Biological Conservation 24 (1982) 147-156

5-2-25
PN-AAP-864/G2
ISN-34367

PATTERNS OF DEPLETION IN A KENYA RHINO POPULATION AND THE CONSERVATION IMPLICATIONS

DAVID WESTERN

Animal Research and Conservation Centre,
New York Zoological Society,
Box 48177, Nairobi, Kenya 23235

ABSTRACT

The Amboseli black rhino population has been monitored closely over 13 years and its decline to near extinction levels parallels its fate elsewhere. The patterns and causes of decline are attributed directly to human agencies, initially resulting from changing social and political circumstances amongst pastoralists, recently due to poaching for horns. The general conservation implications are discussed and the need to contain the international trade in horns is considered the overriding priority, due to the difficulty and expense of eliminating poaching.

INTRODUCTION

The black rhino *Diceros bicornis* (L.) has declined rapidly throughout its range over the last few years (Hillman & Bradley Martin, 1979; Hillman, 1980). Its near extinction is attributed largely to poaching, stimulated by the illegal trade in horns (Parker & Bradley Martin, 1979).

Because long-term census records are seldom available for any species, it is rare that we are able to chart the fate of a healthy population to the point of extinction (Western, 1978). The Amboseli rhino population presents a closely monitored example which reflects the pattern of extinctions in rhino populations throughout Africa. Some problems and requirements of conserving rhino in the wild are underscored by this case study and are elaborated in the discussion.

Amboseli was considered in the 1950s to support one of the highest known densities of black rhino anywhere. At that time, within the 390 km² which now constitutes the Amboseli National Park, the warden estimated some 120 animals (S. Downey, pers. comm.). Most rhinos were confined to the woodlands and swamp margins which cover little more than 200 km² (Western & Sindiyo, 1972).

Biol. Conserv. 0006-3207/82/0024-0147/$02·75 © Applied Science Publishers Ltd, England, 1982
Printed in Great Britain

By 1967 the population was estimated to number 55 and thereafter declined at 12% per annum to approximately 35 animals in 1971 (Western & Sindiyo, 1972). Over 75% of the decline was attributed to spearing. The reasons included a political dissatisfaction amongst the Maasai with their impending displacement in favour of a national park, a redirection of their traditional lion hunting practices (most lions were now secure behind a circle of tourist buses) and, increasingly, a financial motive as the Maasai shifted from livestock subsistence to a market economy.

By 1971 the rhino population of the Amboseli basin (which is roughly the present National Park) was relatively discrete from adjacent populations in the Mt Kilimanjaro forest 20 km to the south and in the Chyulu Hills and Tsavo National Park 50 km to the east. The population of the Amboseli basin and its immediate environs then numbered some 40 to 45 rhinos. This figure comprised 35 rhinos regularly resident in the basin, and a further 5 to 10 around the periphery and occasionally found within it. It was predicted that at the prevailing rate of decline the population would be exterminated by 1977 (Western & Sindiyo, 1972).

RESULTS

Reduction in population

The pattern of mortality and decline between 1971 and 1977 was almost identical to that of the preceding 5 years, and the continued decline was monitored using both aerial and ground observations.

Beginning in 1973 a regular series of counts was established based on a systematic sample of 8500 km^2 of Eastern Kajiado (Fig. 1). The counts, roughly bi-monthly, sampled between 6 and 8% of the area. Details of the procedure have been presented elsewhere (Western, 1975, 1978). Simultaneously an individual recognition file of all rhinos observed in the Amboseli basin was established and maintained until 1977. Individuals were photographed and identified using techniques described by Goddard (1966) and Mukinya (1973). Individual recognition methods enabled all animals in the Amboseli population to be catalogued, that is, within the basin and immediate surroundings.

Table 1 summarises the results of aerial counts for Amboseli together with numbers at known dates using individual recognition records. Before evaluating the numbers, limitations of the aerial counts need mention.

Because the method was designed for multi-species counts of herbivores numbering generally in the thousands, the low sampling intensity gives an extremely high variance for species which are a few in number and patchily distributed (Western, 1975). A high intercount variation in rhino numbers can therefore be expected using this method, but taken over a sufficient number of counts and length of time, any strong trends in numbers will become evident. By contrast, estimates of numbers based on individual recognition should be relatively accurate since the area

2

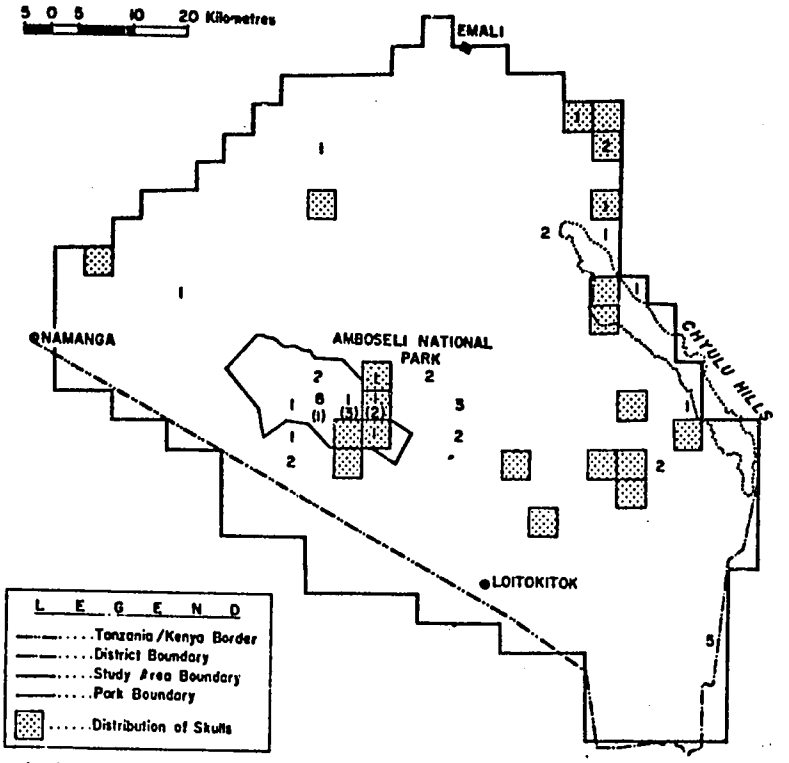

Fig. 1 Distribution of accumulated rhino sightings from aerial sample counts from October 1973 to December 1975 and from January 1976 to February 1979 (in brackets). The location of skulls is based on accumulated sightings between 1973 and 1979.

was covered consistently on the ground with the specific aim of locating as many rhinos as possible. Further, because these records were accumulated over time, rather than instantaneously, it is not possible to match each aerial count with a ground estimate. They have been interpolated where necessary to give corresponding ground estimates (Table 1). Because the ground counts give a more or less accurate figure of the true population size, the average difference between them and the aerial counts will give a measure of undercounting from the air. The figure will be useful in calibrating rhino estimates for other populations in similar habitats where only aerial counts are available. Averaged over all counts the aerial estimates are 57% of the known population.

Figure 2 summarises the population trends for Amboseli over the last 13 years. Both the individual recognition records and the aerial counts show significant and similar patterns of decline to a near-extinction level in 1977. By then the few left were rarely recorded on aerial counts. The decline ceased in late 1977 and by mid 1981 had increased to 14 animals. The reasons will later be discussed in more detail.

The decline from some 35 animals in 1971 to 8 by 1977 was consistent with earlier

3

TABLE 1
INDIVIDUAL RECOGNITION AND AERIAL COUNTS OF THE AMBOSELI RHINO POPULATION. BRACKETS INDICATE INTERPOLATIONS.

Date		Individual recognition	Aerial count
1973	October	(38)	43
	December	36	13
1974	March	(34)	13
	May	32	6
	August	(30)	0
	October	(29)	20
	December	28	22
1975	March	(27)	0
	May	(26)	50
	July	(25)	37
	October	(24)	21
	December	23	0
1976	February	(21)	19
	April	(20)	0
	August	(17)	11
	October	(15)	10
	December	14	0
1977	January	(13)	0
	May	(11)	0
	October	8	0
1978	January	(8)	0
	March	(9)	0
	May	(9)	0
	October	10	0
	December	10	0
1979	February	11	29
1980	March	11	0
	July	12	0

trends and close to the prediction made in 1972 (Western & Sindiyo, 1972). That projection was based only on animals counted within the basin, and did not include the entire Amboseli population which was approximately 20% larger.

Reduction in range

The reduction in range of rhinos in Amboseli and adjacent populations can be documented from aerial counts (Fig. 1). Here, the pooled sightings for the period October 1973 to December 1975 show two discrete populations, Amboseli and Chyulu Hills. One or two isolated individuals were found north and west of Amboseli. The accumulated sightings from January 1976 to February 1979 demonstrate that the Amboseli population was soon confined within, or immediately around, the park boundaries and that the Chyulu Hills population had declined to extinction, or close to it.

Prior to the 1950s rhinos were found throughout Eastern Kajiado (D. Zaphiro, pers. comm.), though even then localised dry season populations centred on Amboseli, Chyulu Hills and Kilimanjaro, and there was undoubtedly a wet season overlap in populations. The expansion of the Amboseli population during the rains

4

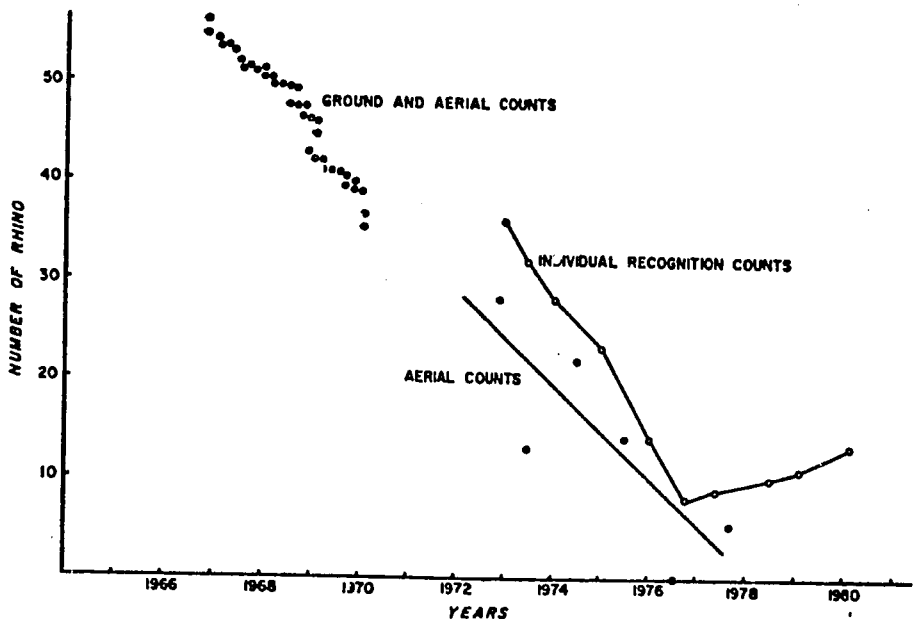

Fig. 2. Aerial and individual recognition counts of the Amboseli rhino population. The black dots are based on counts of Western & Sindiyo (1972), and on averaged yearly aerial counts (see text); the open circles on totals of individually recognized animals.

was still pronounced in the early 1970s (Western, 1973). Moreover, rhino skulls, which are visible at least 10 years after death, have been detected from the systematic aerial counts over most of the region, indicating a once continuous, if seasonal, distribution (Fig. 1).

DISCUSSION

Causes and patterns of mortality

It is difficult to record all rhino deaths because a large number go undetected outside the central area of the national park. Western & Sindiyo (1972) reported that at least 75 % of the rhino mortality in Amboseli between 1967 and 1971 resulted from human agencies. Since then three deaths were recorded in 1973, 4 in 1974, 8 in 1975, 11 in 1976 and 8 in 1977. No records are available for 1972 and no deaths have been recorded since late 1977 until now (May 1981). From 1971 to 1977 94 % of the deaths were attributed to human agencies. Of the 2 rhino not killed by humans, one adult died from unknown causes and another sub-adult was killed by lions after having separated naturally from its mother. In all other cases animals were killed either by spearing, shooting, or as a result of these activities. In three cases the calves of poached females were too young to defend themselves and were killed by

5

predators. Few calves less than 3 years of age survive predators if separated from their mothers. In summary, though already the principal cause of decline prior to 1972, death by man later became virtually the only cause of mortality. Most of the early decline was due to changes in the ecology and attitudes of the Maasai, who are the traditional inhabitants of the area. Livestock and human numbers rose rapidly between 1944 and 1961, due to water schemes and to veterinary and medical improvements (Western, 1973). There was consequently greater use of the dry season range, particularly the swamp-edge pastures. This undoubtedly led to more interactions between Maasai and rhinos and the initial decrease can conceivably be attributed to more spearings than previously simply for protection.

Since 1947, when the Amboseli National Reserve was established, there has been a concerted effort to remove the Maasai from the basin and to establish a national park. At a time when the expanding human and livestock populations were causing land shortage, the Maasai viewed antagonistically all attempts to expropriate land for wildlife. Efforts to establish a park led to reprisals by the warriors, who concentrated on spearing rhinos. It soon became a sport to replace the former lion hunts now made difficult by the presence of large numbers of tourists attracted to the central prides.

The motivation for killing rhinos changed in the early 1970s largely to one of commercial gain, coinciding with the impoverishment of the Maasai during the drought of 1972 to 1977 (Western & Grimsdell, 1979) and with the increase in the wholesale price of rhino horn from some US$24 per kg in the 1960s to US$300 per kg in 1978 (Bradley Martin, 1980). The greater profitability also attracted a number of professional poachers from outside the Maasai community.

The decline of the 1970s continued despite intensive anti-poaching efforts. In 1971, when still a reserve, a Landrover was donated to Amboseli by the East African Wildlife Society specifically to stem rhino poaching. Efforts increased in 1974 when 388 km^2 was established as a national park. However, the Maasai continued using the park until alternative water was made available in 1977 and poaching increased substantially during the height of the drought, 1975 to 1977, despite intensive anti-poaching efforts, aided by an aircraft patrol.

Another factor of importance in rhino mortality was the location at which animals were killed. Of 35 cases for which the site of poaching is known, all but seven, or some 80%, occurred outside the main tourist viewing areas, even though over 70% of the rhinos were located within it. Of those rhino killed within the main viewing area, most were speared rather than shot, and usually in the denser wooded or bushed areas.

The decline in rhinos ended in 1977 and, through natural recruitment they increased to 14 by mid 1981. The reversal can be attributed to two main factors. First, the Maasai were officially excluded from the national park in that year, and apart from sporadic incursions, no longer bring in their livestock. Although they do still enter without livestock to obtain the social services not yet available outside the

6

Park, the number of entries are minimal compared with the pre-1977 levels. Secondly, since 1977 the Maasai immediately around the national park have been given financial returns from it (Western & Henry, 1979) and have become more sympathetic towards wildlife. The financial benefits to the Maasai have probably done more to stop rhino poaching than the exclusion of the Maasai, since it is still easy for Maasai poachers to move about unsuspected on foot.

The improvement in the status of Amboseli permitted the reintroduction of 2 rhinos from Laikipia, where a few scattered individuals still exist in a predominantly agricultural area. Both animals died from anthrax within 2 weeks of their release; the source of the disease was not determined. Further reintroductions are anticipated to hasten the recovery and add genetic diversity to the population.

There is clearly some protection given by the presence of tourists and by intensive anti-poaching efforts. In the absence of either, the Chyulu Hills population of rhinos probably became extinct in the late 1970s. However, at best even the close security and monitoring possible in Amboseli has no more than marginally slowed the losses, and recent reversals can be attributed more to the benefits the local population now get from the area than to increased anti-poaching measures.

Conservation implications

Unlike many species, it is difficult to argue that the black rhino faces extermination through loss of habitat. Its wide geographic range (Dorst & Dandelot, 1970), its tolerance of diverse habitats (Goddard, 1970) and its limited competition with domestic stock, make it one of the least vulnerable large African ungulates to either habitat compression or change. Its rapid extermination even within the protection of parks and reserves testifies to its susceptibility to poaching, and ultimately to the international demand for its horn.

The widespread failure of anti-poaching measures underlines the difficulties of conserving rhinos. Wherever poaching efforts have been intensive they have been reduced to near-extinction levels (Hillman & Bradley Martin, 1979). The population in Tsavo National Park (East and West), for example, declined from nearly 8000 in 1969 to less than 100 in 1979 and over the same period in Kenya as a whole from over 15,000 to less than 1500 (Hillman and Martin, 1979).

The difficulties of protection are due to a number of factors. Rhinos are generally solitary (except for females with calves), have fairly conservative patterns of movement, a small home range (Goddard, 1967), are easily approached and easily speared or shot. Even in heavily patrolled areas such as Amboseli, it is relatively easy for a single poacher to approach and spear a rhino without attracting attention. So little time is needed to remove a horn, that the poacher can leave the scene long before vultures attract attention.

The vulnerability of rhinos contrasts markedly with elephants which are equally or more profitable. However, the elephants' social grouping, range of movement and the difficulties of killing them inconspicuously make poaching them much more

1

difficult and risky. Furthermore, the difficulties of moving ivory compared with rhino horn make the entire operation a larger and more conspicuous undertaking. The risks undoubtedly account for the lesser impact on elephants than rhinos over the same period of time (Douglas-Hamilton, 1979).

A rhino's vulnerability to poaching, the increasing value of its horn and its slow reproduction—from 6·8 % to 10·9 % annual birth rate (Goddard, 1970; Western & Sindiyo, 1972)—make it unrealistic to expect more than a chance recovery from the low population levels in Amboseli and elsewhere. Only rapid intervention and close management offer some hope of conserving more than a few remnant populations.

I consider the only realistic hope for conserving a reasonable number of rhinos in the wild lies in regulating internationally the trade in horns. Until recently no mechanisms existed by which to govern the trade and efforts to conserve endangered species concentrated on protecting them in the wild. The introduction by the International Union for the Conservation of Nature and Natural Resources (IUCN) of the Convention in International Trade in Endangered Species of Fauna and Flora (CITES) in 1973 was an attempt to regulate trade. While limiting trade in some species, it has failed to do so in the case of rhino because the main markets such as China, Japan, North Yemen and until 1978, Hong Kong, were not party to the convention. Only 5 of the 20 countries in Africa have ratified CITES and only 4 of at least 10 importing countries.

The challenge in conserving rhinos is to switch the emphasis from numerous, drawn out, risky and expensive anti-poaching battles over an enormous area, to a collaborative international effort to identify and regulate markets dealing in horn. A study of the trade has been initiated by Bradley Martin (1980). There has, however, been a reluctance amongst conservation agencies to switch tactics. Most international conservation agencies simply find it easier to raise funds for conspicuous conservation action in the field than clandestine operations in the market. Nevertheless, field operations can offer no more than a temporary reprieve for rhinos; unless the financial profitability of horn is reduced, the species will disappear from the wild.

In the short term a number of conservation measures can slow the rate of decline. These range from a tighter legislation to increased anti-poaching efforts, active relocation, and breeding programmes.

From a theoretical perspective, priority should centre on conserving the largest populations because they have the most potential for sustained genetic viability. In practice, for a given cost, the intensity of anti-poaching diminishes with the size of a protection area. The largest rhino population counted was in Tsavo National Park, yet it has all but disappeared, despite excellent anti-poaching efforts. Cost-effectiveness may therefore favour the conservation of smaller, high density populations such as in the Aberdares and Mt Kenya National Parks.

A solution frequently discussed is to dehorn the surviving rhinos. It is, however, risky where large predators are abundant, which is the case almost everywhere

8

rhinos occur. Mortality in calves would be substantially increased were females unable to protect them, since they remain highly vulnerable to predation until over 3 years of age. Adults are also subject to predation (Simon, 1962; Ritchie, 1963) and would be even more vulnerable without horns to defend themselves. The effectiveness of the horn in defence is described by Goddard (1967) in a case where a female rhino gored to death a male lion. Dehorned rhinos would be impossible to protect from predators. Nevertheless, the method must at some point be tested. It would be best done by dehorning a proportion of a population and monitoring their survivorship relative to those still horned. A cost-effective appraisal could thus be made for the technique.

Most present efforts in rhino conservation are based on a combination of public relations campaigns, close surveillance, and translocations of animals from threatened to safe sanctuaries, the combination varying with circumstances. Efforts to coordinate the programmes internationally are being made by the IUCN Survival Service Commission on Rhinos, based in Nairobi (Hillman, 1980). With so few rhino remaining it is inevitable that opportunistic approaches have developed, but in the longer term a continued interchange between localized and small populations must be coordinated if the risks associated with inbreeding are to be averted. The Amboseli rhino shares similar problems with most others. Some 50% of the remaining rhinos in Kenya occur in populations numbering less than 30 to 50 individuals (Hillman, 1979). Soulé (1980) states that the maximum sustainable rate of inbreeding in a population is approximately 1%, equivalent to a genetically effective size of 50 animals. Once the numbers drop as low as 50, it is doubtful whether this does constitute an effective breeding pool since animals tend to disperse over a considerable area such that few males actively contribute to the breeding stock. The Amboseli population, at a low of 8 animals in 1977, had only two breeding males and three mature females. Given such low numbers and localized populations it is inevitable that the black rhino will, like the white rhino, have to be managed in many cases as a national or even international herd. Here, in order to maintain genetic viability, individuals will need to be exchanged between conservation areas, much as captive species are now exchanged between zoos (Conway, 1980).

ACKNOWLEDGEMENTS

I am grateful to Daniel M. Sindiyo, the Director of the Wildlife Conservation Management Department, and the Wardens of Amboseli National Park, Joe Kioko and Bob Oguya for their support of this work, to Harvey Croze, Steve Cobb, Chris Hillman, Patrick Hamilton, David Maitumo and Chris Gakahu for their skill and assistance with the Ilkisongo aerial counts and to the New York Zoological Society for financial support of the project. Kes Hillman has been of great help in discussing the conservation of rhinos.

9

REFERENCES

BRADLEY MARTIN, E. (1980). Selling rhinos to extinction. *Oryx*, **15**, 322–3.

CONWAY, W. G. (1980). An overview of captive propagation. In *Conservation biology: An evolutionary approach*, ed. by M. E. Soulé and B. A. Wilcox, 198–208, Sunderland, Mass., Sinauer.

DORST, J. & DANDELOT, P. (1970). *A field guide to the larger mammals of Africa*. London, Collins.

DOUGLAS-HAMILTON, I. (1979). *The African elephant action plan*. Nairobi, IUCN/WWF/NYZS Elephant Survey and Conservation Programme. (Mimeographed).

GODDARD, J. (1966). Mating and courtship of the black rhinoceros (*Diceros bicornis* L.). *E. Afr. Wildl. J.*, **4**, 69–75.

GODDARD, J. (1967). The validity of censusing black rhinoceros populations from the air. *E. Afr. Wildl. J.*, **5**, 18–23.

GODDARD, J. (1970). Age criteria and vital statistics of a black rhinoceros population. *E. Afr. Wildl. J.*, **8**, 105–22.

HILLMAN, K. (1980). Trying to save the rhino. *Swara*, **2**(3), 23–7.

HILLMAN, K. and MARTIN, E. (1979). Will poaching exterminate Kenya's rhinos? *Oryx*, **15**, 131–2.

MUKINYA, J. G. (1973). Density, distribution, population structure and social organisation of the black rhinoceros in Masai Mara Game Reserve. *E. Afr. Wildl. J.*, **11**, 385–400.

PARKER, I. S. C. and BRADLEY MARTIN, E. (1979). Trade in African rhino horn. *Oryx*, **15**, 131–58.

RITCHIE, A. T. A. (1963). The black rhinoceros (*Diceros bicornis* L.). *E. Afr. Wildl. J.*, **1**, 54–62.

SIMON, N. M. (1962). *Between the sunlight and the thunder*. Collins, London.

SOULÉ, M. E. (1980). Thresholds for survival: maintaining fitness and evolutionary potential. In *Conservation biology: An evolutionary approach*, ed. by M. E. Soulé and B. A. Wilcox, 151–9. Sunderland, Mass., Sinauer.

WESTERN, D. (1973). *The structure, dynamics and changes of the Amboseli ecosystem*. PhD thesis, University of Nairobi.

WESTERN, D. (1975). Water availability and its influence on the structure and dynamics of a savannah large mammal community. *E. Afr. Wildl. J.*, **13**, 265–86.

WESTERN, D. (1978). *An aerial method of monitoring large mammals and their environment*. Nairobi, UNDP/FAO Wildlife Management Project.

WESTERN, D. & GRIMSDELL, J. J. R. (1979). *Measuring the distribution of animals in relation to their environment*. Nairobi, African Wildlife Leadership Foundation, Handbook No. 2.

WESTERN, D. & HENRY, W. (1979). Economics and conservation in Third World National Parks. *BioScience*, **29**, 414–18.

WESTERN, D. & SINDIYO, D. M. (1972). The status of the Amboseli rhino population. *E. Afr. Wildl. J.*, **10**, 43–57.

10