands 1977-1994. Ministry of Planning & National Development, Department of Resource Surveys & Remote Sensing, P.O. Box 47146, Nairobi, Kenya.

IUCN. 1994. IUCN Red List categories. IUCN, Gland.

IUCN/ROSA. 1992. Angola: Environment status quo assessment report. IUCN Regional Office for Southern Africa, Harare, Zimbabwe.

Jachmann, H.; Kalyocha, G. 1994. Surveys of large mammals in nine conservation areas of the central Luangwa Valley (1994). Luangwa Integrated Resource Development Project Document No. 19, Chipata, Zambia.

Jeffery, R.C.V.; Malambo, C.H.; Nefdt, R. 1989. Wild mammal surveys of the Kafue Flats 1989. Report to Director, National Parks & Wildlife Service, Chilanga, Zambia.

Kapungwe, E. 1994. Aerial census survey of large mammals in Musalangu and Munyamadzi Game Management Areas, Luangwa Valley, November, 1994. Report to Director, National Parks & Wildlife Service, Chilanga, Zambia.

Kgathi, D.K.; Kalikawe, M.C. 1993. Seasonal distribution of zebra and wildebeest in Makgadikgadi Pans Game Reserve, Botswana. *African Journal of Ecology 31*: 210-219.

Lamprey, R.H. 1994. Aerial census of wildlife of Omo and Mago National Parks, Ethiopia, July 29-August 4, 1994. Ecosystems Consultants, London, U.K.

Lamprey, R.H.; Michelmore, F. 1996. The wildlife protected areas of Uganda: Preliminary aerial survey results and their assessment plus initial recommendations. EC Wildlife Support Project, Ministry of Tourism, Wildlife & Antiquities, Kampala, Uganda.

Lockwood, L. 1996. Lewa Downs: A new conservancy. *Swara 19* (3): 20-23.

Mefit-Babtie SRL. 1983. Development studies in the Jonglei canal area: Final report. Vol. 5: Wildlife studies. Mefit-Babtie SRL, Glasgow, Rome & Khartoum, & Executive Organ of the National Council for Development of the Jonglei Canal Area, Khartoum, Sudan.

Meldrum. A. 1996. New "conservation fund" to benefit Zimbabwe parks. *African Wildlife Update 5* (3): 4.

Mkanda, F.X. 1993. Status of elephants and poaching for ivory in Malawi: A case study in Liwonde and Kasungu National Parks. *Pachyderm 16*: 59-61.

Munthali, S.M.; Banda, H.M. 1992. Distribution and abundance of the common ungulates of Nyika National Park, Malawi. *African Journal of Ecology 30.* 203-212.

Mwima, H.K.; Yoneda, K. 1995. Preliminary report on the aerial censuses of large mammals in the Lower Zambezi National Park. Report to Director, National Parks & Wildlife Service, Chilanga, Zambia.

Oglethorpe, J.; Oglethorpe, J. 1996. Battle-scarred Gorongosa Park to reopen to tourists. *African Wildlife Update 5* (6): 3.

Prins, H.T.T.; Douglas-Hamilton, I. 1990. Stability in a multi-species assemblage of large herbivores in East Africa. *Oecologia 83*: 392-400.

Rowe-Rowe, D.T. 1994. The ungulates of Natal (2nd edition). Natal Parks Board, Pietermaritzburg, South Africa.

Runyoro, V.A.; Hofer, H.; Chausi, E.B.; Moehlman, P.D. 1995. Long-term trends in the herbivore populations of the Ngorongoro Crater, Tanzania. *In* Serengeti II: Dynamics, management, and conservation of an ecosystem; Sinclair, A.R.E.; Arcese, P. (Editors), pp. 146-168. University of Chicago Press, Chicago, U.S.A.

Sinclair, A.R.E.; Arcese, P. (Editors). 1995. Serengeti II: Dynamics, management, and conservation of an ecosystem. University of Chicago Press, Chicago, U.S.A.

Tanzania Wildlife Conservation Monitoring. 1991. Wildlife census Burigi-Biharamulo 1990. Frankfurt Zoological Society, P.O. Box 14935, Arusha, Tanzania.

Tanzania Wildlife Conservation Monitoring. 1992a. Wildlife census Ugalla River 1991. Frankfurt Zoological Society, P.O. Box 14935, Arusha, Tanzania.

Tanzania Wildlife Conservation Monitoring. 1992b. Wildlife census Katavi-Rukwa November 1991. Frankfurt Zoological Society, P.O. Box 14935, Arusha, Tanzania.

Tanzania Wildlife Conservation Monitoring. 1993a. Wildlife census Mkomazi 1991. Frankfurt Zoological Society, P.O. Box 14935, Arusha, Tanzania.

Tanzania Wildlife Conservation Monitoring. 1993b. Wildlife census Sadani 1991-92. Frankfurt Zoological Society, P.O. Box 14935, Arusha, Tanzania.

Tanzania Wildlife Conservation Monitoring. 1994. Wildlife census: Greater Ruaha, wet and dry seasons 1993. Frankfurt Zoological Society, P.O. Box 14935, Arusha, Tanzania.

Tanzania Wildlife Conservation Monitoring. 1995a. Aerial census of Tarangire National Park, wet and dry seasons 1994. Frankfurt Zoological Society, P.O. Box 14935, Arusha, Tanzania.

Tanzania Wildlife Conservation Monitoring. 1995b. Wildlife populations and human activities in Moyowosi and Kigosi Game Reserves, Tanzania: Aerial survey, wet season 1994. Frankfurt Zoological Society, P.O. Box 14935, Arusha, Tanzania.

Tanzania Wildlife Conservation Monitoring. 1995c. Aerial survey of the Selous Game Reserve, Mikumi National Park, and surrounding areas, dry season 1994. Frankfurt Zoological Society, P.O. Box 14935, Arusha, Tanzania.

Tembo, A. 1995. A survey of large mammals in Sioma-Ngwezi National Park, Zambia. *African Journal of Ecology 33*: 173-174.

Thouless, C.R. 1995a. Aerial survey for wildlife in Omo valley, Chew Bahir and Borana areas of southern Ethiopia. Report to Ethiopian Wildlife Conservation Organisation. Ecosystems Consultants, London, U.K.

Thouless, C.R. 1995b. Aerial surveys for wildlife in eastern Ethiopia. Report to Ethiopian Wildlife Conservation Organisation. Ecosystems Consultants, London, U.K.

Verschuren, J. 1975. Wildlife in Zaire. *Oryx 13*: 149-163.

Wahl, M.; Naude, K. 1996. National register of protected areas in South Africa 1996. Department of Environmental Affairs & Tourism, Pretoria, South Africa.

Wilson, V.J. 1997. Biodiversity of Hwange National Park. Part 1: Large mammals and carnivores. Report to Department of National Parks & Wild Life Management. Chipangali Wildlife Trust, Bulawayo, Zimbabwe.

Yoneda, K.; Mwima, H.K. 1995. Report on the aerial census of large mammals in the Kafue National Park. Report to Director, National Parks & Wildlife Service, Chilanga, Zambia.