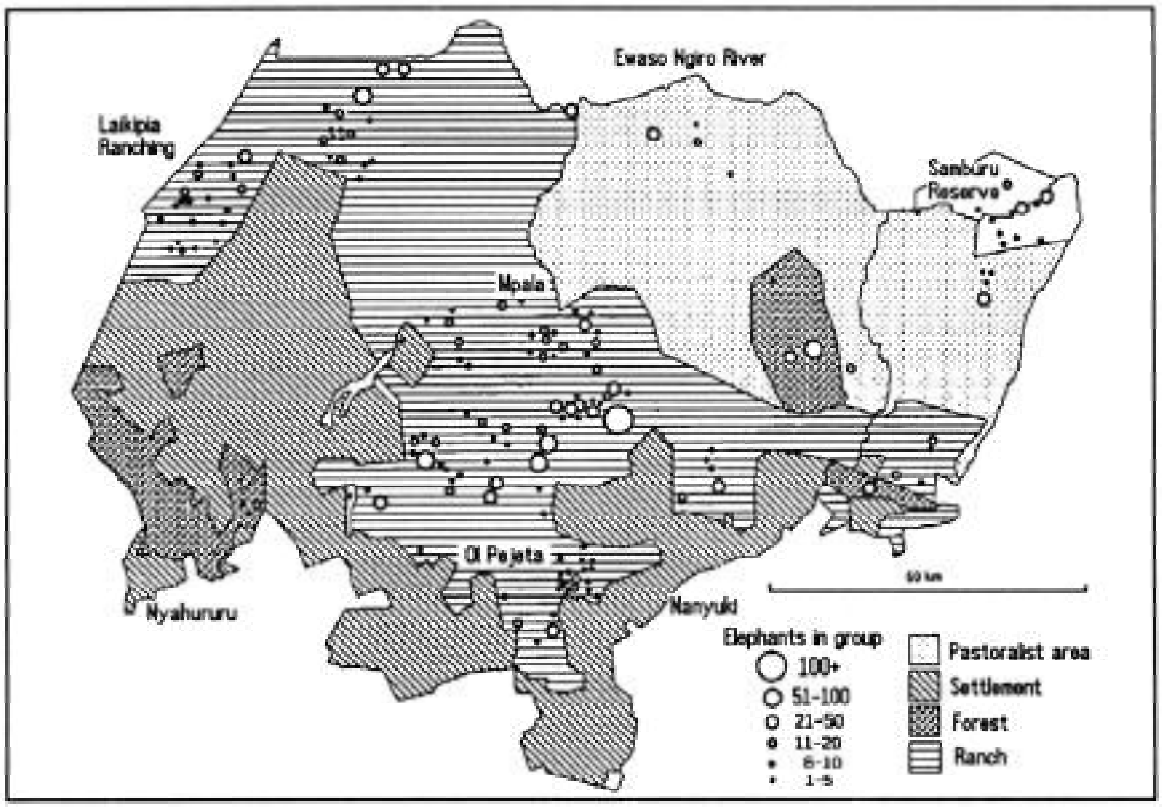

Distribution of elephants seen during an aerial survey of Laikipia on 15-16 September 1990.

Radio-tracking of Elephants in Laikipia District, Kenya

Chris Thouless and Anthony Dyer

Introduction

One of Kenya's largest elephant populations lives for much of the year on private land in Laikipia District. Few elephants were found here before the increase in poaching in Samburu District, and it is believed that they moved south to Laikipia because of the greater security found on ranches. However, because these ranches are being sold for small-scale farming settlement schemes, the elephants are coming into increasing conflict with people. Elephants leave the ranches at night and raid crops on adjoining farmland. The Laikipia Elephant Project was established to study and to find ways of reducing this conflict.

The Laikipia elephants were known to move away from the ranches at certain times of year and an essential first step towards the conservation of this population was to gain information on their movements. Both satellite and conventional VHF collars have been used. Satellite tracking has not proved satisfactory (see Thouless *et al*, pp 28-33). This paper describes technical aspects of the conventional tracking programme and presents some initial results.

Methods

Selection of animals

The total aerial count conducted in September 1990 (Thouless, 1991) was taken as an initial basis for the selection of animals to be immobilised and collared. As far as possible one collar was put on for every group, or groups, totalling more than one hundred animals. Only females were collared, since their movements are

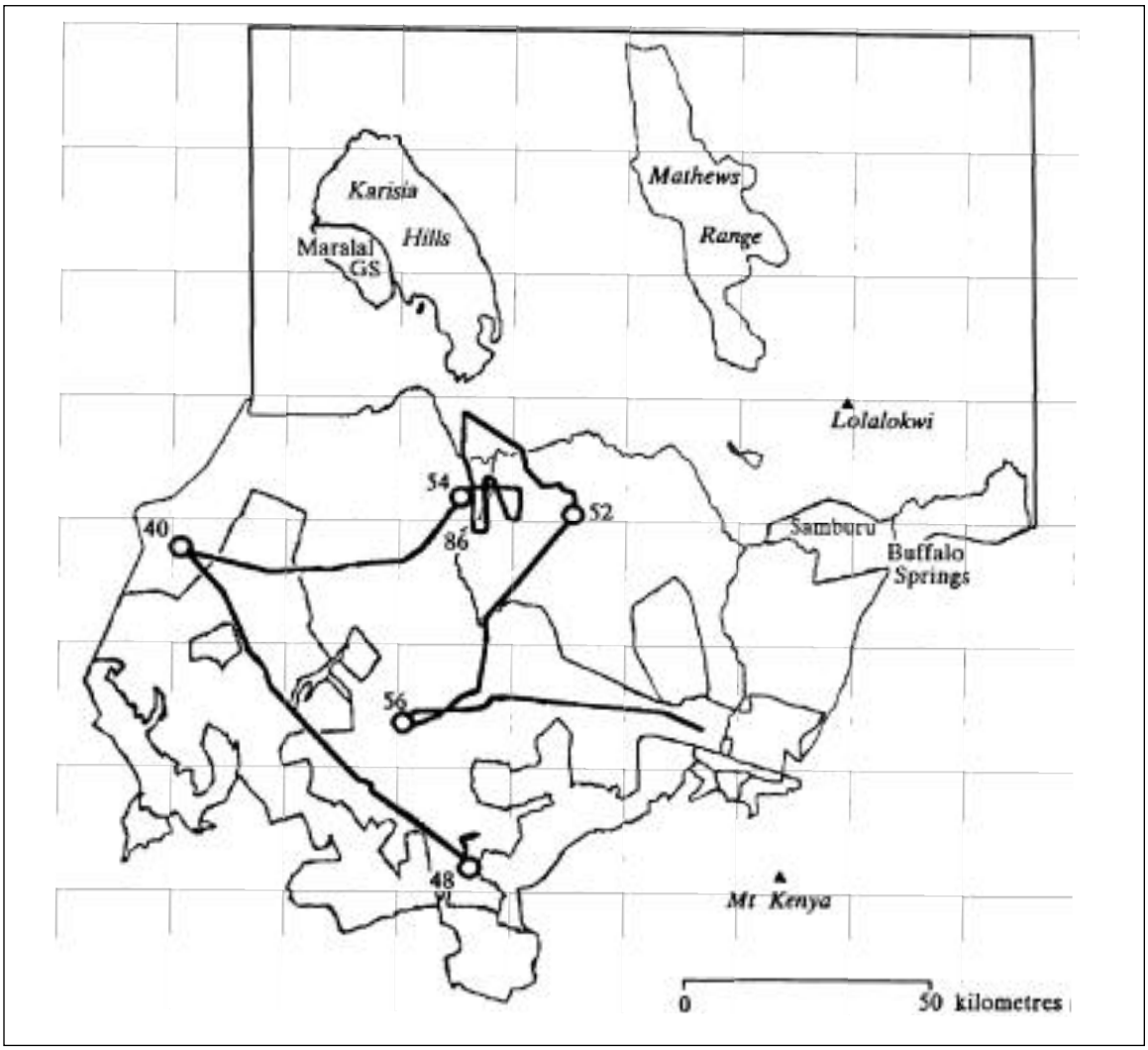

Figure 1 :*Path of radio-tracking flight recorded using Trimble GPS directly onto digitised maps. Numbers indicate identities of located elephants.*

more likely than those of bulls to be representative of the population. Matriarchs and females with young calves were rejected, because such animals are more likely to be defended by their family once they were immobilised. Sixteen cow elephants had been collared by the end of 1991, from a total population of approximately 2,500.

During the initial immobilisation operations, elephants were collared on Mpala, O1 Pejeta and 01 Ari Nyiro Ranches in central, south and west Laikipia respectively. By the time the first seven animals were collared, the main herds seen during the count had moved away, and later darting operations took place when these herds returned to places where they were accessible. Additional elephants were collared near Isiolo in January 1991, in the Mathews Range in April, and in northwestern Laikipia in September.

Most darting operations were carried out on *foot*, using a light aircraft for spotting, and with the immobilising dart fired from a range of about 20 m. Six elephants have been immobilised by darts shot from a helicopter, either a Gazelle provided by the British Army Air Corps, or a Hughes 500 from the Eden Wildlife Trust.

Collars

The radio collars were produced by Telonics Inc. A brass plate with four stud-bolts protruding outwards

is placed against the elephant's hide. Both ends of the collar, which is made of machine belting, have holes cut to match the bolt pattern. After each end of the collar is fitted over the bolts, a second brass plate is fitted, sandwiching the collar ends. Four nuts are tightened down onto this plate to secure the assembly. The transmitters are totally imbedded in acrylic and hang at the bottom of the collar. Aerials about 20 cm long project from each side of the transmitter and are sewn into the collar.

Tracking

Most of the radio tracking was carried out from the air, using a De Havilland Beaver, Helio Courier, Piper Supercub, Cessna 207 or Cessna 185. The Supercub and Beaver were found to be most satisfactory, because of their ability to perform well at low speeds. Although fuel consumption was higher in the Beaver, this was compensated for by better climbing performance and greater power reserves, which made low speed flying in mountainous areas safer.

The aeroplanes were fitted on each wing strut with H-Adcock aerials pointing forwards and downwards at an angle of approximately 30 Coaxial cables connected the two to a switching box which allowed the observer to listen either to the signals from both aerials simultaneously or to switch between left and right. The receiver was a Telonics TR2 with a scanner attachment TS-1.

Pattern of flight

On taking off, a course was steered towards the last known position of an elephant, at an altitude of more than 1,000 ft above ground, and by comparing the signals received from the aerials mounted on each wing, the animal could be approached almost directly. One problem with the outward-pointing aerial configuration is that weak signals from animals immediately ahead are difficult to pick up, and it was sometimes necessary to fly in S-shaped bends until one of the aerials was pointing directly towards the transmitter. Once nearby, the aircraft was taken to a lower altitude and the elephant group located visually. If there were several groups in the area, the aircraft circled each group until the one was found for which the strongest signal always came from inside that circle. This process was repeated until all animals were located, although to reduce flying time those elephants that hardly moved after being collared were not located on every flight. When animals could not be located, the aircraft was taken to 4,000 ft or more above ground level, and this was usually sufficient for a signal to be picked up. Figure 1 shows a typical flight pattern.

Information recording

The position of collared elephants was found by reference to a 1:50,000 map and was recorded as a four-figure grid reference. Usually the location could be determined to within one kilometre, but in some areas where there were few ground features the accuracy dropped to two kilometres. For some flights a Trimble Pathfinder GPS receiver was used to get a precise location.

The size of the group of the collared animal was recorded. Small groups were counted exactly, larger ones were photographed using a 35 mm camera with 105 mm lens and 400 ASA colour print film, and counted later. Groups were considered to be separate if they were divided by more than 500 m. Also recorded were habitat type, distance from the nearest surface water and type (eg, dam, river, temporary rain-pool) and the distance from human activity (eg, houses, manyattas, herds).

Frequency of flights

Radio-tracking from aircraft has continued since November 1990, with flights taking place at intervals of from one to just over two weeks (Figure 2). In most cases the interval was 8-10 days. A total of six flights took place in 1990 and 40 in 1991. CRT was observer on all but five flights and AD pilot on all but 12.

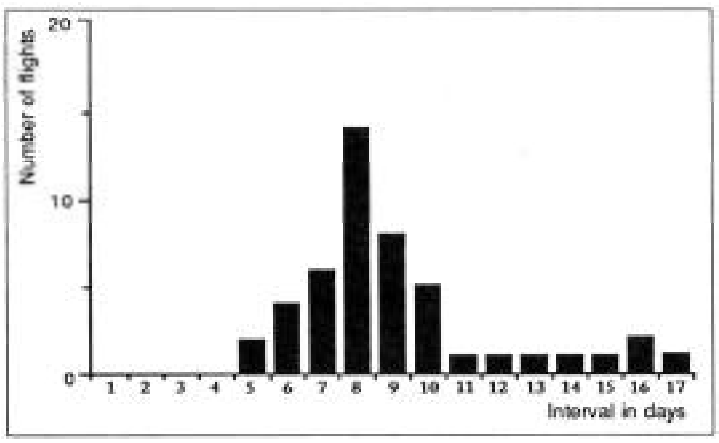

***Figure 2** : Interval in days between radio-tracking flights, 1990-1991*

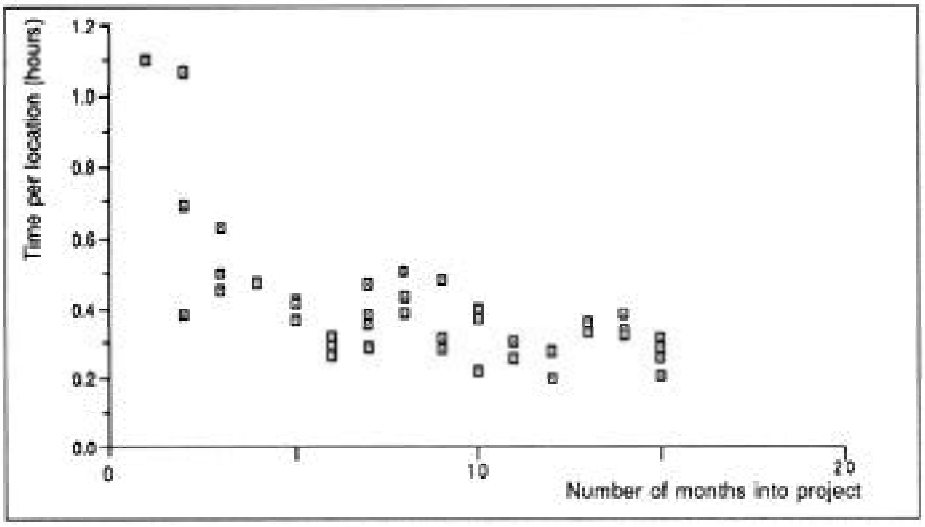

Figure 3 : *Times taken per location*

Analysis
Maps of the study area were digitised at a scale of 1:250,000. Additional digitised maps of land-use within Laikipia District were provided by the Laikipia Research Programme. Information on movements was printed out using Arc/info. Analysis of ranging patterns was carried out using an experimental Macintosh programme, Wildtrack, developed by Oxford University's Wildlife Conservation Research Unit.

Results

Performance of collars
None of the collars failed during the study. In December 1991, one of the collared elephants was shot by game rangers during an attempt to move her herd out of a ranch, and the collar was removed. Apart from some splitting along the edge of the collar, there were no serious signs of wear. Another collar from a sedentary animal was removed in January 1992, and no marks of rubbing were visible on the animal's neck.

From the air elephants have been detected from a distance of 100 km, and from over 15 km on the ground. However, when animals are in steep-sided valleys the range is considerably reduced.

Ease of finding
In the course of six tracking flights in 1990 collars were located 39 times, each location taking an average of 33 minutes of flying time. During 1991, 442 locations were found during 40 flights, each collar taking an average of 16 minutes. The improvement in efficiency is shown in Figure 3. Not every collar was searched for on every flight. Two elephants were extremely sedentary, and these were located once per month. During the dry season, when most of the elephants were far south, the fairly sedentary elephants in the northern Mathews Range were only located every second flight in order to conserve flying time.

On only two occasions (0.4%) did we fail to detect a radio signal from an elephant that we were attempting to locate. On two other occasions a signal was picked up for which we only established the general direction because location would have meant flying within a Restricted Area or operational zone. Twenty four times (5% of all locations) we were unable to see the group that the collared elephant was in or to get a location more accurate than to within about five kilometres; we were certain about the general area. This was usually because the animal was in difficult terrain, such as forest or a steep-sided valley where the radio signal bounced, or we were starting to run out of flying time, or else because of the need to avoid flying low over an operational anti-poaching zone. Occasionally we were unable to see a herd, although by circling we knew the exact location, because the elephants were in thick forest.

Home Ranges
The tracking operation has produced one of the most complete records available of the movements of a migratory elephant population in Africa. This is a result of the success of the collars and our cability to carry out regular monitoring flights.

Five of the elephants had home ranges (minimum convex polygon) of more than 2,000 km^2. They had

small dry season (June to October) ranges on the Laikipia ranches, but once the rains started they moved north into Samburu District, up to the plains to the south and east of the Mathews Range. These movements took place in a short time, with distances of over 100 km covered in a week. Although the animals formed large groups of several hundred individuals in these areas, they moved in much smaller family units, with the different collared animals moving north over the course of several weeks. As temporary water supplies in these areas dried up, the elephants drifted south to the Laikipia ranches, where there were abundant dams, but spent time in intervening areas, which they had passed through without stopping on the way north. A second rainy season in April was followed by a shorter return to the northern areas. Figure 4 shows the movements of one of these elephants.

A second group of animals had home ranges of 500-2,000 km^2. This included three elephants collared near Isiolo, one collared in central Laikipia and two collared from the northern Mathews Range. The latter were clearly remnants of a larger population that had been heavily poached. There were few adult females, with a

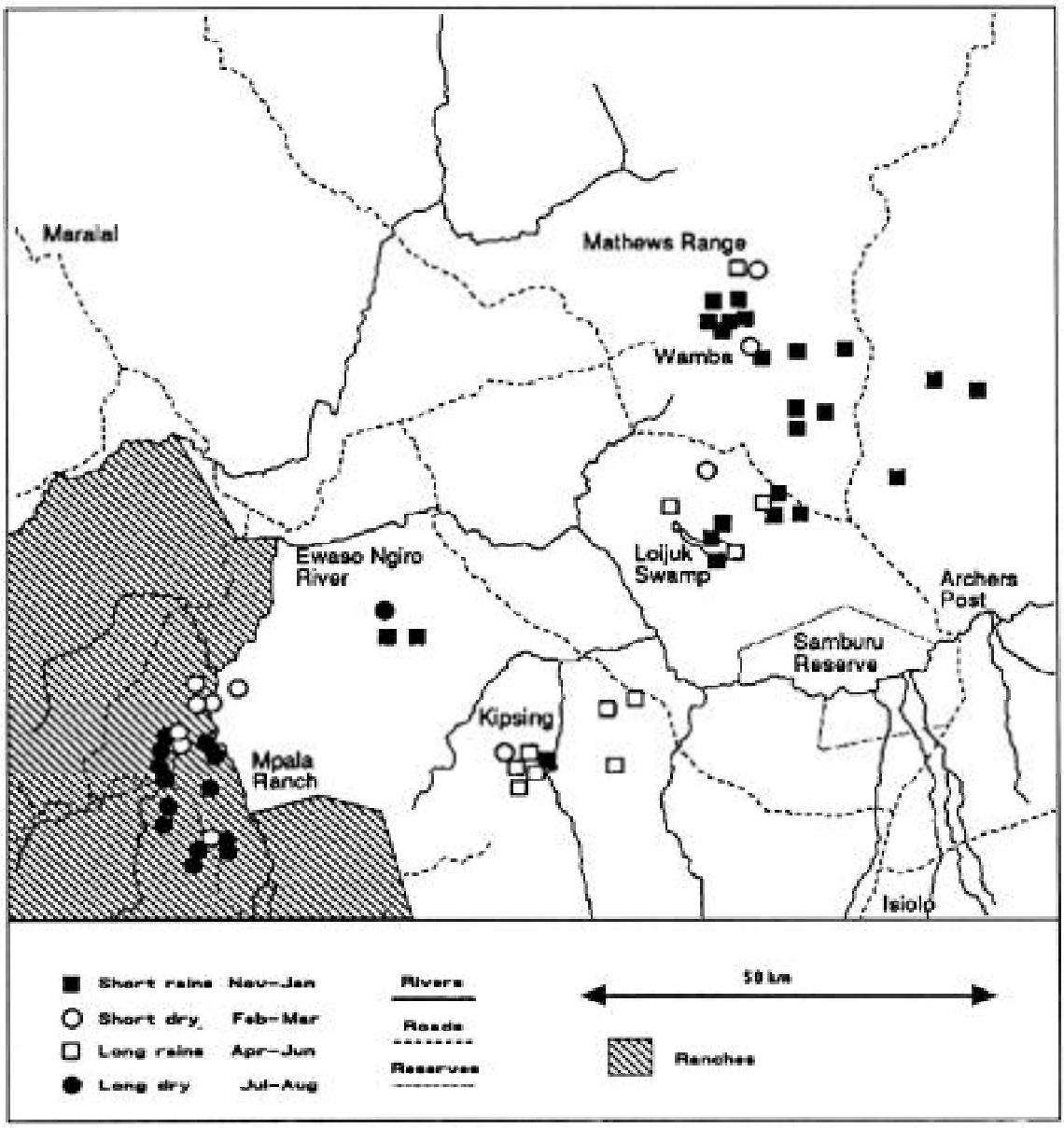

Figure 4 : *Movements of elephant number 46 in Laikipia and Samburu Districts in northern Kenya.*

large population of five-to-ten-year-olds, and they were much more nervous than any of the other animals we followed. Two elephants moved hardly at all after being collared, and had home ranges of less than 500 km^2 on 01 Ari Nyiro and 01 Pejeta Ranches.

Three additional elephants were collared in western Laikipia in September 1991. There is insufficient information to calculate home sizes for these individuals.

Table : Home ranges for radio-collared female elephants in Laikipia and Samburu Districts. Figures given are for 100% and *95%* minimum convex polygons in sq km.

Elenhant#	100%	95%	N
40	100	100	22
42	1,310	1,060	38
46	4,800	4,510	50
48	140	140	23
50	600	530	37
52	3,470	2,960	50
54	2,180	1,800	34
56	2,010	1,710	48
58	3,470	3,330	50
66	4,390	3,850	49
78	3,940	3,280	28
82	2,460	2,440	14
84	840	580	20
86	1,000	850	14
92	710	710	20

Conclusions

For the purposes of the present study conventional radio tracking using aircraft has proved very successful even though the elephants are moving over large distances and using hilly areas where signal reception is difficult. It has usually been possible to find 15 elephants spread over 15,000 km^2 in less than five hours of flying time. This success is partly due to the performance of the equipment and to the availability of suitable aircraft at low cost (typically $100 per hour) within the study area. Radio tracking has given much information of value for management that could not have been obtained in any other way. One striking feature of the results is the variation between individual elephants and the importance of tracking a sufficiently large sample size of animals. If the project had relied upon satellite tracking it would have been possible to get more detailed (but less reliable) movement data on a much smaller sample of animals, and inappropriate biological conclusions might have been drawn. In fact, for management purposes conventional tracking with less frequent locations of an even larger sample would have been useful. It is clear from reports of elephant movements in the district that even with 16 collared animals in a population of about 2,500 we are missing important movements. However, this may be because most of the elephants that are crop-raiding or killing people are bulls or small and elusive cow-calf groups. Selecting a suitable sample for collaring is extremely difficult, since animals with very different movement patterns will often be found in the same area.

In the past, population estimates for Samburu and Laikipia were considered separately, but it is clear from the radio tracking that, depending on the time of year that counts are conducted, this may either result in a considerable under- or over-estimate of the number of elephants in the two dis-tricts. There are many elephant populations in Kenya whose status is to a large extent unknown because of the lack of information about their movements. In regions such as the borders with Uganda and Ethiopia, conventional radio tracking is unlikely to be feasible, but it may have considerable value in the areas surrounding Mt Kenya, the Aberdares, Shimba Hills, Meru and the Ndotos Ranges, for obtaining more accurate population estimates and for ascertaining the effects of proposed management such as fencing and of land-use changes.

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