

Final report for National Geographic Committee for Research and Exploration

The Giant Forest Hog (*Hylochoerus meinertzhageni*) of Kibale National Park, Uganda

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ABSTRACT

African wild suids living in forest environments have been poorly studied and some species as the Giant Forest Hog (*Hylochoerus meinertzhageni*) -the largest species of wild pig of the world- are disappearing at alarming rates, especially the Eastern Africa populations due to habitat encroachment and hunting pressure. Here we present results of the first ecological study on this species in Kibale National Park, a mountain- tropical forest of southwestern Uganda. The goal of this research was to determine group size, group's movement patterns, habitat use, and foraging patterns. We also assessed parasites transmission among giant forest hog, bush pig and domestic pigs living in the periphery of the park. Despite having failed to attach radiotelemetry devices on individuals of giant forest hog we tracked for two years two groups of this species and estimated home range, foraging patterns, and habitat use. With the help of automated camera traps deployed in salt licks and bathing points we also obtained the first account of group size and group structure for the population of Kibale National Park. More than 300 feces of both wild species were collected and analyzed to determine gastrointestinal parasites communities. Groups of giant forest hog moved in areas close to 10 km² and home range was estimated at 10.7 km² (Fixed Kernel at 95%) with a core area of 2.7 km² (Fixed Kernel at 50% of observations). Areas with dense bushes and sparse trees seem to be the favorite habitat for the GFH where they feed on the herbaceous species and rest in shady areas under the densest thickets of 5 x 5 m approximately called "sleeping sites. Groups of GFH were captured on camera traps 28 different times and the more than 500 photos obtained showed that group size is highly variable and ranges from 3 to 11 individuals with occasional sightings of solitary individuals. Large groups are conformed by a dominant male, one or two additional males, several adult females, and up to four juveniles. Fourteen species of gastrointestinal parasites were found in both, the bush pigs and the giant forest hog, and it was found that individuals living far from humans have less parasites species and less prevalence than individuals living in the park periphery. Conservation of the largest pig of the world in Eastern Africa will require the protection of forest ecosystems and the mosaic of habitats associated to them as the dense bushes and open gaps surrounded by forest. Kibale National Park is one of the last strongholds in Uganda of the population of this endangered species.

INTRODUCTION

The Giant Forest Hog (*Hylochoerus meinertzhageni*; hereafter GFH) is the largest wild suid of the world with males reaching more than 250 kg and one meter in height (Wilson and Mittermeier 2011). The massive body is covered by black hair and has naked prominent cheeks and tusks that protrude from the mouth horizontally. This species lives in tropical Africa from Ethiopia to Western Africa in scattered populations inhabiting diverse vegetation types, ranging from bamboo forest and subalpine forest to lowland swamps and secondary growth thickets (Kingdom 1979, d'Huart 1978). A highly herbivore species, the GFH feeds on herbaceous species from dense bushes or thickets to grasslands, but always close to forest that the group uses likely for refuge. The GFH is a social species living in family groups with a dominant male, and several females with piglets, typically forming groups from 8 to 12, but sometimes aggregations of 40 animals have been seen (Kingdom 1979). The GFH is listed as Least Concern on the IUCN red list (<http://www.iucnredlist.org/>), but there is evidence that at least the Eastern African populations have been decreasing at alarming rates in the last 30 years (Tumukunde et al. 2014).

Kibale National Park (Kibale N.P. hereafter) is a 795 km² park at the foothill of the Rwenzory mountains in southwestern Uganda. The park is famous because is one of the few remnant pieces of mountain tropical forest in the area holding populations of 12 primate species including the endangered red colobus (*Procolobus rufomitratu*s) and chimpanzee (*Pan troglodytes*). In addition to GFH and primates Kibale N.P. is also home to savanna elephants (*Loxodonta africana*), bush pigs (*Potamochoerus larvatus*) and several forest antelopes and carnivores species, among them the golden cat (*Profelis (Caracal) aurata*).

In Uganda, Kibale N.P. and the adjacent Queen Elizabeth National Park (Queen Elizabeth N.P. hereafter), hold the largest population of GFH in the country and are one of the strongholds of the populations for Eastern Africa (d'Huart and Kingdom in press). In the decade of 1970, a major study was conducted on the ecology of the species by J.P. d'Huart in Virunga National Park, DRC, a park that is the continuation of Queen Elizabeth N.P. The seminal work of d'Huart and posterior of Kingdom (1979), and Klingel and Klingel in 1995 in Queen Elizabeth

N.P. reported GFH as a highly herbivore species that lives in groups that often split in subgroups (especially subadult males or pregnant females) and that were living in highly densities (10.5 individuals per km² in Virunga National Park, DRC; d'Huart 1978) and in sometimes large groups (up to 24 individuals for Queen Elizabeth N.P.; Klingel and Klingel 2004; and 13.2 for Virungas N.P.; d'Huart 1978). It was determined that groups need an area of 5.03 km² in Virungas N.P. to fulfill its basic requirements (d'Huart 1978). However, not a study had focused yet on ecological aspects of GFH under close forest ecosystem as the Kibale N.P. It is unknown if group's size and area used remain the same and if groups have a stable composition in forest ecosystems. Therefore, in 2012 and with the great support of National Geographic Committee for Research and Exploration (grant # 9189-12), and from El Colegio de la Frontera Sur (Campeche, Mexico) this study was initiated with the goal of investigate ecological aspects of the two species of forest wild pigs (the GFH and the BP) of Kibale N.P. We aimed to investigate for GFH ranging patterns as home range, habitat use, and socioecological aspects such as group size and social behavior in relationship with foraging patterns. At the same time we wanted to investigate parasites transmission between the two species of wild pigs and the domestic pigs living on the periphery of the KNP. Here we present the main results that were obtained from two years of data collection in terms of socio-ecological aspects and movement patterns of GFH, and parasites transmission for the two species and the domestic pigs.

MATERIALS AND METHODS

Study Site

Kibale National Park (Kibale N.P. hereafter) is a 795 km² park at the foothill of the Ruwenzory mountains in southwestern Uganda (Fig. 1). The park is located at 1500 masl located in western Uganda (0°13'–0°41' N and 30°19'–30°32' E) (Chapman et al. 1997). The main vegetation type is tall-closed canopy rainforest (57%) with a mosaic of swamp (4%), grasslands (15%), pine plantations (1%), and colonizing forest (19%) (Chapman and Lambert 2000). Mean annual rainfall is 1,778 mm. Daily temperature maxima and minima averaged 23.7°C and 15.5°C, respectively, from 1990 to 1998 (Gillespie and Chapman 2001). The park is famous because is

one of the few remnant pieces of mountain tropical forest in the area holding populations of 12 primate species including the endangered red colobus (*Procolobus rufomitratus*) and chimpanzee (*Pan troglodytes*). In addition to GFH and primates Kibale N.P. is also home to savanna elephants (*Loxodonta africana*), bush pigs (*Potamochoerus larvatus*) and several forest antelopes and carnivores species, among them the golden cat (*Profelis (Caracal) aurata*). However few studies have focused on the terrestrial mammals (Naughton-Treves 2008).

Study Design

We attempted to capture and attach radiotelemetry collars to individuals of GFH for several months and with several techniques. We tried tracking them and shooting a dart filled with anesthetics, we waited for the group in salt licks or bathing points, and attempted to drive them to specific designed nets. No technique produced results and after 6 months of trying all techniques no individual was captured. Therefore, we relied on the tracking skills of our field assistants. Three field assistants (two of them former poachers) were hired and their tasks were to closely track two groups of GFH living in areas close to Makerere University Biological Station in Kibale N.P. and with the help of a handheld GPS (GPSMAP62s GARMIN, Inc, Olathe Kansas, US), collect daily data on group location, feeding habits, group composition and habitat use for GFH and additionally to sampled fresh feces of GFH and bushpigs.

Groups were tracked five days at week, three weeks per month, from June 2012 to June 2014. Location points were used to construct home ranges using Fixed Kernel with 95% of the observations and the core used areas with the 50% of observations. Fixed Kernel method was selected due to the lower effect of fixes autocorrelation and to outliers (Seaman and Powell 1996, Kernohan et al. 2001). Minimum convex polygons were also constructed as this method is very common and allows comparison with other ecological studies of home range (Kernohan et al. 2001).

Additionally, in July 2013 we deployed 8 automated camera traps (Reconyx HyperFire C800 Professional IR) in salt licks or bathing points inside the preliminary home ranges of two groups of GFH already estimated the previous year. The cameras were visited every month to

download data and check battery status. Camera settings were set up in high frequency with no delay between photos. Reconyx brand is one of the fastest cameras on the market and have a very long and sensible field of capture. Photos obtained were analyzed in terms of social and sex structure of groups. Daytime and behavior were also documented and analyzed.

Fresh feces of GFH and bushpigs were collected opportunistically while following the two groups of GFH. Feces were kept in alcohol at 70% and then standard sedimentation procedures were used to process samples at Makerere University Biological Field Station in Kibale (Tumukunde et al. unpublished data), then samples were examined to determine species composition and prevalence (proportion of individuals infected) of parasites species in GFH and bushpigs as well as domestic pigs living in the periphery of the Kibale N.P. (Tumukunde et al. unpublished data).

RESULTS AND DISCUSSION

Movement Patterns

After tracking two groups of GFH for two years we collected more than 500 location points that were used to estimate home range and habitat use. Groups of GFH are under high pressure in Kibale due to poaching (Hance 2015), therefore it was difficult to habituate the group to human presence and groups usually fled when humans approached. To avoid the spatial bias of human presence we selected only these points where the groups have been contacted for first time every day. In that way we avoid spatial locations that have been product of animals fleeing from trackers. We used these points to estimate home range. Home range was estimated at 10.7 km² (Fixed Kernel at 95% of observations) with core areas used of 2.7 km² (Fixed Kernel at 50 % of observations) and 8.8 km² using the Minimum Convex Polygon method (100% observations) (Fig 2). The groups seem to be territorial and they did not share space. Their territories seem to be fixed and animals visited all corners of the territory in approximately one-month cycles.

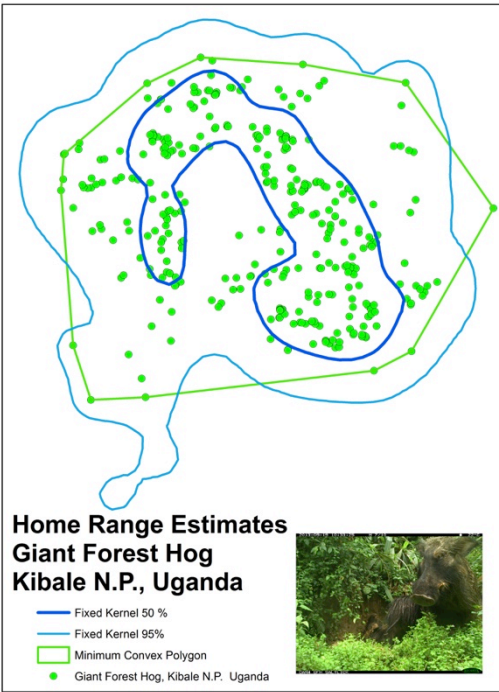


Figure 2. Home range estimated with Fixed Kernel and Minimum Convex Polygon methods for the Giant Forest Hog (*Hylochoerus meinertzhageni*) in Kibale National Park, Uganda

Habitat Preferences

Groups home range were located in forest that includes primary pre-montane forest, riverine forests, forested swamps, *Papyrus* swamps, and several open areas of secondary/regenerating forest that were the consequence of selectively logging 40 years ago (Chapman et al. 2010). These regenerating areas have only a few large trees, but they have dense thickets of shrubs, mainly composed of *Mimulopsis* spp, *Acanthus pubescens*, and *Piper* spp (Lawes and Chapman 2006). Preferred habitat type were dense bushes formed by herbaceous surrounded by mature forest. The GFH feed on at least XX species of plants with XX% of these being herbaceous species. Preferred food species observed were XXX and XXX and XXX. These plants were highly abundant in the dense bushes of the gaps surrounded by forest. Besides finding food species GFH used these dense bushes as refuge by constructing large tunnels inside that use to escape from danger in a very secretive way throught the dense thickets. GFH uses bushes as sleeping sites as well. We have found 25 sites of approximately 5 x 5 m under dense coverage where the soils have been cleaned of debris and where the groups have rested

several times. Often, there are also latrines associated to these sites separated 1 or 2 m from the sleeping sites. In addition, GFH visited salt licks and bathing points often. The preferred time is between 18:00 to 20:00 and in these sites they wallow in the mud. Due to camera trap data we have noticed that in several instances the dominant male have priority to wallow while other members wait their turn outside the mud.

Group Size and Structure

GFH were captured in camera in 28 instances and we obtained more than 500 photos of the species (see Appendix I). Group size varied from solitary individuals to 11 members of Rwembata group. Group size of Rwembata group was estimated at 11 individuals despite not always all of them were shown in the camera. It was evident that a dominant male exists but at least one or two subadult males are in the group too, the rest were between 3 to 4 adult females and 2 to 4 juveniles always present with the group. Dura group was more elusive to camera traps but tracking them we estimated that is conformed by between 10 to 12 individuals with similar sex and age structure than Rwembata group. Despite GFH forming stable groups, in several instances we have observed solitary individuals travelling alone, or females with piglets. We even observed an adult male travelling with two piglets.

Parasites Presence and Prevalence

A total of 362 fecal samples were collected during 2012, of which 127 were from bushpigs, 166 from GFH and 69 from domestic pigs living in the periphery of the park

Overall, 92.8% of the animals were infected with at least one parasite species, with 61.9% of animals being multi-infected. Fourteen parasite species were identified: *Anoplocephala* sp., *Ascaris suum*, *Eimeria deblieki*, *E. polita*, *E. scabra*, *E. spinosa*, *Fasciola* sp., *Hyostromylus* sp., *Isospora suis*, *Metastrongylus* sp., *Moniezia* sp., *Oesophagastomum* sp., *Strongyloide* sp., and *Trichuris* sp. Among these parasites, *A. suum* showed the highest prevalence (57.7%) in all three hosts species with a prevalence of 29.9% in bushpigs, 72.9% in GFH and 72.5% in domestic pigs (Taken from: Tumukunde et al. in prep).

Our results indicate that season and proximity to park influence gastrointestinal parasite communities, but these effects are more pronounced for certain host species than others. The results suggest a possibility of cross-species transmission, but further investigation is required to test this hypothesis for particular parasite taxa (Taken from: Tumukunde et al. in prep).

Brief Report on Other Terrestrial Species of Kibale National Park.

In addition to photos of GFH, camera traps allowed us the glimpse into the behavior of other species that live in the rainforest of Kibale N.P. and that are very secretive and difficult to see. Among these species are red and blue duiker (*Cephalophus weynsi* and *Philantomba monitcola*), Kibale-forest elephants groups with babies (*Loxodonta africana*), golden cats (*Profelis (Caracal) aurata*) and L'Hoesti monkeys (*Cercopithecus lhoesti*), among others.

Red duikers were the most common mammal specie captured with camera traps and its relative abundance is the highest of all terrestrial mammals' species of Kibale National Park. Red duikers prefer to feed in early hours and then again in the crepuscular hours. Blue duikers were less abundant in relation to red duikers. L'Hoesti monkey, a species though to be very rare in relationship with other primate species, was recorded in almost all camera trap stations and its relative abundance was only surpassed by the red duikers.

Camera traps also revealed group size in elephants, with the observation of two groups of 6 and 12 respectively mostly composed by females and some juveniles and newborns. Elephants like to wallow on the mud and to spray all the body with it. In addition, we were lucky to have recorded an interaction between a marsh mongoose (*Atilax paludinosus*) and a golden cat one night, with the apparent dominance of the space by the golden cat (see Apendix II).

CONCLUSIONS

This is the first ecological study on forest living GFH. Two years of tracking data reported that GFH living in forest ecosystems have larger home range than those living in mixed of forest and open areas (d'Huart 1978). GFH of Kibale N.P. depends on the dense bushes that grown in the gaps that are surrounded by forest. These areas are kept open by elephants that feed on

herbaceous species (Struhsaker et al. 1996), therefore a possible association between elephants and GFH is suggested but needs further test. Group size in Kibale N.P. is smaller than reported elsewhere (Virungas N.P and Queen Elizabeth N.P.; d'Huart and Kingdom in press) but social structure is similar than groups living in open areas.

GFH in Kibale N.P. are under high poaching pressure (Hance 2015; PI pers. obs.) and the population of the park could be eliminated in the near future. Losing the population of GFH of Kibale N.P. would mean to lose one of the stronghold of the Uganda population and also the only one left living in forest ecosystem.

Conserving the GFH of Kibale N.P. and the terrestrial fauna of the park would assure that ecosystem process are carried out and the park maintains its integrity. It also means that the largest of the pig of the world would be roaming secretively for many years more and would amaze the future generations by moving quietly but coordinately across Kibale N.P.

Ugandan rainforest, as well as all eastern African rainforest, are facing great pressure from the growing human population and are being encroached every day (Plumptree et al., 2007). In addition, terrestrial mammals face great pressure from poachers when they set snares traps mostly for ungulates, but these traps can harm other species such as chimpanzees, L'Hoesti monkeys and baboons, as well as elephants (Hance 2015). For example, in a single trip of the snare removal team of Kibale, they have removed 59 snares in only four days patrolling Kibale National Park (J. T. Okwilo Snare removal team chief, pers. comm.). It is urgent to study and protect the terrestrial mammal community of Kibale rainforest as it may be the stronghold of the population of species that otherwise have been extirpated almost elsewhere, i.e. giant forest hog, L'Hoesti monkey. Understanding the basic ecological information such as relative abundance, group size and behavior, and habitat and space requirements of these species are fundamental to elaborate conservation plans designed for them. This study with the great support of the Committee for Research and Exploration from National Geographic intended to supply pieces of that information.

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**APENDIX I. PHOTOGRAPHIC RECORD OF
GIANT FOREST HOG (*Hylochoerus
meinertzhageni*) OF KIBALE NATIONAL
PARK, UGANDA**







**APENDIX II. PHOTOGRAPHIC RECORD OF
TERRESTRIAL MAMMALS OF KIBALE
NATIONAL PARK, UGANDA**

*Elephants in mud baths and one with a
snare scar in the trunk*





Golden cat and Mongoose





2014-04-03 18:28:29 M 3/5 24°C
CAM7 GFH TRAIL
2014-02-08 13:32:40 M 2/10 23°C
Salisbury National Geographic ECOSUR



2013-12-30 15:54:55 M 5/10 24°C
CAM4 GFH SALT LICK
2013-09-02 12:44:14 M 4/5 21°C



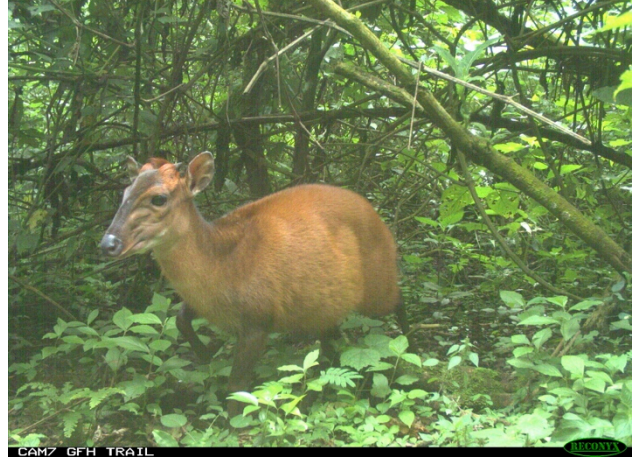
CAM4 GFH SALT LICK
2013-10-27 11:11:42 M 1/10 23°C



CAM7 GFH TRAIL
2014-05-03 15:34:56 M 10/10 20°C



CAM4 GFH SALT LICK



CAM7 GFH TRAIL



