

Reintroducing a large herbivore: a remote sensing and modeling approach to determine the mountain bongo's (Tragelaphus eurycerus isaaci) past and present critical habitat

A report on additional field research conducted in 2006

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Background

The mountain bongo (*Tragelaphus eurycerus isaaci*) is an endangered tragelaphine antelope subspecies endemic to East African montane forests. This animal, now reduced to several small populations in Kenyan mountain forests (the largest of which is in the Aberdare Mountains), is the subject of a reintroduction campaign that aims to re-establish a viable wild population on Mount Kenya (see <http://www.rarespecies.org/africa.html> for more details on the program).

An ecological research program supporting the reintroduction effort commenced in 2005 with three months of field work. Prior to this report, three field research seasons were spent collecting habitat use data in the Aberdare Mountains. Reports detailing these three research periods are available online at www.rarespecies.org/LDEfldrpt.pdf, www.rarespecies.org/bngoII.pdf, and www.rarespecies.org/LDE_3.pdf). The research campaign focuses on collecting field data on the bongo's habitat utilization, which will provide input for statistical models to determine bongo habitat selection, and serve as ground truth for satellite-image based habitat mapping. Dung samples collected during this research will contribute towards a population genetics assessment of the Aberdares, Mount Kenya, Eburru, and Mau bongo populations.

Research is conducted through the Rare Species Conservatory Foundation (RSCF), and is additionally supported by the Wildlife Conservation Society (WCS), the Explorers Club Washington Group, and the National Aeronautics and Space Administration (NASA). The work will contribute to satisfying the requirements for a PhD degree for the principal investigator (PI), and an MSc degree for the assistant PI.

Fieldwork is undertaken in conjunction with the established Bongo Surveillance Programme (BSP), which is affiliated with the Rhino Ark Foundation and run by Mike Prettejohn. Both the BSP and this research are conducted in collaboration with the Kenya Wildlife Service (KWS).

Field Campaign and Methodology

This report details the findings of a final period of field research comprising three separate excursions conducted between July and September, 2006. Two of the expeditions focused on the southern forests of Mount Kenya, and one on the previously un-surveyed southwestern area of the Aberdares Salient.

The expeditions were led by A.G. Mwangi, an MSc Wildlife Management student from Moi University who was the assistant project leader during the previous three field seasons. Working together with the experienced trackers and staff of the bongo surveillance team (led by Mike Prettejohn) and with KWS rangers, Mr. Mwangi surveyed forests for bongo habitat utilization

signs. The trackers searched for bongo tracks, dung, and feeding signs. Where such signs could be confidently identified, circular plots of 11.3 m radius were centered on these. The following data on forest structure and composition were collected within these plots: diameter at breast height (DBH) of trees larger than 7.5 cm, height of 3 highest trees per plot, and number of shrubs (< 7.5 cm DBH) intercepted by a horizontally held stick (1.2 m long) in two 22.6 m transects, as well as slope, aspect, elevation, and landscape position. Species composition for each measure was also recorded. Samples of fresh dung (< 3-4 days old) were collected where encountered and stored in plastic laboratory vials with 95 percent ethanol. DNA extracted from these samples will be used to: 1) confirm the trackers' identification of the species, and 2) estimate population and range size through identification of individual bongo.

Fewer data parameters were collected during these expeditions than on previous excursions. Grid data points (i.e. plots at a priori established sites—see reports on previous field seasons for description of such sites) were also not recorded. The reasons for this reduction in data collection effort were: 1) to maximize the area covered in search of bongo sign; 2) to allow for reduced manpower (one of the investigators was not present); 3) because a large number of grid points were collected during the previous seasons. The data collected during these three expeditions will serve as validation points for predictive habitat models.

Sample plots were geo-referenced using a Garmin GPS60CS global positioning system (GPS) and an external active antenna, which was raised on a 5 m collapsible pole to improve signal when under canopy. Each position was recorded as the average of all per second readings taken while plot data were recorded (each sample required ~35-120 minutes to complete). The locations of human activity signs encountered were also recorded.

Survey areas were accessed primarily on foot following an initial approach with the project vehicle, where roads and tracks allowed. Expeditions lasted for 6 days, and consisted of sampling within a several kilometer radius of a base camp. Each base camp was typically used for 3 days.

Field Research Results

A total of 18 days were spent in the field over the course of the three expeditions, of which 11 were devoted to field data collection. The remaining 7 days were consumed by vehicle and foot travel between field sites and base camps. A total of 13 bongo sample plots were recorded, and 26 dung samples were collected. The following is a breakdown of each expedition's findings. (Note: The numbering of these expeditions follows on from the third season's, which ended with Expedition 12.)

Expedition 13: July 3rd - 8th

The forests above Kihari and Ragati Gates on the south-southwestern side of Mount Kenya were sampled during this 6-day expedition. Evidence that bongo still occur in this area was found during a November, 2005 expedition by a team from Lewa Downs Conservancy, led by William Duckworth-Chad. The BSP made three subsequent trips (in March, May, and June, 2006) to the general area surveyed by Duckworth-Chad, finding evidence of bongo on each occasion. The first two trips resulted in 10 and 21 dung samples, respectively. No dung samples were collected

during the June, 2006 trip, although sign of bongo were found at one location. Figure 1 details the areas covered and points collected during these three expeditions.

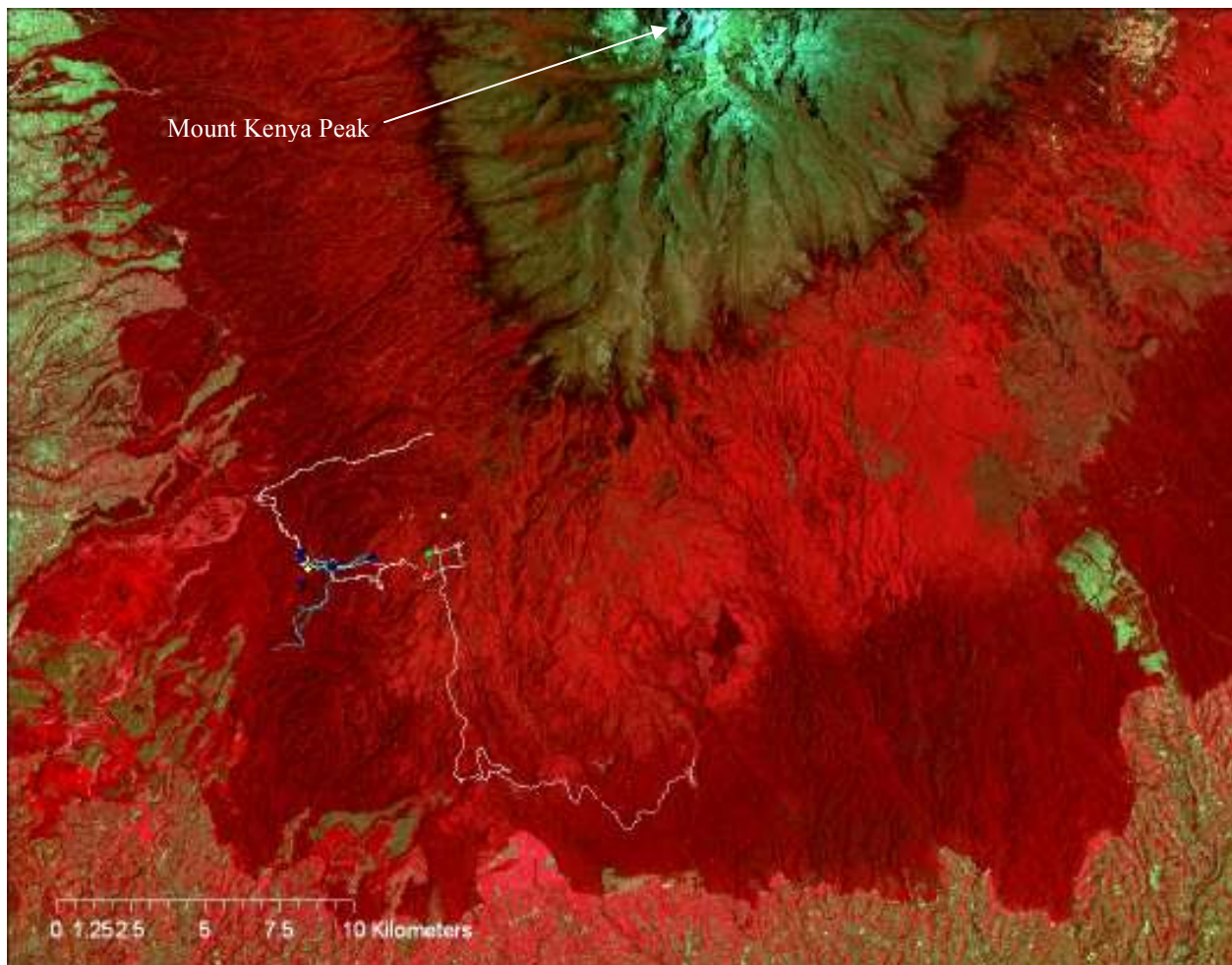


Figure 1: Location of bongo dung samples and areas traversed during the March, May, and June BSP expeditions to southern Mount Kenya. Yellow points represent dung samples collected during the March expedition, blue points indicate those collected during the May expedition. The lone green point shows where the only bongo sign was found on the June trip. The light blue lines detail the (partial) area traversed by the BSP during May, while the white lines show the area covered in June. No track data were available for the March excursion, and the author did not possess any spatial data relating to the Lewa expedition.

The focus of this trip was to build on the information collected by the four previous expeditions by adding habitat selection data. Bongo habitat use data were recorded at three points on this excursion. Tracks followed by the team suggested that at least six animals were present in the area surveyed. Human sign was found at six locations, including evidence of poaching (hunters' camps) and charcoal making. Eighteen dung samples were collected.

A Bushnell camera trap was erected at one location during this expedition, although it failed to capture any images of bongo.

Figure 2 details the data points recorded and the area traversed on this expedition in relation to the points collected and area traversed by the subsequent Expedition 14. The dung samples collected during the March and May BSP expeditions are also detailed, as is the placement of the camera trap.



Figure 2: Detail of areas traversed and data points collected during the 13th and 14th Expeditions above Ragati and Kihari Gates on the southern slopes of Mount Kenya, in relation to areas covered and data collected during the three BSP trips to this area in March, May, and June, 2006. Bongo data points collected during the 13th Expedition are indicated by the black antelope head on a yellow background, while bongo points from the 14th trip feature the black antelope head on the green background. Human signs are indicated by light blue (Trip 13) and brown (Trip 14) triangles. The location of the camera trap deployed during Trip 13 is shown by the black circle. Dung samples collected during the BSP excursions are shown with white (March) and orange (May) crosses. Areas traversed are indicated by the heavy blue line (Expedition 13), the heavy white line (Expedition 14), the thin yellow line (May BSP trip), and the thin grey line (June BSP trip). No track data are available for the March BSP trip.

Expedition 14: July 24th – 29th

The area visited during Expedition 13 was re-surveyed during this six-day excursion, as well as a previously un-visited area extending two kilometers to the south.

Fresh bongo sign were not found during this expedition. A number of utilized areas were encountered, but the most recent of these was approximately 4-5 days old. Three sample plots were collected around these older signs, which ranged from 4-5 days to approximately 1 month old. Only one dung sample was collected. Fresh evidence of poachers and dogs, however, was present, and one person was encountered, who said that he was going to join others who were making charcoal. The individual was escorted to the team's extraction point, where he was released due to a lack of evidence on his person regarding illegal activity. A total of five human signs were recorded during this trip.

Figure 2 details the area traversed during the trip and the locations of collected data points in relation to the previous BSP and Rare Species' expeditions to this area.

Expedition 15: July 24th – 29th

This trip was conducted in the western end of the Salient, in an area extending several kilometers to the north from the Ruhuruini-Mutubio Road. This area was not surveyed during the previous three field seasons, and was sampled on this final expedition to determine if bongo could be found higher up and further south in the Salient.

A total of five bongo plots were recorded during this trip, ranging in age from several weeks to less than one day old. Seven dung samples were collected. Sixteen signs of human activity were found, including evidence of honey-hunting and camping (presumably related to poaching and honey-gathering). Human sign ranged in age from several months to approximately one week old. Figure 3 shows the area traversed and locations of collected data points in relation to bongo points recorded during the previous three field seasons.

Summary of Expeditions

The three final field expeditions have added invaluable data to the overall habitat selection research program. The Mount Kenya data are particularly valuable in that they will provide some ability to validate the predictive habitat models developed using the Aberdares data. This means that bongo habitat will be identified with greater confidence on Mount Kenya than was previously expected. These two Mount Kenya expeditions, together with the previous BSP and Lewa Expeditions also indicate the threat that the remaining Mount Kenya bongo face from rampant human activity.

The last expedition to the Upper Salient enhance the existing Aberdare dataset by providing data from a fresh area, which are likely to provide greater insight into both bongo habitat selection and range size. Inferences into the latter will depend on the findings of the genetics study.

Figure 4 details the locations of data points collected during Expeditions 13-15 in relation to Mount Kenya and the Aberdares and data points collected on previous expeditions.

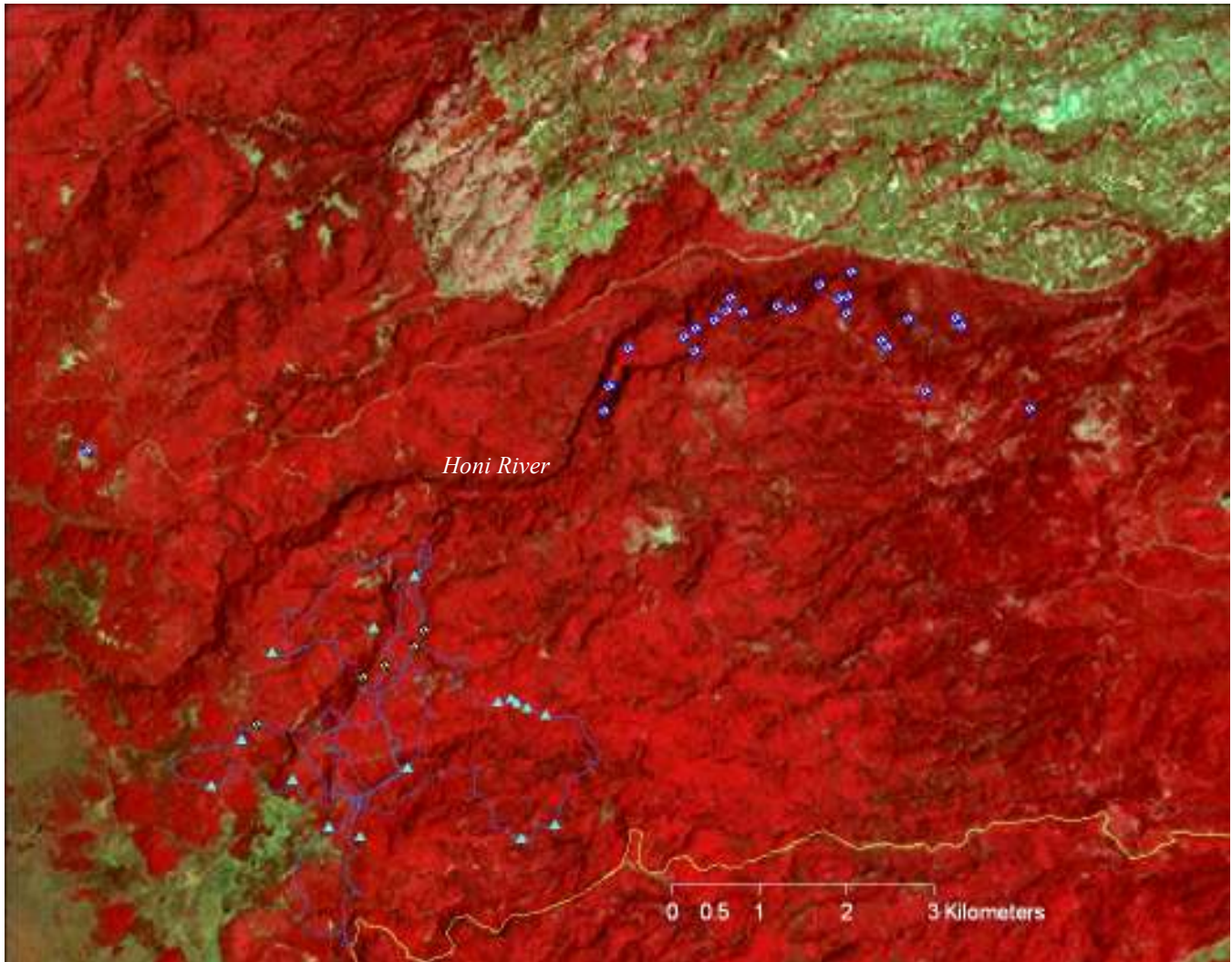


Figure 3: Area traversed and data points collected during Expedition 15, in relation to plots collected in the Salient during the three previous field research seasons in the Aberdares. The black antelope heads on yellow background represent bongo data points collected during Expedition 15, while the blue antelope heads on white background show the closest bongo points collected during the three previous research field seasons. The blue triangles denote human activity signs recorded on Trip 15, while blue lines show the area covered during this expedition. The yellow line marks the Ruhuruini-Mutubio Road.

Data Analysis and Ongoing Work

An initial analysis comparing the relative abilities of the collected field data (from Expeditions 1-12) and several remotely-sensed datasets to predict bongo habitat distribution in the Aberdares was completed in early December. The resulting paper is currently being reviewed for publication with the journal *Remote Sensing of the Environment*. This work will be made available following the completion of recommended revisions.

This work will be followed by further remotely-sensed analysis of habitat on the Aberdares and Mount Kenya. Primary goals are to: 1) use satellite data to map important habitat variables throughout the study area, including such features as basal area, average canopy height, canopy cover, bamboo density, etc.; 2) develop regression models to predict the distribution of forest

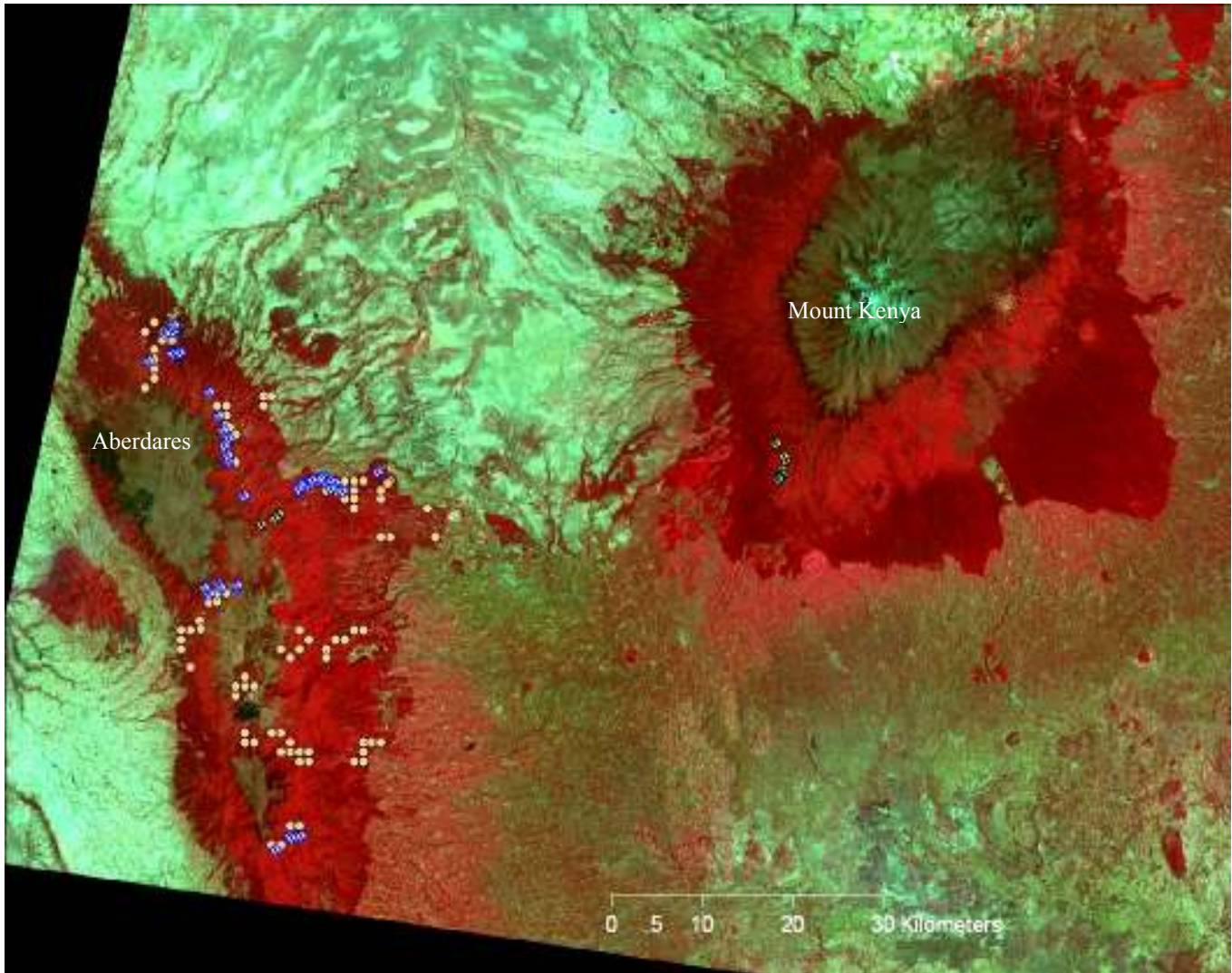


Figure 4: Data points collected during Expeditions 13-15, in relation to data points collected during the previous three field seasons. Points collected on Mount Kenya are represented by black antelope heads on yellow (Expedition 13) and green (Expedition 14) backgrounds. Expedition 15 (in the Aberdares) points are shown with black antelope heads on yellow background, while points collected during the previous three field seasons are indicated with beige circle (grid points) and blue antelope heads on white background (bongo data points).

understorey structure that cannot be detected with remotely-sensed data; 3) determine how the distribution of habitat variables has changed over the past 20 years using archived satellite images.

Mr. A.G. Mwangi, the leader of Expeditions 13-15, is currently working on his MSc dissertation, which entails using geographical information system (GIS) modeling to predict the distribution and density of human activity in the Aberdares. These data will provide important input into the predictive habitat models, and will assist KWS in helping to plan management interventions.

A comprehensive assessment of the feasibility of identifying individual bongo using microsatellite DNA will be undertaken at Cardiff University in January. The results of this

assessment will determine whether the full population genetics study can be undertaken using the 200 + dung samples collected by the BSP and RSCF.

Acknowledgements

Hearty thanks are due to Adam Mwangi, who provided the driving force and leadership on these three expeditions. He proved himself to be a capable leader and scientist, and his work has been of incalculable value to the overall research effort. He promises to be an important contributor to the field of Kenyan conservation science.

As during Expeditions 1-12, much of the success of these final trips can be attributed to the outstanding cooperation and assistance provided by the Kenya Wildlife Service. Aberdare National Park Senior Warden Wambani and the Assistant Director Mountain Area Warutere were extremely supportive and unfailingly provided the authority and ranger support necessary to conduct this research. Assistant Warden (Environmental Education) Gichohi cannot be thanked enough for his outstanding assistance in organizing the permits and personnel needed for the research team to operate in the ACA and Mount Kenya, as well as for his general interest in the team's work. The Officers of Mount Kenya National Park are also thanked for providing ranger assistance and authority to conduct work in the Mount Kenya National Reserve, as are the rangers who accompanied these expeditions. The Director of Biodiversity, Ecosystems and Research for KWS, Dr. Richard Bagine, is again thanked for smoothly enabling this research project with the necessary approvals and authorities.

As always, this research project would have been extremely difficult (at best) to conduct without the continuing hard work and knowledge of Mike Prettejohn and the surveillance team, composed of Joseph Kariuki, Matthew Gichuri, Boniface Nderitu, Stanley Gichure, Laban Kariuki, and Joshat Korage, Kiragu Gichuri, and Peter Mwangi.

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