Sightings and Habitat Use of the Northern Lesser Galago (*Galago senegalensis senegalensis*) in Niumi National Park, The Gambia

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Abstract: Galago senegalensis have the widest distribution of any nocturnal primate in Africa, extending from Senegal through to East Africa, a distance of over 7000 km. Yet few field studies of this species are published. Here we present the first field study from The Gambia, in the westernmost part of their geographical range. The study was conducted in Niumi National Park from 28 April to 12 May 2012. We aimed to determine whether there are any differences in the habitat use and characteristics of G. senegalensis in The Gambia compared to elsewhere, and to assess possible conservation threats. We took systematic measures of heights used by galagos during their activity, their grouping tendencies, sleeping site use and *ad libitum* observations of behaviour and pelage colour. We collected 703 data points related to habitat use and inter-individual distances. Galagos used all vegetation strata from the ground to 15 m with a modal height of 4-6 m. Animals slept alone on 30% of the observations and in groups on 70%. Twenty-four calls were recorded. Calls were similar to those recorded for other populations of G. senegalensis but pelage coloration differed from other populations. In The Gambia, G. s. senegalensis was more social during their active period compared to G. s. braccatus. Individuals of G. s. senegalensis were observed solitary in 40% of the encounters and in groups of ≥ 3 individuals in 23%. The galagos in Niumi NP were observed near human settlements, and were not reported to be hunted. However, there is concern that the natural vegetation is being undermined by high levels of anthropogenic disturbance, specifically trampling of the undergrowth by cattle, thus decreasing the preferred habitat for galagos. Niumi NP provides an ideal location for long term studies of G. s. senegalensis.

Key words: behaviour, biogeography, bushbabies, conservation, grouping tendences, Strepsirrhini

Résumé: *Galago senegalensis* est le primate nocturne africain avec la distribution géographique la plus large, s'étendant du Sénégal au l'Afrique de l'Est, une distance de plus de 7000 km. Pourtant, peu d'études de cette espèce ont été publiées. Nous présentons ici le premier étude de Gambie, dans la partie occidentale de son aire de répartition géographique. L'étude a été menée dans le parc national Niumi du 28 Avril au 12 mai 2012. Nous avons voulu déterminer s'il existe des différences dans l'utilisation de l'habitat et les caractéristiques de *G. senegalensis* en Gambie par rapport à d'autres sites d'étude et évaluer les menaces possibles pour la conservation de l'espèce. Pendant cette étude, nous avons pris des mesures systématiques des hauteurs utilisées par les galagos au cours de leur activité, leurs tendances de regroupement, leur utilisation des sites pour dormir, et des observations ad libitum de comportement ainsi que leur vocalisation et la couleur du pelage. Nous avons recueilli 703 points de données liés à l'utilisation de l'habitat et les distances inter-individuelles. Les galagos utilisent toutes les couches de la végétation à partir du sol jusqu'à 15 m, avec une hauteur modale de 6,4 m. La hauteur moyenne des arbres et l'espacement étaient 5,4 m et 3,8 m respectivement. Les animaux dormaient seuls de 30 % des observations et en groupe de 70 %. Vingt-quatre appels ont été enregistrés. Les appels étaient similaires à ceux enregistrés pour *G. senegalensis* ailleurs en Afrique, mais la coloration du pelage était différente des autres *G. senegalensis*. En Gambie, *G. s. senegalensis* était plus sociable au cours de la période d'activité par rapport

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à *G. s. braccatus. G. s. senegalensis* n'a été observé solitaire que dans 40 % des rencontres et en groupes de \geq 3 individus dans 23 % des rencontres. Les galagos dans le parc national Niumi ont été observé à proximité des villages, et n'ont pas été indiqué à être chassées. Cependant, il est à craindre que la végétation naturelle soit diminuée par des niveaux élevés de coupe sélective, le surpâturage et le défrichement des terres pour les cultures. Une préoccupation est le piétinement des sous-bois par les vaches, réduisant ainsi l'habitat de prédilection des galagos. Le Parc National Niumi offre un emplacement idéal pour les études à long terme de *G. s. senegalensis*.

INTRODUCTION

Galagos (bushbabies) are nocturnal primates distributed throughout sub-Saharan Africa from Senegal to South Africa, and are found in forest, woodland, and savannah habitats. Some 24 species are currently recognised (Bearder et al. 2008; Nekaris & Bearder 2011; Nekaris 2013), an increase from the previous six acknowledged species in the genus (Osman Hill 1953). The species with the widest distribution, Galago senegalensis, extends from western Senegal (G. s. senegalensis) through to Kenya, Tanzania, and Ethiopia in the east (G. s. sotikae, G. s. braccatus and G. s. dunni), a distance of over 7000 km (Nash et al. 2013). Yet field studies of this species cover only a small number of populations in the eastern part of their geographical range (e.g., Haddow & Ellice 1964; Butler 1967; Nash & Whitten 1989; Ambrose 2002; Off et al. 2008; Butynski & de Jong 2012). Data are also available from museum specimens (Jenkins 1987; Masters & Bragg 2000; Masters & Brothers 2002) and from individuals kept in captive colonies (Izard & Nash 1988; Zimmermann 1989).

Here we present the first field study of *G. senegalensis* in The Gambia, at the westernmost part of their geographical range. During this study we aimed to: 1) determine whether there are any differences in the habitat use and characteristics of *G. senegalensis* in The Gambia compared to elsewhere, and 2) assess possible conservation threats to the population of *G. senegalensis* under study.

The Gambia has progressive wildlife laws whereby all wildlife species, regardless of their conservation status, are protected. All activities not compatible with protected area status are prohibited under the Biodiversity/ Wildlife Act 2003, including illegal hunting and felling of trees within national parks (Nije *et al.* 2011). There are currently eight protected areas in The Gambia, covering 4.27 % of the country's land area (Camara 2012). Understanding the habitat use of *G. s. senegalensis* and identifying the conservation threats they might face in The Gambia is crucial for planning effective conservation management strategies.

METHODS

Study area

The study was conducted in Niumi National Park on Jinack Island, on the shores of the Atlantic Ocean (13° 33' N 16° 31' W), about six kilometres north of the capital Banjul (Figure 1). Niumi NP is one of only two national parks on the northern shore of the Gambia River. Jinack Island is separated from the mainland only by the narrow river Niji Bolon and Niumi NP encompasses almost the whole island. The Niumi NP was gazetted in 1986 and is contiguous with the Delta du Saloum National Park and Biosphere Reserve in Senegal. The terrestrial part of this Gambian national park covers an area of 49.4 km² (Nije et al. 2011). The vegetation is mainly open woodlandsavannah adjacent to the coast, dominated by tree species such as baobabs (Adansonia digitata), bembé (Lannea acida), gingerbread plum (Neocarya macrophylla), African locust bean tree (Parkia biglobosa) and West African copal (Daniellia oliveri), as well as shrubs such as acacias (Acacia albida), red spike thorn (Maytenus senegalensis), prickly-ash (Zanthoxylum Senegal zanthoxyloides), Combretum nigricans and sicklebush (Dichrostachys glomerata). The last two shrubs tend to be dominant in areas where there has been clearance for agriculture in the past. The natural vegetation has been increasingly degraded by human activities. In previous generations, before the declaration of Niumi NP, the human population living within the park cleared land for rice cultivation, watering collecting points, and grazing of their animals. Since then, these activities have expanded every year (Nije et al. 2011). Uncontrolled grazing by cattle and donkeys is still occurring within the National Park, as well as selective cutting, fruit collection and the planting of exotic trees, including the neem tree (Azadirachta indica), cashew trees (Anacardium occidentale), mangoes (Mangifera indica) and blue gum (Eucalyptus globulus). Onions, maize, rice, and cannabis are cultivated and irrigated from deep wells dug into the sand. These wells indicate that the water table has dropped in recent years, as the wells are drying up.

Data Collection

The study was conducted from 28 April to 12 May 2012, at the end of the dry season, which extends from November to May. We used Petzl Zoom head torches with red filters to observe the galagos, aided by the galago's yellow/orange eye reflections. The use of red light allowed us to observe the animals without disturbing them, as red light is invisible to them. It also allows the observer to develop better night vision (Charles-Dominique & Bearder 1979; Nekaris 2003). Pilot surveys



Figure 1. Map of The Gambia showing the location of the Niumi National Park.

were conducted in cashew plantations near one of the two villages within the National Park, but the broad leaves of cashews made observations difficult so we moved to an area of natural vegetation further south. The grazing activities of domestic animals in the area produced many pathways, giving us easy access when following the galagos. We followed individuals away from their sleeping sites each evening and back again at dawn. Most observations were within three hours after dusk and three hours before dawn, but one all-night session was conducted on the night of the full moon (5 May 2012). The total survey effort accounted for 70 hours.

We approached the animals slowly and carefully until they ignored our presence, usually after about 45 min. It was then possible to follow them for up to two hours at a time. If the animal was lost, it was nearly always possible to find another within a few minutes. We recorded the estimated height of each individual at first sighting, and then at five minutes intervals for as long as possible. At each interval we noted whether the animal was travelling alone or with others, and whether there was any physical contact with other individuals. We recorded travelling "with others" when two or more individuals were travelling at a distance of \leq 20 from each other. We also recorded data on sleeping site use, including numbers of individuals and time of entry and exit.

We noted behaviours ad libitum, including foraging, feeding, locomotion, social interactions, and mating (Bearder & Doyle 1974; Nash 2003). Animals were photographed extensively, enabling us to examine their pelage characteristics and proportions for comparisons. When we heard vocalising, we noted time, call type, the vocalization context and associated behaviour. Calls were recorded with a Marantz PMD222 cassette recorder and Sennheiser K6 microphone with an ME67 directional extension.

For the vegetation survey we employed the method of point-quadrat sampling (Ganzhorn 2003). We established sampling points randomly 50 m apart along compass bearings within the study area. As galagos use a wide range of strata, we included all trees and shrubs. We measured the distance from the sampling point to the nearest tree or shrub in each quadrat, together with tree height and the diameter at breast height (DBH).

RESULTS

Out of the 70 hours of surveying we followed galagos for a total of 58 hours, during which we collected 703 5-minute interval-samples relating to habitat use and inter-individual distances. All animals we observed appeared to be adults, based on body proportions (Oates 2011; Nash et al. 2013), and one female appeared to be pregnant. The pelage of the galagos was pale grey, with the tail noticeably darker than the body. Circum-occular markings were circular and the ears were relatively small in comparison to other populations of G. senegalensis (Nash et al. 2013). The galagos used all available strata from ground level to 15 m. The mean height use observed was $4.1 \pm$ SD 2.5 m (Figure 2). One galago was observed to leap six meters between trees. On 10 occasions we observed an individual crossing on the ground for up to 25 m by means of bipedal hopping.

The galagos left their sleeping sites on average 17 minutes after sunset (n = 11) and returned again on average 41 minutes before sunrise (n = 9). We observed individuals using two different sleeping sites: one 5 m up in a dense tangle of the climber *Zanthoxylum zanthoxyloides* surrounding a dead tree, the other in a



Figure 2. Height use of G. s. senegalensis and tree heights based on vegetation survey.

hole at 1.5 m in a dead stump. A further two potential sleeping sites were indicated by an individual that investigated the known sleeping hole during the night and then entered two new tree holes within a 30 minute period; one 2 m up on a tree trunk and the other at 1.5 m in a hollow stump.

Animals slept alone on 6 occasions (30%) and with one or more others on 14 occasions (70%). During their active period individuals were observed alone in 40% of the encounters, in pairs in 37%, and in groups of \geq 3 individuals in 23% of the encounters (Figure 3).

On four nights we observed a male maintaining close contact with a female, associated with copulations lasting

three to seven minutes. These included pelvic thrusting and grasping. No vocalisations were heard and the pair was only once joined briefly by another individual. We observed feeding on insects in the trees and on the ground, where animals searched the leaf litter. Fruit eating and gum licking were both photographed (Figure 4). Urine washing was not observed.

Twenty-four bouts of calling were recorded. Calls were typically brief, lasting a few seconds, with only one bout of calling lasting 30 minutes (n = 38). Based on the call types described by Zimmermann *et al.* (1988), six call types were heard: yaps (Fwa), honks (Woo1), explosive coughs (Tjong), buzzing coughs (no equivalent),



Figure 3. Number of G. s. senegalensis involved in grouping whilst active at night and at sleeping sites.



Figure 4. Galago. s. senegalensis eating fruits of Lannea acica and consuming gum.

sneeze (Ft) and gewit (Fwa variant). Calling was most frequently associated with antagonism and chasing, with the calling individual fleeing and descending towards the ground. Calls used in this context were yaps, gewits, and explosive coughs. Honking calls were given in the context of reassembly at dawn and also soon after leaving the sleeping site at dusk. The buzzing coughs were heard in association with yaps and explosive coughs, whilst sniffs were made when attempting to jump close to the observer.

We surveyed 20 randomly distributed point quadrat sampling plots, measuring a total of 80 trees, including shrubs. The mean vegetation height was $5.4 \pm$ SD 3.4 m (range 1 - 16 m; Figure 2). The mean DBH of trees was $11.23 \pm$ SD 4.54 cm (range 3.74 - 19.26 cm). The mean distance between trees was $3.8 \pm$ SD 2.6 m (range 0.2 - 11.2 m), indicating an average tree and shrub density of 1,912 trees/ha.

DISCUSSION

Figure 5 compares the facial markings and body pelage of the study animals to G. moholi (once considered a subspecies of G. senegalensis; Nash et al. 2013) and Kenyan G. s. braccatus and G. s. sotikae. Galago moholi has diamond-shaped, as opposed to the round circumoccular markings of G. s. braccatus, G. s. sotikae and G. s. senegalensis. The light grey pelage of G. s. senegalensis is the least colourful within the species, lacking the yellow/ russet colouring on the limbs of G. s. sotikae and G. s. braccatus. The tail of G. s. senegalensis is grey-brown in colour and noticeably darker than the body, as in the other three galagos. Our impression was that the study animals were similar in size to G. moholi (average weight ~200 g) and smaller than G. s. braccatus (average weight 315 g in males and 250 g in females) (Izard & Nash 1988; Pullen 2000).

The animals were seen relatively low down at our study site with a mean height of 4.1 m compared to 7.4 m for G. s. braccatus in Kenya (Off et al. 2008), and to G. s. senegalensis in Uganda, which was observed mainly at 10-12 m (Ambrose 2002). Our findings resemble those of Nekaris and Bearder (2011) with proposed heights of 1-4 m as the most used strata in G. senegalensis. In our study, G. s. senegalensis used substrates below 10 m almost exclusively (96.5%), whilst Off et al. (2008) found that G. s. braccatus occurred below 10 m in 59% of the observations (Off et al. 2008). Both G. s. braccatus and G. s. senegalensis were observed on the ground for less than 3% of all observations. The use of lower strata at Niumi NP might be related to the area being highly affected by human activities and the low occurrence of taller trees (mean vegetation height was 5.4m).

Galago senegalensis are known to use both tree hollows and dense tangles of vegetation as sleeping sites, as well as building nests (Haddow & Ellice 1964; Bearder *et al.* 2003; Butynski & de Jong 2012). Although tree hollows were observed as sleeping sites in this study, *G. s. senegalensis* slept mostly in a dense tangle of vegetation, which is consistent with other subspecies of *G. senegalensis* (Bearder *et al.* 2003; Off *et al.* 2008; Nekaris & Bearder 2011). This choice of a densely shaded sleeping site may provide protection from the sun and easy escape routes from diurnal predators (Bearder *et al.* 2003).

In The Gambia, *G. s. senegalensis* was more gregarious during the night compared to studies by Off *et al.* (2008) on *G. s. braccatus* and by Haddow and Ellice (1964) on *G. s. senegalensis* in Uganda. In our study, *G. s. senegalensis* was observed alone in only 40% of the encounters, whereas *G. s. braccatus* was solitary on 81% of encounters (Off *et al.* 2008), and the Ugandan *G. s. senegalensis* on 56% (Ambrose 2002). Furthermore, *G. s. senegalensis* in The Gambia was observed in groups of \geq 3 individuals



Figure 5. (a) *G. s. senegalensis* in The Gambia, (b) *G. s. sotikae* in Kenya, (c) *G. s. braccatus* in Kenya, (d) *G. moholi* in South Africa (5a & d by S.K. Bearder, 5b & c by Y. de Jong and T. Butynski).

on 23% of the encounters, whilst *G. s. braccatus* only 3% (Off *et al.* 2008) (Figure 3). The difference in sociality compared to the eastern *G. senegalensis* populations may have been influenced by the timing of the study, as this study was conducted during the mating season.

We observed chasing and mating at the beginning of May, and a female appeared in a late stage of pregnancy. Previous studies of G. senegalensis in Sudan (Butler 1967) point to seasonal breeding, and this is probably also the case in The Gambia. The gestation length for *G*. s. braccatus is recorded as 141-142 days with 92% single births (Izard & Nash 1988). Given a similar gestation for G. s. senegalensis, a birth period around mid-June (based on the pregnant female) to mid-September (based on observed mating) is indicated. Further observations are required to confirm the timing of births, particularly towards the end of June and around mid-September. The apparent absence of urine washing during this survey is unusual and deserves further study. Urine washing is normally common in galagos and is thought to enhance grip when moving in dry habitats (Harcourt 1981; Nash et al. 2013). Most calls were similar to those recorded for G. senegalensis elsewhere in Africa, although the buzzing coughs have never been recorded in any G. senegalensis previous to this.

In this study, galagos were seen searching for and eating insects and gum and the fruits of *Lannea acida*, but the relative proportions of each are not known. *Galago senegalensis* is known to eat insects, fruits and gums, but few detailed studies have been conducted on their diet (Nekaris & Bearder 2011; Oates 2011; Nash *et al.* 2013). Fruit eating is rare in the closely related *G. moholi* and is infrequently reported in the diet of *G. senegalensis*, although Kingdon (1971) and Nekaris (2013) note feeding on fruits of *Tamarindus* (Fabaceae), *Sclerocarya* (Anacardiaceae) and *Balanites aegyptiaca* (Zygophyllaceae).

The people in and around Niumi NP seemed to have limited knowledge about the galagos and were often unaware of their existence. A few people had seen their eye-shine when using torches at night, but they had not associated this with a primate. The galagos occur in Niumi NP despite high anthropogenic disturbance. There is concern that the natural vegetation is being increasingly depleted by high levels of selective cutting, over-grazing and land clearance for crops. Of specific concern is the uncontrolled activity of cattle and donkeys. This inhibits the normal regeneration of vegetation and protection of the sand dunes bordering the coast. With progressive wildlife laws under the Biodiversity/Wildlife Act 2003 already in force in The Gambia, the problem is evidently one of enforcement.

This brief study provides a starting point towards understanding similarities and differences between populations of *Galago senegalensis*, and we hope that the data presented here will provide baseline information for longer-term studies. We consider Niumi NP as an ideal location for long term studies to investigate galago ecology, behavior, and conservation status in more detail.

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