A pilot study of *Galago senegalensis senegalensis* on Jinack Island, Niumi National Park, the Gambia, 27 April to 15 May 2012

Report to the Nocturnal Primate Research Group

Magdalena Svensson and Simon Bearder,

Faculty of Humanities and Social Sciences, Oxford Brookes University (m.svensson@brookes.ac.uk; skbearder@brookes.ac.uk)

Abstract

Lesser galagos (bushbabies; *Galago senegalensis senegalensis*) were studied for the first time in the field on the coast of the Gambia at the end of the long dry season. We observed the animals with red torchlight for 30 hours and recorded aspects of their behaviour at 5 minute intervals, together with photography and tape recording. We also conducted a vegetation survey of their preferred habitat. Bushbabies utilised all vegetation strata from the ground to 15 m with a modal height of 4-6 m. Average tree height and spacing was 5.4 m and 3.8 m. Individuals usually foraged alone but were seen together on 21% of observation intervals and were seen mating on 4 nights. One animal appeared to be pregnant. Individuals occupied a tree hollow during the day and groups of up to 5 slept together in a dense climber on 22 consecutive days. Fruit eating was confirmed for the first time and there was a complete absence of urine washing behaviour. Calls were similar to those recorded for *G. senegalensis* elsewhere in Africa but pelage colouration differed from *G. s. braccatus*. The study site and facilities are ideal for a more detailed study with radio tracking but the natural vegetation is increasingly encroached by human activities and the water table appears to be dropping.

1. Introduction

Bushbabies (galagos) are nocturnal primates distributed throughout sub-Saharan Africa from Senegal to South Africa. Some 24 species are currently recognised from forests, woodlands and savannahs (Bearder 1999; Bearder *et al*. 2008). The species with the widest distribution, *Galago senegalensis*, extends from western Senegal (*G. s. senegalensis*) to Kenya (*G. s. bracccatus*), a distance of over 7000 km, yet field studies of this species are rare and only relate to Sudan and Kenya (Haddow & Ellice 1964; Butler 1967; Nash & Whitten 1989; Off, Isbell & Young 1998). Limited data are also available from museum specimens (Masters & Bragg 2000; Masters & Brothers 2002) and in captivity (Izard & Nash 1988; Zimmermann 1989). Tape recordings of its calls are available from Kenya, Uganda and Ghana, but the extent of call variation within this species remains unknown (Zimmermann 1985; Zimmermann *et al*. 1988).

This pilot study aims to measure behaviour, ecology and morphology in the Niumi National Park, the Gambia, for comparison with populations elsewhere in Africa and those held in captivity in European Zoos. We hope to establish whether there is significant variation between populations that may indicate whether they can be housed together in captivity and whether the structure of their calls varies across their geographical range (dialects).

As this is the first field study of *G. s. senegalensis* we also wanted to document other aspects of their behaviour. During this short study we concentrated on systematic measures of heights used by bushbabies during their activity, their grouping tendencies, sleeping site use and reproductive behaviour. We also surveyed the structure of the vegetation and took photographs and tape recordings wherever possible.

2. Study Site and Methods

This study was conducted in the Niumi National Park on Jinack Island, the Gambia (13° 33' N 16° 31' W). The National Park is situated on the north shore of the river Gambia, around six kilometres north of the capital Banjul (Fig. 1).

The vegetation is mainly open woodland-savannah adjacent to the coast, dominated by tree species such as; baobabs (*Adansonia digitata*), bembé (*Lannea acica*), gingerbread plum (*Neocarya macrophylla*) and West African copal (*Daniellia oliveri*) as well as shrubs such as; acacias (*Acacia albida*), red spike thorn (*Maytenus senegalensis*) and Senegal prickly-ash (*Zanthoxylum zanthoxyloides*). The natural vegetation is increasingly being degraded by human activities (uncontrolled grazing by cattle and donkeys, selective cutting and the planting of exotic trees, including the neem tree (*Azadirachta indica*), cashew trees (*Anacardium occidentale*), mangoes (*Mangifera indica*) and blue gum (*Eucalyptus globulus*) and farming of onion, maize and rice). Irrigation from wells dug into the sand shows that the water is dropping in recent years, as the wells are drying (Fig. 4). The study was conducted towards the end of the dry season which extends from November to May.

Figure 1. Map from Google Earth indicating the study site, Jinack Lodge and the village of Jinack Niji.

Sympatric mammals include hyenas (*Crocuta crocuta*), slender mongoose (*Galerella sanguinea*), patas monkeys (*Erythrocebus patas*), vervet monkeys (*Chlorocebus sabaeus*), rabbits (Leporidae), squirrels (Sciuridae), fruit bats (Pteropodidae) and African clawless otter (*Aonyx capensis*). There were also unconfirmed reports of honey badgers (*Mellivora capensis*). Crocodiles and sea turtles are common and there is a famously rich avifauna.

We observed the bushbabies with red light from a Petzl Zoom head torch, aided by the brilliant reflection from their eyes. The use of red light is important because it is invisible to the animals, whereas white light causes their pupils to contract and they look away and retreat. It also allows the observer to develop full night vision (Charles-Dominique & Bearder 1979).

Our first nightly survey was conducted in cashew plantations near the village of Jinack Niji, where several animals were sighted, but viewing was made difficult by the dense vegetation. We then surveyed an area of mainly natural vegetation further south which proved to be ideal as the main study site. We approached the animals slowly and carefully until they

ignored our presence, after approximately 45 min. After that it was possible to follow them for longer periods (up to a maximum of 2 hours in one case). The uncontrolled grazing of cattle resulted in many pathways, giving easy access when following the bushbabies.

Most observations were within 3 hours after dusk and before dawn, but one all night session was conducted on the night of the full moon (5 May 2012). We routinely noted the state of the moon and the weather conditions each night.

2.1 Vegetation Survey

The method of point-quadrat sampling was employed for the botanical survey (Ganzhorn, 2003). Sampling points were established randomly 50 m apart along compass bearings within the study area. At each point a long stick was thrown into the air and a second stick placed at 90° to form four quadrats. The distance was measured from the centre to the nearest tree in each quadrat, together with the height of the tree and its diameter at breast height (DBH).

2.2 Height use, Grouping and Sleeping Sites

We followed the animals away from their sleeping sites each evening and back again at dawn. We recorded the height of each individual when first seen, and then at five minutes intervals for as long as possible. We also recorded the heights of other animals seen. At each interval we noted whether the animal was travelling alone or with others, and whether in physical contact.

2.3 Calling Patterns

All call types were noted and recorded where possible with a Marantz PMD222 cassette recorder and Sennheiser K9 microphone with an ME67 directional extension. We noted the time of the calls and their contexts and associated behaviour.

2.4 Other Behaviours

Behaviour was sampled *Ad libitum*, including foraging, feeding, locomotion, social interactions and mating. Behaviours were photographed wherever possible with a Canon EOS 600D camera, Canon 70-200 EF zoom lens and a Canon Speedlight 430EX II flash.

3. Results

3.1 Vegetation Survey

We surveyed 20 randomly distributed point quadrat sampling plots, with measures of 80 trees. The average tree height was 5, 4 m, ranging between 1 - 16 m (Fig. 2). The average distance between trees was 3, 8 m, ranging between 0, 2 - 11, 2 m (Fig. 3) indicating an average tree density of 1912 trees/ha. The tree cover, pathways and coastline are clearly visible using Google Earth (Fig. 4).

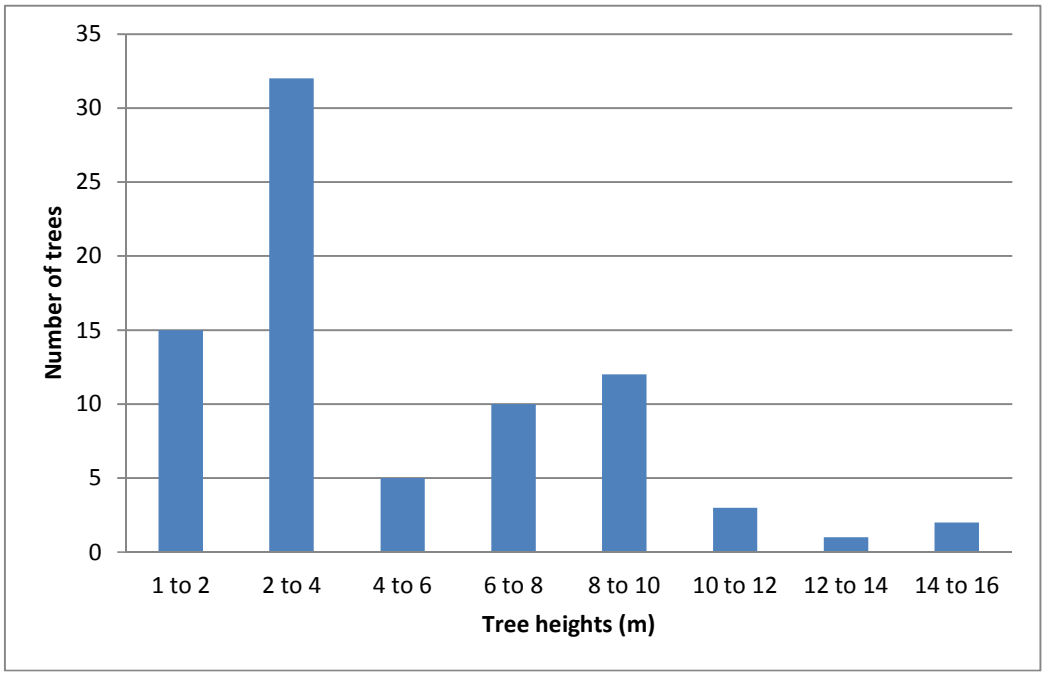

Figure 2. Heights of trees

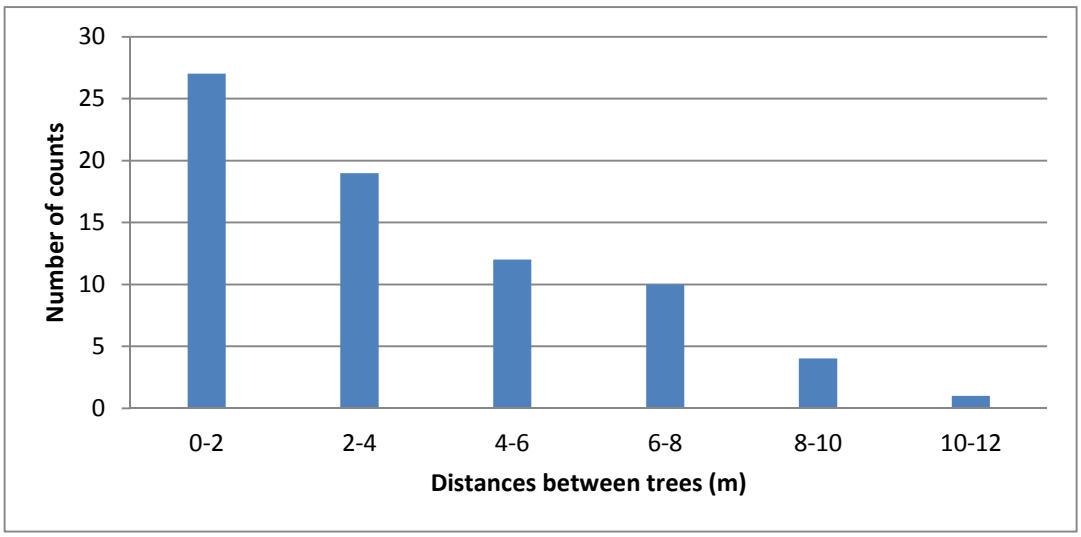

Figure 3. Distance between trees

Figure 4. Map over the study site between the ocean and farmed land. Open wells dug into the sand can be seen as white circles.

3.2 Height use, Grouping and Sleeping sites

We followed the bushbabies for a total of 30 hours from (28 April – 12 May 2012), during which we recorded 703 individual heights and measures of proximity. They used all strata from ground level to 15 m. Preferred heights are shown in Fig. 5.

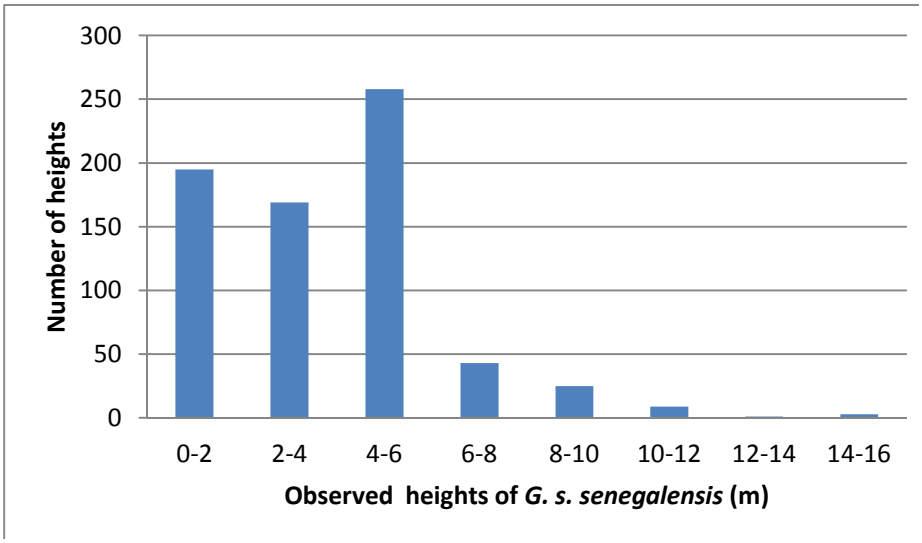

Figure 5. Height use of *G. s. senegalensis*

In addition to sleeping in groups (see below), individuals were seen in close association on 154 of the 703 recorded five minute intervals (21%). They were in physical contact during 25 intervals (see mating behaviour below). The number involved in each grouping is indicated in Fig. 6.

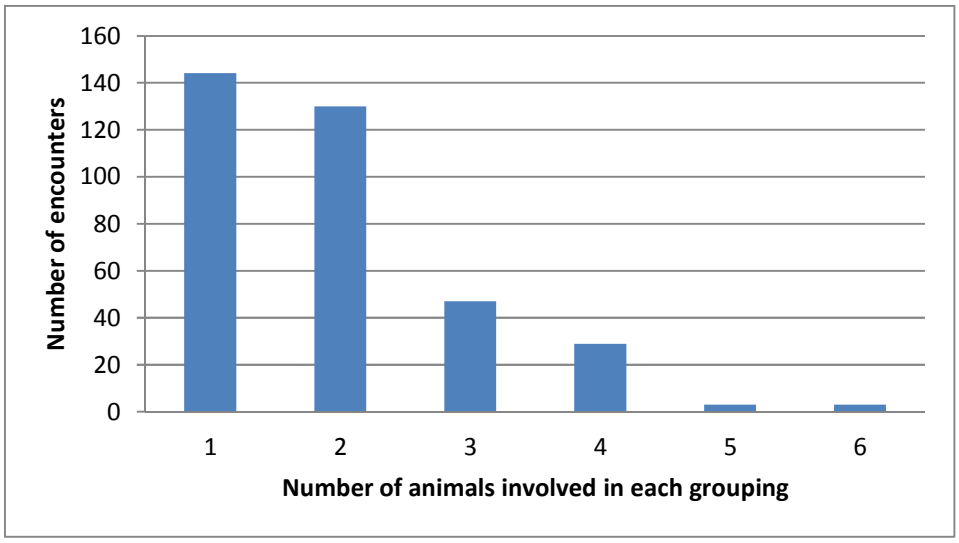

Figure 6. Number of animals involved in each grouping at night

The animals left and returned to their sleeping sites within a few minutes of the time that the observers could see colours. This was on average 17 minutes after astrological sunset (N=11) and 41 minutes before astrological sunrise (N=9) (Chenaiiq, 2007).

We observed individuals returning to two sleeping sites at dawn; one 5 m up in a dense tangle of the climber Senegal prickly-ash (*Zanthoxylum zanthoxyloides*) surrounding a dead tree and a hollow stump with a hole at 1, 5 m (see Fig. 7 & 8). A further two potential sleeping sites were indicated by one animal seen investigating a known site followed by two new tree hollows within a 30 minute period, a hollow 2 m up on a tree trunk and another hollow tree stump at 1,5 m .

On one occasion we observed displacement of individuals when several *G. s. senegalensis* arrived at the sleeping site at dawn. Eight animals entered the sleeping tree, however only five of the individuals remained in the tree, the other three had to leave, and one was seen entering a hollow tree stump instead.

Figure 7. Tree hole used as a sleeping site

Figure 8. *Zanthoxylum zanthoxyloides* used as a sleeping site

Sleeping site use was observed on 12 days at the two sites. Animals slept alone on 7 occasions and in groups on 16 occasions (Fig. 9).

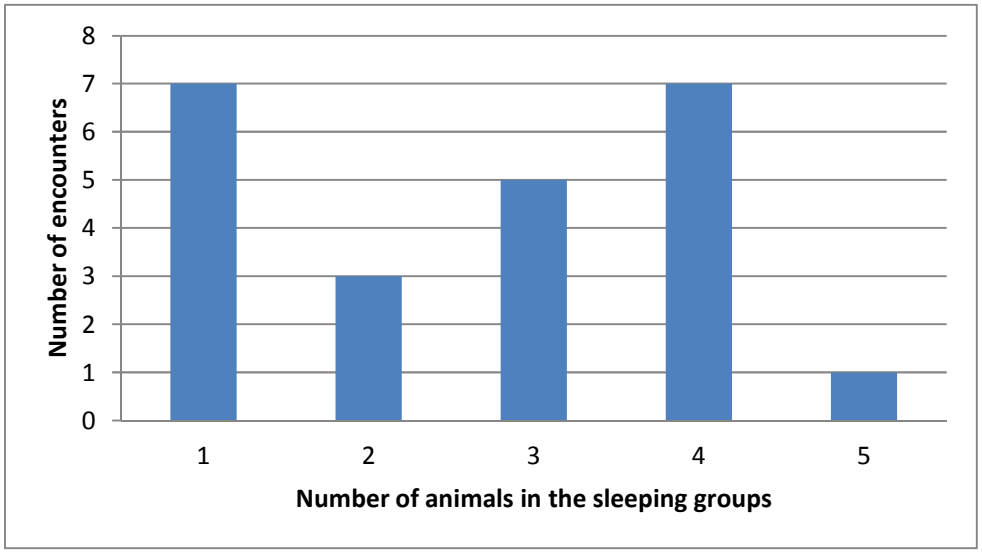

Figure 9. Groupings at sleeping sites

3.3 Calling Patterns

Calls were typically brief, lasting a few seconds with only one bout of calling lasting 30 minutes (N=38). Six call types were heard (Table 1). Twenty four of these calls were recorded for further analysis and comparison with populations in other parts of Africa.

Table 1. Calls made by *G. s. senegalensis* in Niumi National Park. Call names from Zimmermann *et al* (2008).

Call type	Bouts heard
Yaps (Fwa)	17
Honks (Woo 1)	8
Explosive coughs (tjong)	6
Buzzing coughs (?)	4
Sneeze (Ft)	2
Gewit (Fwa variant)	1

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.

3.4 Other Behaviours

3.4.1 Foraging and feeding

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 (Fig. 10 & 11).

Figure 10. *G. s. senegalensis* eating fruits of *Lannea acica*

Figure 11. *G. s. senegalensis* consuming gum

3.4.2 Social interactions and mating

We noticed that pairs of animals sometimes moved together and groomed each other, chased and played. Grooming and chasing were common in and around the sleeping sites at dawn and dusk. On four occasions we observed courting and prolonged copulation from three to more than five minutes. This included pelvic thrusting and grasping (Fig. 12 & 13). The dates were 2 May, 3 May and 4 May and again on 10 May. The mating pair was alone except for one brief interaction with a third individual when short bouts of yapping were heard. Otherwise the mating bouts were quiet. One animal photographed appeared to be pregnant (Fig. 14).

Figures 12 & 13. Mating *G. s. senegalensis*

Figure 14. A pregnant-looking *G. s. senegalensis*

3.4.3 Locomotion

Two notable facts emerged concerning the way the animals moved through the trees. First, on the night of the full moon we were able to measure a leap between trees of 6 m. Second, Urine washing, normally common in galagos and thought to enhance grip in dry habitats (Nash in press), was never observed.

4. Discussion

4.1 Comparisons with Other Populations

Fig. 15 compares *Galago moholi*, *G. s. braccatus* and the study animal. *G. moholi* has relatively larger and darker ears and diamond-shaped as opposed to round eye-markings. The pelage of *G. s. senegalensis* is the least colourful of the three and the tail is noticeable darker than the body. Our impression was that the study animals were similar in size to *G. moholi* (< 200 g) and smaller than *G. s. braccatus* (> 200 g) (Nash *et al*. 1989). This study confirms for the first time that *G. s. senegalensis* eats fruit (unlike *G. moholi*) and the apparent absence of urine washing is unusual. These differences have implications for captive management in zoos.

Figure 15. From left to right: *G. moholi* (South Africa), *G. s. braccatus* (Kenya) (from: http://www.wildsolutions.nl/) and *G. s. senegalensis* (the Gambia).

Different species of bushbabies are known to be distinguished by distinct vocal profiles (a set of structurally different call types). Initial comparison of the calling patterns indicates that *G. s. senegalensis* shares essentially the same vocal profile as *G. s. braccatus,* which differs from the vocal profile of *G. moholi* (Zimmermann 1985; Zimmermann *et al*. 1988). Both subspecies made buzzing honks (also called woo1) at dawn and dusk (vocal advertisements). Despite the overall similarity in the call repertoires, one call heard in the Gambia appeared to be unusual, the buzzing cough. Further and more detailed comparisons of the call repertoires are needed.

4.2 Reproductive Behaviour

We observed mating on the 2-4 May and the 10 May 2012 and all the animals seen at the study site were adults. Previous studies of *G. senegalensis* in Sudan (Butler, 1967) indicate seasonal breeding, and this is probably 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-September is indicated. However, we also saw one animal that looked pregnant and it is expected that a second birth period may coincide with the start of the rainy season (mid-June). Further observations

are required to confirm the timing of births and frequency of twinning, particularly towards the end of June and around mid-September.

5. Conclusion (further study)

Jinack Island provides and ideal location for a more detailed field study of *G. s. senegalensis* with the aid of radio tracking. The area is easily accessible, with good visibility and an established system of pathways and we benefitted from interest and ecological expertise of local people. However, there is concern that the natural vegetation is being undermined by high levels of selective cutting, over grazing and land clearance for crops. The increasing human population and the digging of ever-deeper wells for irrigation will affect the level of the water table in years to come. The ecological services known to be provided by the maintenance of biodiversity will depend on a continuing balance of human activities and intact wildlife habitats in the Niumi National Park.

Acknowledgments

We thank Karolina Kolackova and Pavel Brandl who helped to initiate this project. The study was made possible thanks to the support and enthusiasm of the proprietors and staff at Jinack Lodge: Amadou Manneh, Devon Caines, Moses Mende, Lamin Sonko, Lamin Jube, Binta Sonko and Nimah Sanneh. We benefited from the expert knowledge of the local ecology of Serjo Manneh, who provided many insights into the recent changes in the habitat due to expansion of human activity. We also discussed local conservation issues with the staff of the Darwin Research Centre in Abuko Nature Reserve, near Banjul. We are grateful for the friendly reception we received from the villages Jinack Niji and Jinack Kajata. Yvonne De Jong kindly provided photographs.

References

Bearder S K & Martin R D (1979). The social organization of nocturnal primate revealed by radio tracking. In, C J Amlaner and D W Macdonald (eds), *A Handbook on Biotelemetry and Radio Tracking.* Pergamon Press: Oxford. Pp 633-648.

Bearder S K, Honess P E & Ambrose L (1995). Species diversity among galagos with special reference to mate recognition. In, L Alterman, M K Izard and G A Doyle (eds), *Creatures of the Dark: The Nocturnal Prosimians*. Plenum Press: New York. Pp. 331-352.

Bearder S K (1999). Physical and social diversity among nocturnal primates: a new view based on long term research. *Primates,* 40: 267-282.

Bearder S, Butynski T M & De Jong Y (2008). *Galago senegalensis*. In: IUCN 2008. Red List of Threatened Species. <www.iucnredlist.org>. Downloaded on 18 November 2008.

Butler H. 1967. Seasonal breeding of the Senegal galago (*Galago senegalensis*) in the Nuba mountains, Republic of the Sudan. *Folia Primatologica,* 5: 165–175.

Charles-Dominique P & Bearder S K (1979). Field studies of lorisid behaviour: the lorisids of Gabon; the galagines of South Africa. In, G A Doyle and R D Martin (eds), *The Study of Prosimian Behaviour*. Academic Press: New York. Pp 567-629.

Chenaiiq (2007). *Sunrise Sunset Calculator Calendar*. Available at: http://www.chennaiiq.com/astrology/sunrise_sunset.asp. Downloaded on 12 June 2012.

Ganzhorn J G (2003). Habitat description and phenology. In, J M Setchell and J C Curtis (eds), *Field and Laboratory Methods in Primatology*. Cambridge University Press: Cambridge. Pp. 40-56.

Haddow A J & Ellice J M (1964). Studies on bush-babies (*Galago* spp.) with special reference to the epidemiology of yellow fever. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* 58: 521–538.

Izard M K & Nash L T (1988). Contrasting reproductive parameters in *Galago senegalensis braccatus* and *G. s. moholi*. *International Journal of Primatology,* 9: 519–527.

Masters J C & Bragg N P (2000). Morphological correlates of speciation in bush babies. *International Journal of Primatology,* 21: 793–813.

Masters J C & Brothers D J (2002). Lack of congruence between morphological and molecular data in reconstructing the phylogeny of the Galagonidae. *American Journal of Physical Anthropology,* 117: 79–93.

Nash L T in press. *Galago senegalensis* (Northern Lesser Galago). In: *The Mammals of Africa.* Volume 2: *Primates* (eds. T. M. Butynski, J. Kingdon & J. Kalina). Bloomsbury Publishing, London.

Nash L T, Bearder S K & Olson T (I989). A synoptic overview of galago species differences. *International Journal of Primatology*, 10: 57-80.

Nash L T & Whitten P L (1989). Preliminary observations on the role of *Acacia* gum chemistry in *Acacia* utilization by *Galago senegalensis* in Kenya. *American Journal of Primatology,* 17: 27–39.

Nekaris KAI & Bearder SK (2011). The lorisiform primates of Asia and mainland Africa: diversity shrouded in darkness In, C J Campbell, A Fuentes, K C MacKinnon, S K Bearder and R M Stumpf (eds), *Primates in Perspective*. Oxford University Press: Oxford. Pp. 34-54.

Off E C, Isbell L A & Young T P (2008). Population density and habitat preferences of the Kenya lesser galago (*Galago senegalensis braccatus*) along the Ewaso Nyiro River, Laikipia, Kenya. *Journal of East African Natural History,* 97: 109–116.

Zimmermann E (1985). The vocal repertoire of the adult Senegal bushbaby (*Galago senegalensis senegalensis*). *Behaviour,* 94: 212–233.

Zimmermann E (1989). Aspects of reproduction and behavioral and vocal development in Senegal bushbabies (*Galago senegalensis*). *International Journal of Primatology,* 10: 1–16.

Zimmermann E, Bearder S K, Doyle G A & Andersson A B (1988). Variations in vocal patterns of Senegal and South African lesser bushbabies and their implications for taxonomic relationships. *Folia Primatologica,* 51: 87–105.

Contacts

Simon K Bearder BSc MSc PhD
Professor Emeritus, Anthropology
Convenor, Nocturnal Primate Research Group
Website: http://ssl.brookes.ac.uk/primate/home/htm
Tel. +44 (0) 7717 810688, Email: skbearder@brookes.ac.uk

Magdalena Svensson BSc MSc
Nocturnal Primate Research Group
Oxford Brookes University, Gypsy Lane, Oxford OX3 0BP, UK
Tel. +44 (0) 7586 313301, Email: m.svensson@brookes.ac.uk