Primates (2016) 57:455–458
DOI 10.1007/s10329-016-0559-6

NEWS AND PERSPECTIVES

Galagos as avian nest predators in South Africa

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Received: 23 June 2016 / Accepted: 21 July 2016 / Published online: 9 August 2016

Abstract Galagos are generally regarded as dietary specialists that feed predominantly on insects and gum. The diet of the thick-tailed greater galago is more varied and also includes fruit and small vertebrates, although the latter is rare and restricted to certain populations. The southern lesser galago is seemingly a more specialist forager, but frugivory was recently reported in two separate populations, suggesting at least some dietary plasticity in this species. The species is not known to consume vertebrates. Here I report on observations of avian nest predation by both thick-tailed greater and southern lesser galagos in Roodewal State Forest Reserve in South Africa. Galagos were responsible for 56 % of nest losses captured on trail cameras. Both species consumed eggs and nestlings of six species of passerines ranging in size from recently hatched to ~30 g nestlings almost ready to fledge. The consumption of vertebrates by the southern lesser galago represents an extension of its diet, as this has not been reported before. The results suggest that eggs and nestlings comprise part of the regular diet of thick-tailed greater galagos in the study area, albeit only seasonal. The consumption of vertebrate prey by southern lesser galagos may represent the expression of latent behavior which is only expressed under certain environmental conditions, e.g., a severe drought, when its regular food base may be diminished.

Keywords *Galago moholi* · *Otolemur crassicaudatus* · Diet · Nest predation · Eggs · Nestlings

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Introduction

Galagos or bushbabies are small to medium-sized, nocturnal, arboreal prosimians that inhabit the forests, thickets, and dense woodlands and savannahs of Africa. Within South Africa, two species are found: the southern lesser galago, *Galago moholi*, and the thick-tailed greater galago, *Otolemur crassicaudatus* (Nekaris 2013). Despite their largely overlapping ranges, different microhabitat preferences generally result in the separation of the two species, although they may be partially sympatric in some areas (Bearder and Doyle 1974; Ray 2014). It has been suggested that areas of sympatry may represent suboptimal habitat, as both species usually occur at lower densities in those areas compared to areas where they occur separately (Bearder and Doyle 1974). Both species can be considered microfaunivore-gumnivores, and as such interspecific competition may reduce the likelihood of sympatry in an area.

Of the two species, the diet of the thick-tailed greater galago is slightly more catholic and, in addition to invertebrates and exudates (gum), the species also regularly consumes fruit (Skinner and Chimimba 2005; Nekaris 2013). However, the relative importance of these components in their diet varies regionally (Nekaris 2013). Occasionally they will consume nectar, flowers, and small vertebrates such as fish, reptiles, and birds, including eggs, but this appears to be restricted to certain populations (Hladik 1979; Mills and Hes 1997; Nekaris 2013). The southern lesser galago was until recently considered a specialist forager, feeding almost exclusively on small invertebrates and gum obtained mainly from *Acacia* species (Bearder and Martin 1980; Mills and Hes 1997; Skinner and Chimimba 2005; Nekaris 2013). A two-year study by Bearder and Martin (1980) in the north of South Africa failed to reveal frugivory despite the availability of

fruit. However, two recent studies performed independently of each other reported instances of opportunistic frugivory in the species (Ray 2014; Scheun et al. 2014), questioning the status of this species as a specialist forager. Furthermore, Scheun et al. (2015), in their study of an urban population of southern lesser galagos, found that anthropogenic food sources such as seeds, fruits, and yoghurt constituted a major component of the diet of that population. These recent findings suggest the species exhibits at least some dietary flexibility in some populations. The southern lesser galago's close congener, the northern lesser galago, *Galago senegalensis*, appears to be more of a generalist forager, with its diet reported to include invertebrates, gums, and to a lesser degree fruits from a variety of species, nectar, and even small vertebrates such as lizards (Kingdon 1997; Nekaris 2013).

Detailed knowledge of the diet and feeding behavior of animals forms the basis of research on topics as wide ranging as demography, behavior, ecomorphology, and the effects of global climate change on populations and food webs (Pineda-Munoz and Alroy 2014). Here, I report on avian nest predation by populations of thick-tailed greater and southern lesser galagos, and present the first evidence of southern lesser galagos feeding on vertebrates.

Methods

Study area

The observations were made during a study of the nesting success of birds in the southern section of Roodewal State Forest Reserve (23°01′58″S, 30°02′28″E), South Africa, between November 2014 and April 2016. The reserve is situated in the savannah biome and the vegetation is described as Soutpansberg Mountain Bushveld (Mucina and Rutherford 2006). The climate in the study area is characterized by wet summers and dry winters with mean annual precipitation ranging from 450 to 900 mm (MAP = 716 mm), and a mean annual temperature of 18.9 °C (Mucina and Rutherford 2006). Roodewal State Forest Reserve and its immediate surroundings are characterized by a mosaic of subtropical moist thickets with a dense tree layer and a poorly developed grass layer, commercial timber plantations, and orchards, mainly of nuts and tropical fruits. Five primate species occur in the reserve, namely chacma baboon, *Papio ursinus*, Sykes' monkey, *Cercopithecus albogularis*, vervet monkey, *Chlorocebus pygerythrus*, and southern lesser and thick-tailed greater galagos. Sykes' monkey, however, is restricted to the evergreen forests on the higher slopes of the Soutpansberg Mountains, and has not been recorded at the study site in the south of the reserve.

Observations

Ten trail cameras (Ltl Acorn Ltl-6210MC) were deployed 3–4 m from active nests to determine the causes of nest failure and to identify nest predators. If there were fewer active nests than trail cameras at any given time, spare trail cameras were deployed at random spots in the reserve to document other mammalian species present. All cameras were set to normal sensitivity motion detection and at 940 nm for infrared night vision. Nests were checked every 4–7 days to determine the outcome and also to check if the trail cameras are still fully operational.

Results

Of the 25 predation events captured on camera during this study, primates were responsible for 15 (60 %). The dominant nest predator was the thick-tailed greater galago ($n = 11$), followed by the southern lesser galago ($n = 3$) and the chacma baboon ($n = 1$). Galagos were recorded predating nests of six passerine bird species, and both eggs ($n = 9$) and nestlings ($n = 5$) were predated (Table 1). Nestlings ranged in size from recently hatched African paradise flycatcher nestlings, *Terpsiphone viridis* (~2.5 g), to 15-day-old yellow-bellied greenbul nestlings, *Chlorocichla flaviventris* (~30 g), close to fledging. Two predation events captured on the trail cameras are presented in Fig. 1.

The three predation events by southern lesser galagos were all recorded in January and February 2016. The first nest predation event occurred on 22 January 2016 at 22:45, when an individual predated two 4-day-old nestlings of an African paradise flycatcher (Fig. 1). The second event was recorded on 25 January 2016 at 22:35, when a nest containing two eggs of a Kurrichane thrush, *Turdus libonyana*, was predated. Another African paradise flycatcher nest containing three eggs was predated on 7 February 2016 at 01:15. It is not clear if the predation events observed were performed by a single individual or if they represented an influx by several individuals.

Discussion

This study revealed that galagos are significant avian nest predators at Roodewal State Forest Reserve and represent the main cause of nest failure. This is surprising, as all published observations to date show that consumption of vertebrates by thick-tailed greater galagos is uncommon and restricted to certain populations, and it is unrecorded in southern lesser galagos (Nekaris 2013). The results of this study add to the growing body of literature showing that

Table 1 Summary of predation events by thick-tailed greater (TGG) and southern lesser galagos (SLG) in Roodewal State Forest Reserve, South Africa

Prey species	Common name	TGG		SLG	
		Eggs	Nestling	Eggs	Nestling
Smithornis capensis	African broadbill	2			
Terpsiphone viridis	African paradise flycatcher	3	2	1	1
Nicator gularis	Eastern nicator	1			
Chlorocichla flaviventris	Yellow-bellied greenbul		2		
Cossypha natalensis	Red-capped robin-chat	1			
Turdus libonyanus	Kurrichane thrush			1	

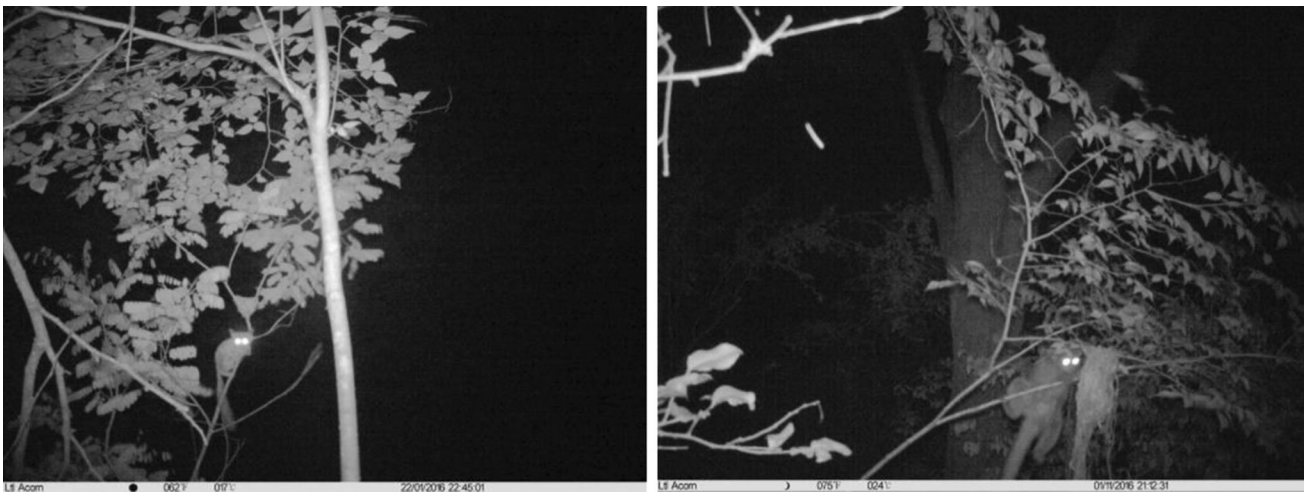

Fig. 1 Predation of African paradise flycatcher nestlings by a southern lesser galago (*left*) and of an African broadbill nest containing two eggs by a thick-tailed greater galago (*right*)

galagos exhibit a considerable amount of dietary plasticity and are less specialized foragers than previously thought. The level of specialization of a species is determined by the interplay of ecology, behavior, and morphology, which may covary in response to environmental challenges (Irschick et al. 2005; Marsh and Chapman 2013). The dietary opportunism observed here may reflect latent behavioral plasticity, which reveals itself only under specific environmental conditions (e.g., harsh droughts forcing individuals to exploit alternative food sources when food becomes scarce) but is retained within the population because of its low evolutionary costs (De Vries et al. 2011).

Galagos in the study area displayed a high degree of opportunistic foraging, as both species consumed eggs and nestlings of six species of passerines with varying life-history strategies. The prey species also construct nests varying in size, shape (e.g., plate, open cup, and ball-shaped), and the level of concealment. However, it is doubtful if the consumption of eggs and nestlings by the thick-tailed greater galago in the study area represent an extension of the diet due to food scarcity, as the species was observed preying on eggs and nestlings in both seasons. It may simply represent seasonal exploitation of a relatively abundant food resource, suggesting that thick-tailed greater galagos may be dietary generalists that include specialist food sources (e.g., gum) in their diet, which is seldom exploited by other vertebrates.

This study extends the known diet of the southern lesser galago to include vertebrates. The southern lesser galago is not common in the study area or occurs at low densities, as the trail cameras failed to record it in the study area at all in the 2014/15 breeding season, and its first recorded presence at the study site was in January 2016. The study area was in the midst of a severe drought in the 2015/16 breeding season, with the area receiving approximately 30 % of its mean annual rainfall. It is therefore possible that the southern lesser galago's usual invertebrate prey base was greatly reduced, forcing it to move into suboptimal areas not usually occupied by the species and to exploit alternative food sources such as eggs and nestlings of birds. These food sources present high energy returns and nutrient resources at relatively low risk to the predator. In fact, at none of the predation events captured on camera were parent birds seen defending the nest contents.

Southern lesser galagos generally occupy harsher and more unpredictable environments compared to the thick-tailed greater galago (Skinner and Chimimba 2005; Nekaris 2013). One would therefore expect greater

ecological flexibility in this species in order to cope with the demands of such environments. The recent reports by Ray (2014) and Scheun et al. (2014, 2015) show that the species may indeed exhibit dietary plasticity, as these studies extended its known diet to include fruit and a variety of anthropogenic food sources. The seemingly atypical, possibly seasonal, exploitation of vertebrate prey by southern lesser galagos in Roodewal State Forest Reserve fits the model of dietary opportunism exhibited by a specialized forager in response to food scarcity, and can be considered adaptive.

To conclude, the results of this study show that galagos in Roodewal State Forest Reserve are significant predators of bird eggs and nestlings. Vertebrate prey, specifically birds, may be a regular seasonal component of the diet of this population of thick-tailed greater galagos. The extension of the diet of the southern lesser galago to include vertebrates may be an adaptive response to harsh environmental conditions and a concomitant decrease in its usual prey base in early 2016 when the region was in the midst of a severe drought. The study also highlighted the value of strategically placed trail cameras to shed light on the diet and behavior of these relatively poorly known and difficult to study nocturnal primates.

Acknowledgments I wish to express my sincere gratitude to Samson Mulaudzi for his assistance with fieldwork, and the Ben de Boer Trust for providing financial support for this project.

References

Bearder SK, Doyle GA (1974) Field and laboratory studies of social organisation in bushbabies (*Galago senegalensis*). J Hum Evol 3:37–50

Bearder SK, Martin RD (1980) *Acacia* gum and its use by bushbabies, *Galago senegalensis* (Primates: Lorisidae). Int J Primatol 1:103–128

de Vries JL, Pirk CWW, Bateman PW, Cameron EZ, Dalerum F (2011) Extension of the diet of an extreme foraging specialist, the aardwolf (*Proteles cristata*). Afr Zool 46:194–196

Hladik CM (1979) Diet and ecology of prosimians. In: Doyle GA, Martin RD (eds) The study of prosimian behaviour. Academic, New York, pp 307–357

Irschick D, Dyer L, Sherry TW (2005) Phylogenetic methodologies for studying specialization. Oikos 110:404–408

Kingdon J (1997) The Kingdon field guide to African mammals. Academic, London

Marsh LK, Chapman C (2013) Primates in fragments: complexity and resilience. Springer, New York

Mills G, Hes L (1997) The complete book of southern African mammals. Struik, Cape Town

Mucina L, Rutherford MC (2006) The vegetation of South Africa, Lesotho and Swaziland. South African National Biodiversity Institute, Pretoria

Nekaris KAI (2013) Family galagidae (Galagos). In: Mittermeier RA, Rylands AB, Wilson DE (eds) Handbook of the mammals of the world, vol. 3: primates. Lynx Edicions, Barcelona, pp 184–209

Pineda-Munoz S, Alroy J (2014) Dietary characterization of terrestrial mammals. Proc R Soc B 281:20141173. doi:10.1098/rspb.2014.1173

Ray IS (2014) Species density of the southern lesser bushbaby (*Galago moholi*) at Loskop Dam Nature Reserve, Mpumalanga, South Africa, with notes on habitat preference. MA thesis. Ball State University, Muncie

Scheun J, Bennett NC, Ganswindt A, Nowack J (2014) Spicing up the menu: evidence of fruit feeding in *Galago moholi*. Primates 55:359–363

Scheun J, Bennett NC, Ganswindt A, Nowack J (2015) The hustle and bustle of city life: monitoring the effects of urbanisation in the African lesser bushbaby. Naturwissenschaften 102:57

Skinner JD, Chimimba CP (2005) The mammals of the southern African subregion. Cambridge University, Cambridge