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HOME RANGE SIZES FOR BURCHELL'S ZEBRA *EQUUS BURCHELLI ANTIQUORUM* FROM THE KRUGER NATIONAL PARK

G. L. SMUTS
Division of Nature Conservation
Private Bag X404
Skukuza
1350

Abstract – Annual home range sizes were determined for 49 marked zebra family groups in the Kruger National Park. Sizes varied from 49 to 566 sq. km, the mean for the Park being 164 square kilometre. Mean home range sizes for different zebra sub-populations and biotic areas were found to differ considerably. Present herbivore densities have not influenced intra- and inter-specific tolerance levels to the extent that home range sizes have increased. Local habitat conditions, and particularly seasonal vegetational changes, were found to have the most profound influence on the shape and mean size of home ranges. The large home range sizes obtained in the Kruger Park, when compared to an area such as the Ngorongoro Crater, can be ascribed to a lower carrying capacity with respect to zebra, large portions of the habitat being sub-optimal, either seasonally or annually.

Introduction

During a more detailed study on the daily and seasonal movements of zebra *(Equus burchelli antiquorum)* in the Kruger National Park (K. N. P.), Republic of South Africa (Smuts 1972, 1974) sufficient data were collected to compute average annual home range sizes for 49 collar-marked individuals captured in different parts of the Park.

In contrast to Grévy's zebra *(E. grévyi)* (Klingel 1969), Burchell's zebra and the mountain zebra *(E. zebra)* (Klingel 1968a) are non-territorial. In the Ngorongora Crater (Klingel 1967, 1968b) and in the K. N. P. it has, however, been observed that zebra groups annually utilize only a small portion of the available habitat. This homing quality and the animal's attachment to an area has marked effects on their distribution and movements.

According to Jewell (1965), who restates the definition of a home range given by Burt (1943), this term may be defined as "the area over which

an animal normally travels in pursuit of its routine activities". In the present study home range sizes represented the approximate area covered by a zebra during an unbroken period of 12 months.

Material and Methods

Between 1969 and 1970 a total of 89 zebra were collar-marked as described by Smuts (1972, 1974). Only adult individuals (both males and females) from family groups were marked and their home range limits ascertained by plotting the resightings of each marked group on a suitable map. The size of each group's home range was determined by connecting the peripheral sightings and then calculating the area of the resulting polygon. Where possible average home range sizes were calculated for different biotic areas and the necessary comparisons made.

Results

Data on home range sizes for 49 family groups, each group containing at least one marked animal, are given in Table 1, with 17 of these being illustrated in Fig. 1.

Table 1

Data on annual home range sizes for 49 zebra family groups marked in various parts of the Kruger National Park between 1969 and 1970

Region as per Fig. 1	n	Home Range Size (km^2)				Total Number of Resightings
		Max.	Min.	Mean	SD	
Northern District	9	262	78	133	63,1	154
Central District	30	566	49	168	111,4	612
Southern District	10	390	69	178	104,0	298
Kruger Park	49	566	49	164	102,0	1 064

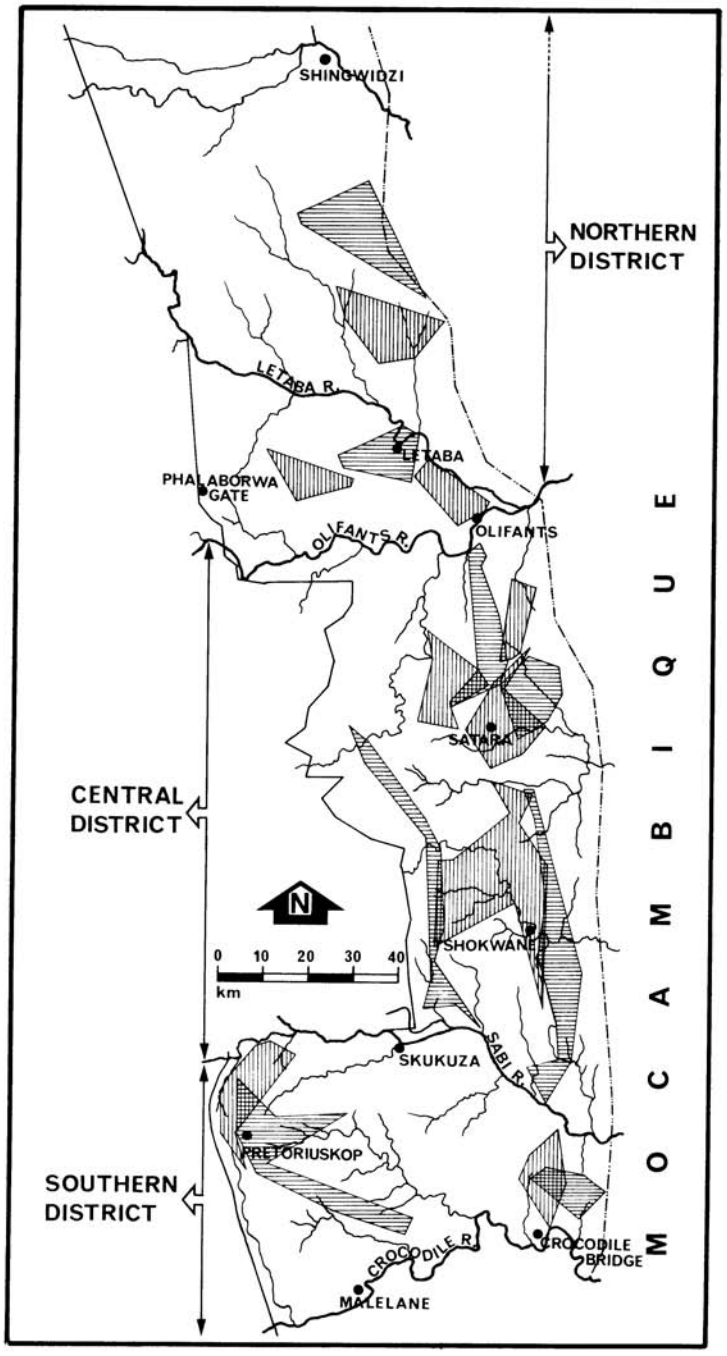

Fig. 1. Annual home ranges for 17 zebra family groups in the Kruger National Park. The long, narrow home ranges in the southern part of the Central District are typical of the migratory zebra. All the other home ranges were from zebra in sedentary or semi-migratory sub-populations.

Discussion

The long narrow home ranges shown for two family groups in the southern half of the Central District are characteristic of the migratory sub-populations which occupy this area (Smuts 1972, 1974). Here also migratory routes have been included in the computation of home range size, since, depending on local conditions, a varying period of time may be spent in the transitional passage area (up to 3 months at times). Jewell (1965), on the other hand, disregards migratory routes when computing home range sizes.

Home ranges with a minimum of overlap have specially been selected for illustration in Fig. 1 and it must be remembered that although an individual group has a certain home range, this area may be partially or totally overlapped by the home range of one or a number of other groups.

Factors influencing home range sizes

Depending on the mobility of an animal, its energy requirements and the habitat, the size of its home range may vary from a fraction of an acre e.g. the opossum *(Didelphis marsupialis)*– 0,5 acres (Fitch 1958) to 3 840 km² e.g. the wolf *(Canis lupus)* in Alaska (Burkholder 1959). Similarly one would expect differences to occur within a single species – depending on its environment.

Since home range is fundamentally an area with a certain productivity that meets the energy requirements of the individual or group that occupies it (Jewell 1965), knowledge of measures such as the normal density at which the animal lives and biomass or standing crop, which indicate the numbers of animals a given habitat can support,should help to elucidate variations in the home range size of the particular species. In addition to these possible long-term effects, factors such as sudden climatic changes, variations in the availability of water, food, fires or predation could also affect the size of an individual home range. Another long-term factor important in regulating the size of a particular home range is the general acceptability of the habitat with respect to the particular species concerned i.e. if the habitat is optimal or marginal.

In addition to variations in home range sizes of a particular species in different habitat types, the home range of a particular individual may vary from one year to the next. In the Central District, for example, where adequate observations on the movements of marked zebra were available for two-year periods, successive home range sizes varied considerably. Typical results over a two-year period for two groups were as follows:

(i) 179 km² (1969) and 159 km² (1970)
(ii) 203 km² (1969) and 142 km² (1970)

In addition to these differences it was found that a particular group was not necessarily dependent on a specific home range, but that it

could, in fact, utilize two quite separate portions of the sub-population's range during succeeding years, or that parts of the home ranges could overlap.

Zebra being a tremendously mobile and restless species, it is obvious that should home range size be computed over a period of five or more years, it could quite conceivably eventually cover most, if not all, of the range of the sub-population. Klingel (1967), for example, illustrates the home ranges of four groups in the Ngorongoro Crater for the period 1963 to 1965. During this time one of these groups utilized an area of about 147 km², while the total area of the Crater (Goddard 1967) is only some 260 km², much of the area also being totally unsuitable to zebra.

Provided a given area had a high primary productivity, one would similarly expect a high density of game species suited to the particular habitat (high biomass). Since an animal's movements are largely determined by its energy requirements, primary productivity would be relevant to an interpretation of its home range size. Herbivore biomass and density, on the other hand, although dependent on the productivity of the area, could affect a particular animal's home range size in quite a different way. This indirect effect could be in the form of increased social interactions resulting in more extensive patterns of daily and seasonal movements, or even an emigration from the area in the case of species with low inter- or intra-specific levels of tolerance.

When surveying the densities of zebra in various biotic areas in the K. N. P. and comparing these to corresponding home range sizes, it is quite clear that this factor is unimportant. In fact one merely has to look at zebra density in the three districts to see that its effects are not at present operating to influence home range size. In the Central District, for example, there is a density of 22 zebra/1 000 ha, while the mean home range size is 168 square kilometer. In the Southern District, on the other hand, there are seven zebra per 1 000 ha, while the mean home range size is 178 km², i.e., although density is much lower than in the Central District, the home range size is greater. These differences obviously reflect reactions to the habitat and not to density. Comparing

Table 2

Densities of large and medium sized herbivores in the three Districts of the Kruger National Park

District	Number of large and medium sized herbivores	Density per 1 000 ha
North	58 933	59
Central	126 050	229
South	60 747	172

the density of zebra in the K. N. P. (11 zebra per 1 000 ha) with that of the Ngorongoro Crater (192 zebra per 1 000 ha) (5 038 zebra in 260 km²) (Turner and Watson 1964) it becomes overwhelmingly obvious that, at this stage, home range size in the K. N. P. is independent of zebra density. The same conclusion can be made when comparing home range size with the density of large and medium sized herbivores (Table 2).

Biomass can similarly be proved to be unimportant and by alluding to figures calculated by Pienaar (1966) the following deductions can be made:

(i) although zebra in the Crocodile Bridge area have the smallest home range (111 km²; n=3), the area has a high density of zebra and the second highest biomass of competing herbivorous species in the whole Park;
(ii) in the Letaba sub-population (area between the Olifants and Letaba Rivers) with the second smallest mean home range size, a similar set of conditions exists. Here, however, the greatest numbers of zebra are found towards the east where habitat conditions are more suitable. The area does, however, have a high biomass of herbivores due to large numbers of buffalo and elephant;
(iii) in the Pretoriuskop-Malelane-Skukuza area, with the largest mean home range size (207 km²; n=7), the actual area utilized by zebra supports a very low biomass of herbivores.

Comparing the biomass for the whole of the K. N. P. i.e. (1 870 kg/km²) (Pienaar 1966) with that of the Ngorongoro Crater (6 215 kg/km²) (Lamprey 1964), where zebra groups have much smaller home ranges than in the K. N. P., it again becomes clear that this factor is unimportant.

Considering the development of a density-dependent inter- or intra-specific intolerance due to high herbivore density and its possible effect on the zebra's home range size and general movements, it is clear that this factor is presently insignificant. Burchell's zebra, in fact, is an animal which, due to its gregarious instinct and sociality, lives harmoniously at relatively high densities. This type of behaviour contrasts markedly with that of territorial antelopes, or species such as the roan antelope, where each herd inhabits a certain area (activity zone) (Joubert 1970) to the almost total exclusion of other herds. In these species, social behaviour has a marked effect on species density, home range size and general movements.

In contrast to inter- or intra-specific interactions which presently have little or no influence on home range size of zebra, the general condition of the habitat is important.

The most obvious effects of habitat on home range size can be demonstrated by comparing two extremes, namely the small home range of the Crocodile Bridge sub-population (111 km²) with that of the Pretoriuskop-Malelane-Skukuza sub-population (207 km²). In the Crocodile Bridge area the large numbers of zebra have a good supply

and distribution of water at their disposal. In addition, the excellent, well grassed parkland aspect of large parts of the habitat makes it an optimal area for zebra. The fact that these zebra can only undertake movements of a limited nature i.e. they are confined between two perennial rivers, a belt of thick deterrent bush and the Lebombo mountains, cannot be an important restriction since none of the marked groups moved over the entire available habitat during the course of one year. In the Pretoriuskop-Malelane-Skukuza unit, on the other hand, zebra also have a good supply and distribution of watering points at their disposal, but the difference lies in the habitat. This area, large portions of which are covered with fairly dense woodland and tall unpalatable grasses, must at present be regarded as one of the poorest zebra habitats in the whole of the Kruger National Park. Potentially the area, however, has a high carrying capacity with respect to zebra and prior to 1947 it used to harbour large herds of zebra and wildebeest. Due to the sub-optimal habitat conditions these zebra have to range over wider areas in search of the conditions which they prefer. Not only does the condition of the habitat affect the movements of these zebra, but it also has profound effects on the average size of family and stallion groups. These aspects will, however, form part of a later publication.

One may thus conclude that the large mean home range sizes for the various zebra sub-populations or for the K. N. P. as a whole (167 km^2), can largely be ascribed to the low carrying capacity of the range when compared to an area such as the Ngorongoro Crater, and to large portions being sub-optimal habitat, either seasonally or annually.

Significance of home range

When observing the sightings of individual marked zebra groups within their home range, it becomes clear that certain areas form foci of activity, while others are less frequently visited. The foci of the activity are the waterholes which are visited almost daily, the animals then moving away either to graze or rest. Each home range thus consists of an area where the animal can feed, drink, rest and reproduce. Depending on its immediate need the animal can, at any time, move to any part of its home range. The ease and accuracy with which zebra, which have travelled many kilometres, locate a waterhole leaves one with no doubt that they are well acquinted with all the features of the terrain within their home range. Here they are familiar with the paths best suited for their use, the best waterholes or grazing areas, the best refuges and with situations where danger usually lurks. In addition to this, the home range habit stabilizes the community organization by reducing the amount of turmoil that would result if all the animals were constantly moving about (Dice 1952).

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