#6 Lehmann 35

0337

Aerial Analysis of Wildlife Population Structures

BY

Lee M. Talbot

Ecologist, Wildlife Research Project, sponsored jointly by United States National Academy of Sciences-National Research Council, Government of Kenya, and New York Zoological Society.

and

D. R. P. Zaphiro

Game Warden, Kajiado District, Kenya Game Department.

21 December 1960

The history and description of the uses of light aircraft in wildlife research and game management in East Africa has been given in a separate paper (Zaphiro and Talbot, 1961). The work described there, and other studies, have shown the practicability of a light aircraft for wildlife census and movement plotting. From previous experience in aerial wildlife work, the authors believed that aerial analysis of age and sex structures in wildlife populations should be practicable in East Africa for most species involved, but that before any such work was applied on a large scale, its accuracy should be checked against other methods of census and analysis. Consequently, starting in June, 1960, a series of experiments were carried out to establish techniques for, and to determine the feasibility and accuracy of, aerial population structure analysis; and in the process, to check the accuracy of the aerial census work involved. The findings of these experiments are presented below.

Methods

The aeroplane used was the Piper Cub Special owned by D. Zaphiro. This single engine, tandem seater, high-wing aircraft is especially suitable for game work because of its manoeuverability, slow flying characteristics, ability to land and take off in very limited spaces and under adverse conditions, the visibility afforded the pilot and observer, and the economy of operation.

The pilot and passenger both acted as observers.

The areas selected were in Narok District, Kenya, and were portions of the area studied intensively for over a year by the Wildlife Research Project. One was an area of roughly 625 square miles immediately to the north of the Kenya-Tanganyika border, continuous with the northern extension of the Serengeti National Park. The other was a strip of roughly 250 square miles running along the Narok-Mara Bridge road, between Aitong and Mara Bridge.

The areas are acacia-savannah land at 5,000 to 6,000 feet elevation, a mosaic of open grass plains divided by wooded or thicket-lined watercourses, with occasional areas of more or less open thorn bush and denser thickets or remnant forest patches. Over thirty species of the larger wild animals are found in the area. For the purposes of this study, however, enumeration and analysis were limited to the following ungulates: Thomson's gazelle, Grant's gazelle, topi, kongoni, wildebeest, zebra, impala, and giraffe.

Initially, herds of given species were observed both from the ground and the air, to determin age and sex identification characteristics by which the population composition could be analysed. The identification characteristics useful in aerial work include relative color, shape, size, tail length, horn presence and size, herd and individual reactions to the aircraft. The procedure used initially was to observe a herd from the air, count and analyse it, them land and repeat the performance from the ground. Various approaches from different altitudes were tried. In some cases, several hours were spent with a single herd before the observers were satisfied with the technique and the results.

The best time for aerial counting is early or late in the day, with the sun at a relatively low angle. Then, when approached from the sunny side the animals' shadows aid greatly in their location and identification.

The best altitude for counting and identifying most animals in the study area was found to be 700 to 1,000 feet. Flying below that level scattered the animals and confused observation, while flying much above it placed the observer too far away to age and sex the animals. Avoiding undue herd disturbance is important, as herd patterns were found to be useful both in counting larger herds and ageing and sexing the individuals. In the case of herds too large to count, age and sex on the first pass over, the pilot would circle at sufficient distance to avoid disturbance, keeping the herd continuously in view from one side. After an initial total count, the pilot would count one age or sex group and the observer another. With a large herd of wildebeest, for example, the pilot might count bulls, the observer yearlings, and the difference between their counts and the initial total count would give the females.

A variety of criteria were used to distinguish males from females and young. With Grant's gazelle, Thomson's gazelle, and impala, horn structure was used for sexing. In addition to these, with wildebeest, tail length was important. With giraffe, relative size and bodily conformation help. No attempt was made to sex zebra. Knowledge of the species' habits is essential. Lone wildebeest and kongoni, for instance, were invariably males. Thomson's gazelle, Grant's gazelle, impala, topi, and kongoni are often found in a harem herd with one adult male, the rest being females and young, occasionally with single males around the periphery or bachelor herds nearby.

The animals' reactions to the aircraft also aided sexing. For example, when slightly disturbed, male wildebeest tend to separate out of small mixed herds, while in larger herds they form small groups around the periphery. At the same time it was noted that the young of most ungulate species react to disturbance by crowding close to their mothers.

The criteria for identifying and analysing herd structure varies from species to species, and from area to area. Consequently, successful aerial work of this type requires considerable knowledge of the animals and their habits, and requires the empirical determination of identification characteristics in each new situation.

In the case of wildebeest, zebra and the gazelles, the larger the herds the more difficult the enumeration and analysis. Tight herds of more than 250 animals should either be photographed or broken into smaller herds for observation; otherwise the results can at best only be estimates. When such photography is required, both total counts and age and sex analysis can be carried out by using a 35mm camera with a 50mm and 90mm lens. The camera is hand held and the pictures are taken by preference out of an open window. The best results are

obtained using Kodak color film. The resulting slide is enlarged by projecting it on a wall or large screen, and the animals show up clearly. The photographs should be taken at an oblique angle, never vertically, and always with the sun behind the camera.

When the identification characteristics and approach techniques were established, flights were carried out over the study areas to make total counts and analyses of the game in the area, and also to make strip sample counts and analyses (observations of game in a strip of given width in a ramdom direction); these analyses were then duplicated from the ground, using two, three, and four trained observers counting from Land-Rovers and from hill tops. The strip sample and total air figures were compared with those from the ground and all then compared with the numbers and herd structure data determined during the past year's study in these areas by the Wildlife Research Project.

To make total counts from the air, the area involved was first divided into units of several square miles, the units being clearly demarcated by physical features such as roads or watercourses. The units were then counted in turn, the order of the count being determined by the likelihood of animal movement from one unit to the next, in order to avoid duplication or loss in the count due to this movement.

Results

In total numbers, sex and age ratios, the aerial analyses tallied very closely with the ground analyses, which in turn tallied with the past year's data for the areas concerned. The strip sample counts and analyses closely matched corresponding total area figures, the maximum discrepancy being near 2%.

Density: In density of principal species of animals per square mile, the minimum discrepancy between air and ground counts (0.4%) was for zebra, which made up 70% of the total number of animals examined. Wildebeest and topi made up another 20% of the total animals enumerated, and the difference between their air and ground counts was 3.8%. The maximum discrepancy (10%) came from impala which made up 0.17% of the total count.

Sex Ratios: The most difficult species of horned animal to sex from the air was found to be wildebeest. The discrepancy between aerial and ground analysis with this species was 4%, the ground counts yielding a ratio of 58.5% males to 41.5% females, while the aerial count gave 54.5% males to 45.5% females.

Age Ratios: Very little difficulty was found in determining from the air the ratio of short yearling young to total numbers of a species, or to total females. In the case of wildebeest, the maximum discrepancy was 2.2%.

Discussion and Conclusions.

From the standpoint of both speed and accuracy, the aerial counts had a distinct advantage. In a typical study count, two hours were spent in the air, during which time the two observers counted, aged and sexed over 2,000 animals. A ground count of the same area using four observers required seven hours in which only 1,000 animals could be recorded. In terms of work accomplished per man hour, 500 animals were counted, aged, and sexed from the air, while only 35 animals were similarly treated from the ground. When working from the ground it was not possible to age and sex 32% of all animals recorded. From the air only 27% of the total animals recorded could not be aged or sexed.

Given a longer period of observation, both methods could undoubtedly provide a higher percentage of age and sex identification, but it was not considered desirable to increase the period of observation of specific herds used in this study for two reasons: 1) increased costs; 2) increased chance of animal movement into or out of the sample area. These factors are more critical in the case of observations made from the ground than with those from the air.

From the standpoint of volume of work accomplished, observation from the ground was only 7% as effective as aerial observation; and at the same time it was 5% less accurate.

The cost comparison between the aerial and ground population analysis is as follows: One hour of flight in the study aircraft costs Shs.75, plus the time and salaries of two observers, estimated at Shs.32. One hour of cross country ground travel by Land-Rover costs about Shs.45 (roughly 15 miles at Shs.3 per mile) plus the time and salaries of two observers, Shs.32. Since in this study for each hour of ground observation an average of 71 individual animals were enumerated and identified as to sex and age, while for each hour of aerial observation an average of 1,000 animals were similarly treated, the cost per animal examined from the ground was $\frac{32 + 45}{71}$ = Shs. 1.08; while the cost per animal examined by aeroplane was $\frac{32 + 75}{1,000}$ = Shs.0.107. On the basis of the animals examined under the conditions of this study the aerial method costs 10% of the ground method.

The results of this study indicate that it is not only possible and feasible to determine sex and age structure of wild animal populations from the air, but it is also significantly more economical and more accurate than doing the same work from the ground.

Summary.

A series of experiments were carried out to establish techniques for aerial analysis of the population structure of wild animals and to determine the feasibility, economy, and accuracy of doing this work by air. Two study areas totalling about 875 square miles were chosen in the acacia-savannah region of the Mara Protected Area of Kenya. Aerial identification characteristics for the age and sex classes of the animals involved were first determined. Then enumeration and analysis of total areas and of strip samples were made, both from the ground and the air. The results were checked against each other and against population numbers and structure data known for the area from the past year's study by the Wildlife Research Project. The results from the strip sample observations matched those from the corresponding total area observations. The aerial method was found to be extremely accurate, both as to enumeration and to age and sex ratio determination; and it proved economical, costing about one tenth of the ground method per animal enumerated.

We wish to express our appreciation to the Kenya Game Department, under whose auspices this work has been accomplished, and to Mr.D.R.M. Stewart, Game Department biologist, for editing the manuscript.