THE VALIDITY OF CENSUSING BLACK RHINOCEROS POPULATIONS FROM THE AIR

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SUMMARY

The efficacy of censusing black rhinoceros (*Diceros bicornis* Linnaeus) populations from the air was tested. Repeated aerial counts were made of the black rhinoceros population centered on Olduvai Gorge, Tanzania, where the number of rhinoceros on the ground is known accurately. Even under the most ideal conditions only 50% of the population was detected by observers in an aircraft, and factors accounting for this are considered. It is concluded that the light aircraft is of limited value in providing estimates of black rhinoceros populations, and estimates based purely on aerial counts are subject to considerable variation.

INTRODUCTION

In East Africa, considerable use is made of light aircraft for censusing wild animal populations, and several estimates (based on aerial counts) of the rhinoceros population in the Serengeti region have been made in recent years. Grzimek and Grzimek (1960), for example, believed that their aerial estimate of 55 for the rhinoceros population of the Serengeti area was relatively accurate, based on their opinion that the animal was conspicuous from the air in the thornbush-plain habitat. They state (*loc. cit.* p. 32): "The conspicuous giraffe and the rhinoceros, for instance, could hardly be overlooked. These animals could be spotted at an extremely distant range, and it was more likely that they would be counted twice rather than that they be missed. For the giraffe, rhinoceros, elephant, oryx, roan antelope, and probably for buffalo, the figures given in the table are considered to be very accurate. Elephants, rhinoceros, and buffalo occurring in rain forests, however, were not included."

The region completed in their aerial census covered most of the Serengeti National Park as it existed in 1958, and included most of the Ngorongoro caldera and the Olduvai Gorge. Subsequent ground investigations in these latter two areas have shown that there are nearly 180 rhinoceros in the Ngorongoro caldera and Olduvai Gorge systems alone (Goddard, 1967). Because of the sedentary nature of the species, the adult population as it exists now was undoubtedly present at the time of the Grzimeks' census. The data presented in this paper support the hypothesis that results of aerial censuses for black rhinoceros should be treated with extreme caution.

MATERIAL AND METHODS

During the period November 1964-November 1966 I conducted a study of the black rhinoceros population in the vicinity of Olduvai Gorge, Tanzania. Individual recognition of animals was achieved by the method described by Goddard (1966), and it was conclusively shown that 69 rhinoceros occupy the study area.

Approximately 85% of the study area consists of open plain, studded with acacia scrub and umbrella acacia *Acacia tortilis* Forsk. The gorge itself, which bisects the study area, consists of *Acacia-Commiphora* type flora, together with considerable growths of *Sansevieria ehrenbergii* Schweinf. The gorge is used by the rhinoceros as a major food source; it is also used as a source of water, obtained from springs present in the gorge, temporary pools, and from certain species of the xerophytic flora which are chewed and discarded.

The black rhinoceros is a very sedentary species (Goddard, 1967), individuals occupying a very localized area of relatively small size. During the two-year period every observation of each individual was plotted on aerial photographs of the area. As a result the number of rhinoceros in the study area

was known accurately, and the extent of their movements and home range known. The animals present were never seen beyond the boundary of the study area, and could always be found in their particular area providing adequate time was spent searching for them on the ground. The "peripheral" rhinoceros population, or those inhabiting the region immediately adjacent to the boundaries of the study area, are different individuals whose home range does not extend into the area under consideration. As a result of these factors, it was possible to check the accuracy and validity of aerial censuses of rhinoceros populations.

To test the efficacy of such censuses, repeated aerial counts were made of the rhinoceros population at Olduvai. On each flight the total study area was surveyed by strip-flying and circling, and as far as possible the same observers were used. The number of rhinoceros seen was recorded as a distribution pattern, i.e. the number seen on the open plain and the number seen in the gorge, and also by their activity at the instant they were first observed, i.e. moving, standing, or lying down.

RESULTS

All pertinent data collected are shown in Table 1. Sixty-nine rhinoceros are known to exist in the study area and it is apparent (from examination of Table 1) that there can be considerable variation in the results of aerial counts. Even under ideal conditions only 50% of the population actually on the ground was detected by observers in an aircraft.

The number of rhinoceros detected from an aircraft depends mainly on the following factors: —

1. Time of day the survey is conducted. Counts are, in general, considerably higher in evening flights after 5 p.m., and relatively low in flights around the hours of mid-day. This is related to the activity pattern of the rhinoceros (see factor 2), and is most easily seen by examining the censuses conducted on 4th February, 1966. Between 1120 and 1255 hrs. nine rhinoceros were detected. On the same day four hours later (between 1658 and 1826 hrs.), and using the same observers and pilot, 34 rhinoceros were observed. This latter period is at a time when the rhinoceros tends to become more active.

2. Activity pattern of rhinoceros. This is related to factor 1. A large percentage of rhinoceros tend to sleep around the hours of mid-day and, unless they are alarmed by the noise of the aircraft and get up, they are not usually seen in cover. Rhinoceros on the open plain are usually seen whether standing, moving, or lying down. In the gorge (or cover), however, it appears that if a rhinoceros is standing or moving it is sometimes seen, but if sleeping, under cover, it is unlikely that it will be detected.

3. Distribution pattern of rhino. In the dry season in the study area rhinoceros tend to spend a large percentage of their time in the gorge. During the long rains (March-May) they tend to make more use of the plains part of their home range in the search for green palatable herbs such as *Indigofera basiflora* Gillett and *Pluchea monocephala* E. A. Bruce. Thus counts around mid-day can be relatively higher because a higher percentage are on the plain (see mid-day census on 25th April, 1966) and hence are more easily detected.

4. Characteristics of the rhinoceros. Some rhinoceros show a marked preference for sleeping in dust depressions, and tend to be camouflaged against this background. One individual on the open plain was not detected at all merely because it was sleeping in an erosion channel, and blended perfectly with its background. It was subsequently pointed out by a ground observer after the survey, but the aerial observers missed it completely.

These dust depressions are sometimes located under shade in the gorge. On several occasions rhinoceros were spotted after the aircraft had passed over them because they happened to get up from their dust "bed", causing a puff

TABLE 1

Aerial counts of the black rhinoceros population in a study area centred on Olduvai Gorge, Tanzania 1965-1966

Date	Type of aircraft	Altitude (ft)	Airspeed (m.p.h.)	No. of Observers	Weather and Visibility	Time of Census	Plain				Gorge				Total Observed	% of rhinoceros population detected
							No.	Activity			No.	Activity				
								Mo.	St.	Ld.		Mo.	St.	Ld.		
26.9.65	Cessna 182	150–500	85–110	3	Dull overcast, heavy cloud: poor	0709–0909	7	4	2	1	13	11	0	2	20	29
4.7.65	Super Cub	200–500	70–100	1	Clear: good	0820–0945	6	1	5	0	10	2	8	0	16	23
4.2.66	Cessna 206	150–300	100–140	3	Bright sun, clear: good	1120–1255	2	2	0	0	7	0	5	2	9	13
25.4.66	Cessna 180	150–400	80–90	3	Bright sun, clear: excellent	1126–1345	21	0	21	0	1	1	0	0	22	32
17.2.65	Super Cub	400–900 Most 900	70–100	1	Bright sun, clear: good	1155-1330	3	0	0	3	0	0	0	0	3	4.5
27.8.66	Cessna 180	200–300	85–110 Flap–used	3	Dull overcast, hazy: poor	1202–1400	5	0	1	4	13	6	7	0	18	26
2.12.65	Cessna 206	100–500	110–140	2	Overcast, weak sun, light showers: poor	1205–1338	6	0	6	0	4	1	3	0	10	14.5
8.9.65	Cessna 182	300–500	90–110	2	Clear and bright: excellent	1428–1557	6	—	—	—	4	—	—	—	10	14.5

2.12.65	Cessna 206	100–500	100–140	2	Dull overcast: poor	1545–1722	9	2	5	2	16	8	8	0	25	36
14.8.65	Super Cub	150–600	70–100	1	Dull overcast: poor	1606–1800	7	—	—	—	14	—	—	—	21	30
27.8.66	Cessna 180	300–400	85–120	3	Dull overcast: poor	1618–1752	5	1	3	1	24	6	18	0	29	42
25.9.65	Cessna 182	400–500	90–110	3	Dull overcast: poor	1621–1815	8	2	6	0	10	6	1	3	18	26
23.10.65	Cessna 182	150–400	85–110	3	Bright; soft shadows; excellent	1624–1814	8	0	8	0	16	11	5	0	21	35
4.9.65	Cessna 182	400–800	90-110	2	Slight overcast: good	1625–1745	5	—	—	—	13	—	—	—	18	26
12.5.66	Helicopter Hughes 269B Model 300	30–300	Hover–70	1	Clear and bright: excellent	1640-1847	14	2	12	0	12	11	0	1	26	38
25.4.66	Cessna 180	150–400	80–90	3	Clear: good	1645-1832	12	0	10	2	13	2	8	3	25	36
4.2.66	Cessna 206	150–300	100–140	3	Bright, soft shadows: excellent.	1658–1826	4	2	2	0	30	22	8	0	31	50
7.5.66	Cherokee 235	150–400	110–150	3	Slight haze, bright sun: good	1700–1832	18	10	1	7	16	9	7	0	34	50

Under "activity" Mo = Moving (includes walking or running), St = Standing, Ld = Lying down. "Activity" refers to the activity of the rhinoceros at the instant the observer first spotted the animal.

Sixty-nine rhinoceros are known to live permanently in the study area.

of dust which was immediately visible to the aerial observer. Rhinoceros tend to flush after the aircraft has passed over them. As a result, on numerous occasions a first search of part of the gorge revealed nothing. On a second flight over the same area, sometimes up to as many as eight rhinoceros were detected, merely because they stood up or took flight.

Some rhinoceros flee immediately they hear the sound of an aircraft. Others do not and may not get up even when "buzzed" at low altitude. In the gorge some rhinoceros frequently inhabit the dense growths of *Euphorbia tirucalli* L. in parts of the gorge, and will not be detected. One rhinoceros was detected by an observer merely because it stuck its head out from underneath a dense growth of this *Euphorbia*. Its head was covered in large quantities of the latex of this highly palatable tree. The observers' attention was immediately attracted by this strange patch of white in the landscape. One male rhinoceros invariably sleeps in the same tunnel under a dense growth of *Sporobolus robustus* Kunth and rarely takes flight even from an aircraft, and will obviously not be seen. Stationary rhinoceros are sometimes detected in thick cover because they have recently wallowed, and the reflection of light from water glinting on their backs is most obvious.

5. Visibility conditions. In dull weather the colour of the rhinoceros tends to blend perfectly with its surroundings, especially at the height of the dry season, when the dull greys of the scrub acacias and *Commiphora* match the colour of the rhinoceros. If the rhinoceros does not move it is sometimes not detected even in the open. Soft evening light with long shadows is excellent for spotting rhinoceros.

6. Altitude of aircraft. During the flight surveys the altitude was varied. It was found that for searching on the plain 400 ft was an optimum altitude. Over the gorge and thicker cover 150-200 ft appears to be optimum. At heights of 800 ft or higher it is quite difficult to detect rhinoceros even in open areas (see census of 17th February, 1965).

The type of light aircraft does not appear to affect the results of a count significantly, except where it limits the number of observers. The low-wing Cherokee 235 reduces visibility, and the high-wing Cessna seems to be preferable for optimum observation. Possibly an important factor affecting the results is the observers' familiarity with the study area on the ground, and the fact that only rhinoceros are being searched for. During a count of the migratory animal populations on the eastern part of the Serengeti plains in January 1966, which included the whole study area, only four rhinoceros were observed. The helicopter count was not significantly different from the counts by fixed-wing aircraft. Its limitation is the number of observers it can carry; its major advantages are its slow speed, and the fact that it tends to flush some rhinoceros.

From the results shown in Table I it is concluded that the light aircraft is of limited value for appraising black rhinoceros populations, even in open thornbush habitat. It seems axiomatic that where an attempt is made to census rhinoceros populations from the air in thick scrub and forest habitat, only a very small proportion of the rhinoceros actually present on the ground will be detected.

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