ECOLOGY, DENSITY AND DISTRIBUTION OF SITATUNGA IN CENTRAL UGANDA

QUAECUMQUE VERA

UNIVERSITY OF ALBERTA

2015 ANNUAL REPORT

Contributors and Cooperators

- Uganda Wildlife Safaris
- Dallas Safari Club
- Northern Alberta Chapter of Safari Club International
- San Diego Chapter of Safari Club International
- International Wildlife Management Working Group of The Wildlife Society
- Uganda Wildlife Authority
- Uganda National Council for Science and Technology
- The University of Alberta

Researchers

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Mark S. Boyce, University of Alberta Professor

Highlights

• First field research season was 25 April through 12 August in the Mayanja River near Ngoma, Uganda

Mark – resight study:

•We used 14 viewing platforms as primary image capture locationsand 28 motion-triggered trail cameras for secondary data collection

•We recorded 211 encounters with sitatunga from viewing platforms, and 294 from trail cameras

•We have identified 34 encounters with 27 unique sitatunga individualsin the month of May

•Individuals identified include 19 males, 6 females, and 2 lambs (sex undetermined)

•Based upon this very preliminary data, we have successfully used a Spatially-Explicit Capture Recapture (SECR) program to estimate the density of sitatunga in the Mayanja River to be 6.8 (95% confidence interval: 2.7-17.1) per square kilometer.

•The extent of the papyrus in the study area is approximately 8.1 km^2, which can support 55.1 (95% confidence interval: 21.9 – 138.5) sitatunga

•During Winter Term 2016, we are recruiting an undergraduate researcher to assist in the identification of individual sitatunga from these images

Telemetry Study:

•We procured 6 GPS collars for adult female sitatunga

•We have secured funding for one GPS collar to fit adult male sitatunga, and are in the process of securing more

•We conferred with the Uganda Wildlife Safaris veterinarian to identify suitable and safe capture techniques

Genetic Diversity Study:

•We collected 28 samples from harvested male sitatunga

•We have procured an import permit to bring the samples to Canada, and the export permit from Uganda is pending

Highlights *con't*

Outreach Efforts

•Facebook page featuring the project (*https://www.facebook.com/wildlifediscoveries/*) has 1197 likes

•Podcast and web series featuring the project (*http://wildlifediscoveries.com/*) are regularly updated with blog posts, images, and project information

•The project has been the subject of two presentations, two interviews, and two print articles

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Background

Sitatunga (*Tragelaphus spekii*) is a spiral-horned African antelope endemic to papyrus marshes and other wetlands of sub-Saharan Africa (12, 35). Although little is known about the ecology of this species, as recently as 2008, the species was suspected to be highly endangered in parts of Uganda (10, 27, 35). To date, there has not been a population estimate for sitatunga in any part of its range; population reports are instead based on expert opinion, which can be highly misleading (10, 17). While trophy hunting in the developing world has the potential to play a key role in conservation of species and habitats, and can be especially important in areas not frequented by tourists, an estimate of the sitatunga population in Uganda is essential to ensure that hunting is managed sustainably (20, 21, 22, 43).

The main reason why little information about sitatunga is known appears to be the difficulty of working in the marshes where they live. Sitatunga are adapted for life in dense vegetation in wetlands and papyrus marshes, making traditional population survey techniques problematic (12, 16). Sitatunga have been noted in camera trap surveys of terrestrial vertebrates (25), but no calculation of home range or density of the population has been made to date.

Previous research in other parts of their range indicates that sitatunga are not restricted to wetlands, using wetland edge as well as natual openings in the forest (bais) during the hours around sunrise and sunset, suggesting that their habitat requirements are more complex than initially thought (12, 13, 35, 39). No analysis of population status can be complete without consideration of potential sources of perturbation. Documented natural predators of sitatunga include leopards (*Panthera pardus*) and nile crocodiles (*Crocodylus niloticus*) (8, 15).

Background *con't*

Of course, humans harvest sitatunga as well, and also affect the species through modifications of natural landscapes (30, 37). Increase in human population,whether or not as a result of development, can lead to increased harvest of bushmeat (24, 29) However, protected areas such as national parks cannot be seen as refugia from human impacts or population declines, as seen in Tanzania, where sitatunga and other species in protected areas endured a decline in popuations over a ten-year period, possibly due to poaching and human encroachment (40). Land use in Uganda include logging, charcoal production, resource extraction, agriculture, and village development.

Charcoal production, a common activity in our study area, causes drastic changes and variability in forest structure and composition (26, 31). Charcoal and wood fuel accounts for over 90% of Uganda's energy production; as such, charcoal is an important economic activity and is expected to steadily increase (19, 26). Fragmentation of habitats can impede dispersal – the movement of young animals as they seek to establish home ranges (9, 40). The effects of habitat fragmentation on dispersal are at least partially dependent on the arrangement of habitat types across the landscape. Thus, understanding dispersal patterns and habitat requirements both become more important in fragmented landscapes (9, 27, 31, 39, 40).

In light of the multiple factors at play in sitatunga population moderation, the importance of having baseline understanding of the habitat requirements and density of the species becomes more apparent. To ensure responsible and sustainable sitatunga hunting, this research will provide crucial baseline information in three key areas: habitat use population size, and genetic diversity. Results from my study, which will be undertaken with support from teams based in Uganda and Canada, will enhance the management of sitatunga in Uganda and several other countries in sub-Saharan Africa.

Objectives and Methods

Objective 1 – Estimate home range size and habitat use of adult sitatunga. We will fit sitatunga with GPS radio telemetry collars to document movement patterns, and we will identify individuals from digital images taken at viewing platforms and trail cameras (18, 42). Camera data in conjunction with movement data provides a temporal and spatial record of habitat use for individual sitatunga, which will allow for modelling of habitat selection, home range, and population density (2, 3, 4, 44). We will identify habitat use by projecting GPS collar data onto GIS maps with delineated habitat types (3). We will calculate utilization distributions (UD), which represent an animal's space use (1, 7). Once a home range is identified, we will use UDs to establish how space use varies according to habitat type; and we will relate these data to habitat selection using resource selection functions (RSFs) and resource utilization functions, linking environmental covariates to patterns of space use (1).

Objective 2 – Estimate density of sitatunga in the Mayanja River of Uganda. We will use both GPS telemetry and camera data to develop a spatially explicit capture-recapture (SECR) model of density (6, 23). RSFs calculated for Objective 1 measure the probability that an area will be used by an animal (4). Linking RSFs with SECR, we can calculate abundance of sitatunga in the study area based upon habitat types (3). Once we have developed a density model for sitatunga in the study area, we will extrapolate the model to other areas of sitatunga range to obtain estimates of sitatunga populations at larger scales (5).

Objectives and Methods con't

Objective 3 – Assess dispersal of sitatunga among subpopulations and determine connectivity of sitatunga habitats. We will use DNA from harvested individuals, captured individuals, and scat piles to determine genetic structure and variability of sitatunga in the Mayanja River valley. We will use a variety of genetic tests to assess for variability and relatedness; from these results we can infer immigration, dispersal, and patterns of paternity for population segments (6, 11, 14, 28, 34).

Study Area

The research is taking place in central Uganda, in the marshes of the Mayanja River system, which is part of the Nile watershed in the Nakaseke District of Uganda. Central Uganda lies between 900 and 1100 m above sea level, and contains multiple lakes, rivers, and swamps (32). The Equatorial Ugandan climate is described as generally rainy,with two dry seasons, December to February and June to August, although there is local variation in the length, timing, and duration of the dry seasons (42). Reports from people familiar with the study area indicate that both dry seasons are characterized by a decrease in rain, although the December to February dry season is drier, longer, and more reliable (Anon.,E. Enyel, P. Symington, R. Okori, pers.comm). On average, little of the land is permanently cultivated (42). Other species present include hippopotamus (*Hippopotamus amphibius*), Nile bushbuck (*Tragelaphus scriptus bor*), Defassa waterbuck (*Kobus ellipsiprymnus*), oribi (*Ourebia ourebi*), bohor reed buck (*Redunca redunca*), warthog (*Phacochoerus africanus*), bushpig (*Potamochoerus larvatus*), and common duiker (*Sylvicapra grimmia*). As part of this study, we will use GIS to map the extent of papyrus and other suitable habitat. The most recent estimates of the total area of papyrus and other wetlands occurred in 1999. The estimate at that time were 30,000 km2 (MWE, unpublished data).

Figure 1. Map of Uganda. Black box indicates the study area (image from Wikimedia Commons)

Results

First field research season was 25 April through 12 August in the Mayanja River near Ngoma, Uganda. We used 14 machans and 28 trail cameras across approximately 10 km of river to record 505 encounters with sitatunga. The papyrus in the study area covers approximately 8.1 km^2.

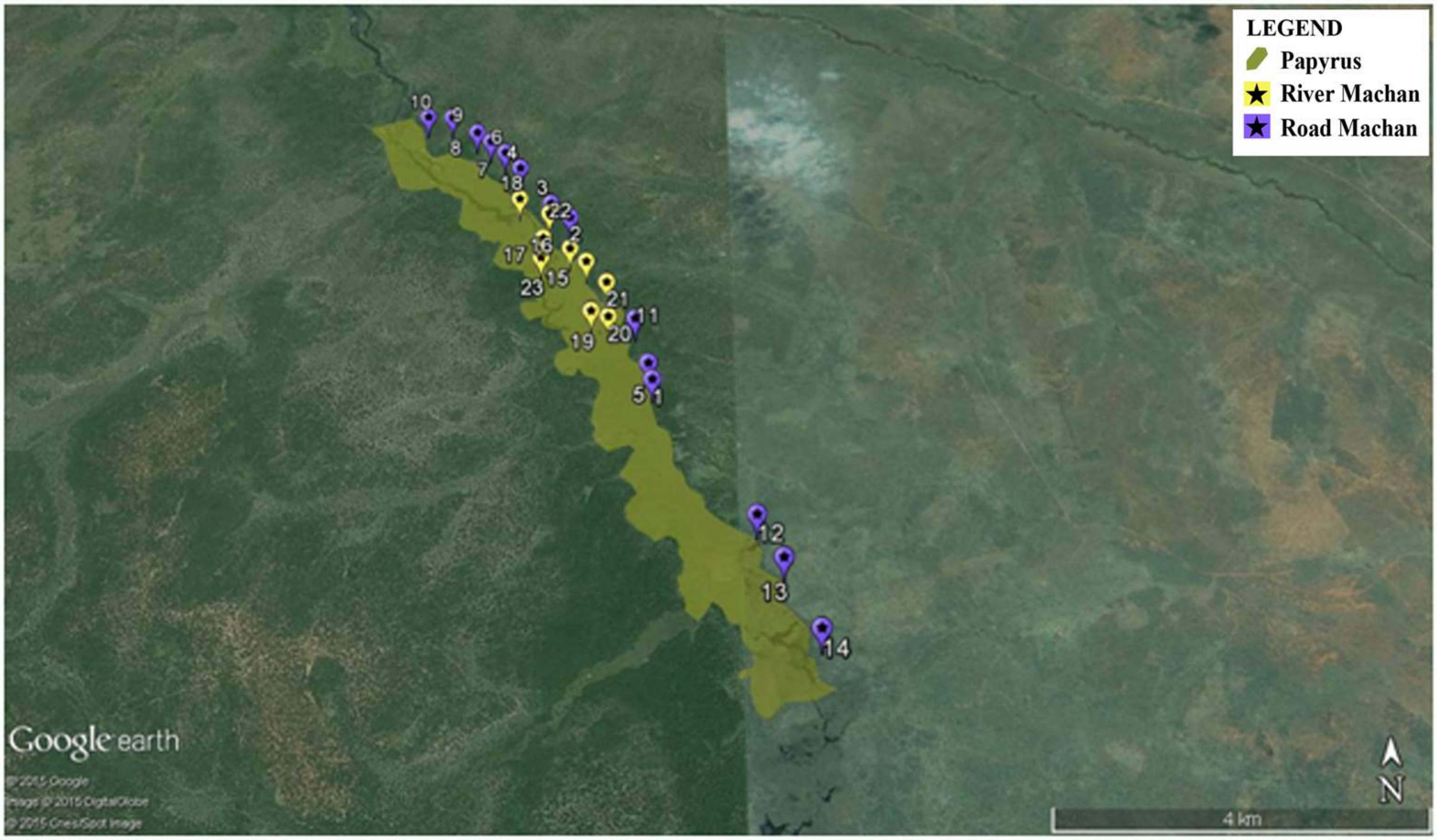

Figure 2. Map of the Mayanja River study area showing the machan locations and extent of the papyrus. Satellite image taken in 2013

We attempted mark-resight at machans a total of 129 times, 65 times in the morning hours around sunrise (approximately 0630 to 0900), and 64 times around sunset (approximately 1630 to 1900). The temperature during data collection ranged from 15° to 31° Celsius, and we recorded 33 rain events during these efforts. We classified an individual as an adult male if horn shape included one full twist. We classified an individual as an immature male if horns were present but did not meet the shape requirement. Sitatunga were classified as lambs when they displayed very small body size and/or were accompanied by a larger adult female. We classified a sitatunga as unknown sex and/or age if we could not completely visualize the head to verify presence of horns, or if the body size was intermediate between lamb and adult female size. When comparing the proportion of male, female, and juvenile sitatunga encounters between machans and trail cameras, we see that there were similar proportions of adult male sightings between the two types of sites, but the proportion of sitatunga of unknown age and/or sex is higher in the trail camera sample. This is likely due to the restricted detection zone of trail cameras and limited available angles to conclusively identify age and/or sex.

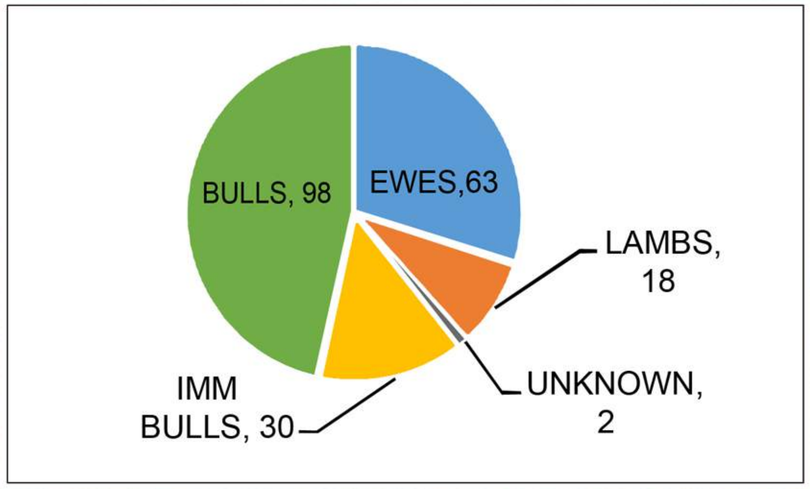

Figure 3. Sitatunga encounters from machans, classified by age and sex. Numbers shown are the number of encounters.

Trail cameras allow monitoring of temporal sitatunga activity patterns, as they are triggered by motion in front of the detection zone. Sitatunga do not appear to be restricted to activity around sunrise and sunset, but are active throughout the day and night. This is consistent with reports from Botswana of sitatunga activity in late morning (12). Future analysis of this data will be helpful in directing mark-resight effort to periods of high sitatunga activity.

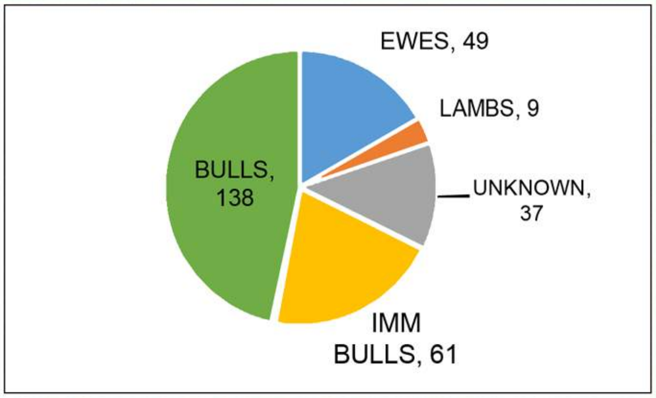

Figure 4. Sitatunga encounters from trail cameras, classified by age and sex. Numbers shown are the number of encounters.

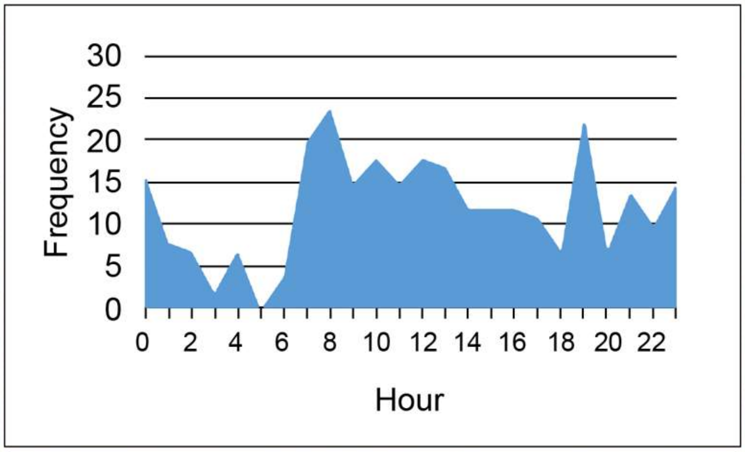

Figure 5. Trail camera detections of sitatunga classified by time of day, April – August 2015.

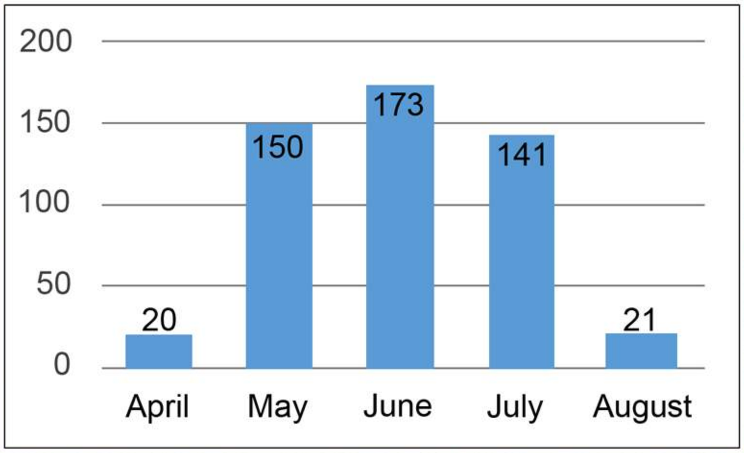

Figure 6. Sitatunga encounters by month, from pooled trail camera and machan data.

Pooling data between trail cameras and machans allows for analysis of monthly trends. We had fewer days available to detect sitatunga in April and August, but the trend for May-July displays a consistency in number of detections during this period. This field season coincided with part of a rainy season and part of a dry season. From June – August, which is supposed to be a dry season, we collected data on 79 days,and we recorded 15 rain events during this period (19% of sampling days were rainy). According to a professional hunter familiar with the study area, sitatunga behaviour changes during the December - February dry season, as sitatunga venture out of the papyrus more often, and part of the swamp is burned (P. Symington, pers. comm). For accurate estimation of population density, it is crucial to collect data during the dry season (November through February). Obtaining data during this time period is a research priority moving forward.

Previous research indicates that sitatunga are generally solitary, with the exception of females with lambs (12). However, our preliminary assessment illustrates that seeing more than one sitatunga is common, and that the species may be more social than previously thought.

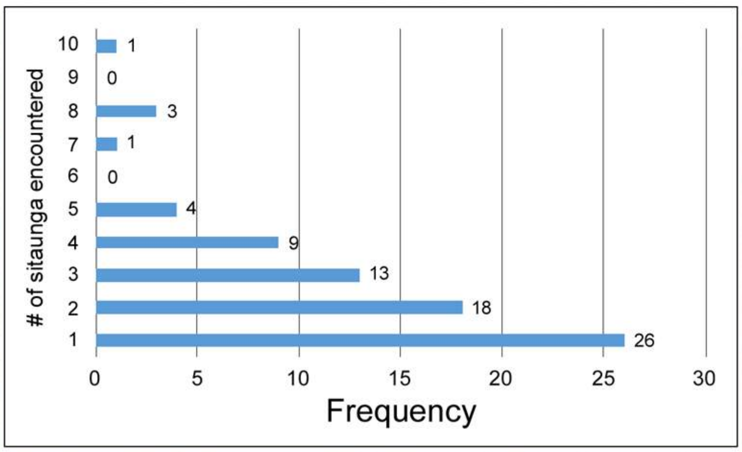

Figure 7. Number of sitatunga encountered per mark-resight attempt, April – August 2015

We have started identification of individual sitatunga based upon spot patterns and horn shape. Thus far, we have identified 27 unique sitatunga from 34 encounters in the month of May. The identified sitatunga include 19 males, 6 females, and 2 lambs (sex undetermined). We have used these preliminary data to program a Spatially -Explicit Capture Recapture (SECR) analysis in program R. This small sample yields an estimated density of sitatunga in the Mayanja River of 6.8 (95% confidence interval : 2.7 - 17.1) per square kilometer. From this estimate, we can extrapolate to estimate that the density of sitatunga in the study area is 55.1 (95% confidence interval: 21.9 – 138.5). Using the 1999 estimate of wetlands in Uganda, the population of sitatunga in Uganda would be 204,000 individuals (95% confidence interval: 81,000 – 513,000). We would caution against any management decisions based upon this initial estimate, because the current estimate is burdened by large confidence intervals, but we expect the interval to contract as more individuals are identified and the number of re-encounters increases.

We are recruiting an undergraduate researcher to assist in the identification of individual sitatunga from these images, and to explore the data further during Winter Semester 2016. We hope to have improved density estimates by April 2016. We were unable to capture adult sitatunga during 2015. However, we procured 6 GPS collars for adult female sitatunga, and have funding for one GPS collar to fit adult male sitatunga. Data provided by these collars will be instrumental in calculating the home range and habitat use of sitatunga. We met with the Uganda Wildlife Authority veterinarian to identify suitable and safe capture techniques, and showed him the study area to identify potential capture locations. Uganda Wildlife Safaris helped us to collect 28 hide samples from harvested male sitatunga for genetic analysis. We have obtained an import permit to bring the samples to Canada, and the export permit from Uganda is pending. Research staff will be trained in genetic extraction techniques during Winter Semester 2016. DNA extraction and analysis will begin once samples arrive from Uganda.

We created Wildlife Discoveries, a website and social media presence dedicated to this research. The Facebook page, (https://www.facebook.com/wildlifediscoveries/) has 1197 likes as of 16 December 2016.

Wildlife Discoveries is on Twitter (@WLDua) with 284 followers. A dedicated website (wildlifediscoveries.com) includes a blog, podcast, and web series. The web series includes a special outreach for children and K-12 educators,called Wildlife Discoveries Kids, and Wildlife Discoveries Sideshow which promotes local events and tourism in Canada.

This set of new media focuses on the sitatunga research project, but has also highlighted other research projects and activities.

We presented a poster highlighting the objectives and methods at the 2015 R.E. Peter Conference at the University of Alberta, and at The Wildlife Society Annual Conference in Winnipeg, Manitoba, Canada. Project staff were interviewed for a public television program in the Czech Republic, and for the Wildlife Discoveries podcast. The research was featured in the newsletter for the International Wildlife Management Working Group.

Timeline

January 2016 – March 2016: obtain required permits; finalize paperwork and travel arrangements; obtain satellite imagery of study area and begin assignment of habitat types; complete identification of individuals from images taken in 2015; complete importation of hide samples; begin DNA extraction and analysis of genetic diversity; complete procurement of collars for adult male sitatunga April – August 2016: perform field capture of adult sitatunga, record demographic information, take genetic samples, and capture animals and affix GPS radiocollars; position trail cameras; maintain camera trap grid, including downloading images, troubleshooting malfunctions, and relocating cameras as necessary; obtain genetic materials from harvested sitatunga in Uganda; compile data from GPS collars deployed August -December 2017: Perform and compile population genetic analysis; troubleshoot any problems detected in the primers and DNA testing methodology; begin estimation of home range size; continue identification of individuals from mark - resight and camera trap data; prepare manuscripts based on field capture of sitatunga

Significance and Deliverables

At completion of this project, we will have estimates of population size, genetic structure, and habitat use of the sitatunga population in the Mayanja River, Uganda. We believe that this will result in improved management decisions for the sitatunga herd and the harvest. Improved harvest management can result in sustained hunting revenue, which will enhance economic development in the local area and conservation of sitatunga habitat. For other regions of sitatunga range, managers will be able to extrapolate population size, which can guide conservation and management for the species across sub-Saharan Africa. This work will also expand and improve existing use of RSFs, by relating the probability of a sitatunga using a habitat type to the landscape level, or a large geographic area that encompasses numerous habitat and land use types, and using that relationship to generate an estimate of population size (3, 4, 6). Finally, this project will expand on methods used to assess elusive and cryptic animal species in similar habitat, such as tapirs, leopard, and Florida panther (30, 33, 38). Improving survey and RSF methods have potential to benefit animal conservation across the world.

Future Research Priorities

We were able to collect substantial mark-resight data during the 2015 field season. Sitatunga are individually identifiable based upon coat markings and horn shape, and preliminary analyses verify that our study design is suitable to generate a density estimate. Our analyses will be vastly improved with GPS telemetry data, thus capture of adult sitatunga is a research priority for 2016. Capture is likely to be easier and safer during the dry season, and it is important to determine if habitat selection or detection of sitatunga change during the dry season, thus scheduling a field season during December – February is essential in the future.

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