
Correlates with the distribution and abundance of endangered Sclater's monkeys (*Cercopithecus sclateri*) in southern Nigeria

Lynne R. Baker^{1*} and Oluseun S. Olubode²

¹Conservation Biology Program, University of Minnesota, 187 McNeal Hall, 1985 Buford Ave., St Paul, MN 55108, USA and ²Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Nigeria

Abstract

A distribution survey of the endangered Sclater's monkey (*Cercopithecus sclateri*) was conducted over a wide area in southern Nigeria using forest surveys and hunter interviews. Sclater's monkey, Nigeria's only endemic primate species, is restricted to a land area of about 28,500 km² in the densely human-populated, oil-producing region of southern Nigeria. Results indicate that this species is not as rare as previously thought; we confirmed its presence in 27 formerly unknown sites. Based on encounter-rate and distribution data, Sclater's monkey is one of the two most abundant diurnal primate taxa across its range. However, the species primarily occupies isolated and degraded forest fragments. Although hunting is widespread, selective hunting of larger-bodied primate taxa offers some respite for the smaller Sclater's monkey. We encountered this species more frequently in forests with relatively high hunting pressure, possibly indicating competitive release in the heavily hunted forests of southern Nigeria. Long-term persistence of Sclater's monkey, which has no official protection throughout its range, depends on the willingness of hunters to target smaller-bodied wildlife (effort-profit trade-off), local bushmeat demand and protection of key forest fragments and the few larger forests in the region.

Key words: *Cercopithecus sclateri*, competitive release, guenon, hunting, Nigeria, primate conservation

Résumé

Une étude de la distribution du moustac de Sclater, *Cercopithecus sclateri*, espèce en danger, a été réalisée dans

une vaste zone du sud du Nigeria, au moyen de recherches en forêt et d'interviews de chasseurs. Le moustac, qui est la seule espèce de primate endémique du Nigeria, se limite à une superficie d'environ 28.500 km² dans la région densément peuplée du sud du Nigeria, où l'on produit du pétrole. Les résultats indiquent que cette espèce n'est pas aussi rare qu'on le pensait; nous avons pu confirmer sa présence dans 27 sites inconnus auparavant. D'après le taux de rencontres et les données de sa distribution, *Cercopithecus sclateri* est un des deux taxons de primates diurnes les plus abondants dans son domaine vital. Cependant, l'espèce occupe principalement des portions de forêts dégradées et isolées. Bien que la chasse soit courante, le choix des taxons de primates plus grands offre quelque répit au plus petit *Cercopithecus sclateri*. Nous avons rencontré cette espèce plus fréquemment dans les forêts où la pression de la chasse était relativement forte, ce qui indique peut-être un relâchement de la compétition dans les forêts du sud du Nigeria où la chasse est très intense. La survie à long terme du moustac de Sclater, qui ne bénéficie d'aucune protection officielle dans toute son aire de répartition, dépend de la décision des chasseurs de cibler aussi des espèces plus petites (compromis effort/profit), de la demande locale pour la viande de brousse et de la protection des fragments de forêt critiques et des quelques plus grandes forêts de la région.

Introduction

Nigeria is home to several endangered primate taxa, all of which occur in the southern part of the country. Some of these include the Niger Delta red colobus (*Procolobus badius epieni*), drill monkey (*Mandrillus leucophaeus*), white-throated monkey (*Cercopithecus erythrogaster pococki*), red-eared monkey (*Cercopithecus erythrotis*), Preuss's monkey

*Correspondence: E-mail: sclateri@yahoo.com

(*Cercopithecus preussi*) and Sclater's monkey (*Cercopithecus sclateri*). Sclater's monkey, a type of guenon, is the only primate with full species status that is endemic to the country. It is listed as endangered by the IUCN (IUCN, 2007). Sclater's and white-throated monkeys are Nigeria's smallest diurnal primates.

In 1904, Sclater's monkey was described and named in honour of zoologist Philip Lutley Sclater, who had a particular interest in *Cercopithecus* monkeys (Pocock, 1904). However, investigations of the distribution of this monkey were not initiated until 1987 (Oates *et al.*, 1992); their surveys found that the species is restricted to the interfluvial rainforest zone between the Niger and Cross Rivers in southern Nigeria. By 1997, several populations in eight of Nigeria's 36 states had been located (Gadsby, 1989; Oates, 1989; Oates & Anadu, 1989; Oates *et al.*, 1992; Powell, 1995; Tooze, 1995, 1996, 1997; R. King & E. Egwali, personal communication).

Southern Nigeria lacks much of its original forest cover and possesses one of the densest human populations in Africa – as many as 863 individuals per square kilometre in the most dense state in the region (National Population Commission, 2007). Remaining tracts of forest tend to be swampy areas that are difficult to farm, strips of gallery forest and sacred groves. Even in the swamp forests of the Niger Delta, habitats have been affected by logging, oil-related pollution, oil exploration and associated degradation (Moffat & Linden, 1995; Carbone, 2003). There are no protected areas in the region, and the few forest reserves offer no protection against hunting and little to no regulation of logging.

Hunting is common throughout southern Nigeria (Oates, Bergl & Linder, 2004; Fa *et al.*, 2006). However, some communities consider certain animals, trees or forests sacred (because of religious or cultural beliefs), and thus such animals are not hunted or otherwise harmed. Sclater's monkey is known to be protected in this way in three such sites (Oates *et al.*, 1992; Baker, 2005).

Prior to our survey, relatively little was known about Sclater's monkey. The objectives of the survey were to: (i) better ascertain its distribution in southern Nigeria, (ii) determine major correlates, such as human disturbance factors, associated with its distribution and abundance and (iii) document current threats and habitat conditions so that the species' conservation status can be more accurately evaluated and understood.

Materials and methods

The distribution and status of Sclater's monkey were determined from forest surveys and hunter interviews. We covered more than 10,000 km by vehicle in southern Nigeria during January–July 2004.

Study area

Our survey was conducted across the Niger–Cross interfluvium, a region that is predominantly low lying (<600 m asl) and marked by low relief, other than a range of hills in Enugu State in the northern portion of the region (Oates *et al.*, 2004). The region has high mean annual rainfall, from 1500 mm in the more northerly states to 4000 mm close to the coast (Barbour *et al.*, 1982; Metz, 1992; Fasona & Omojola, 2005). The rainy season lasts about seven months, from April to October, but is generally longer in the Niger Delta and near the coast (Olaniran & Sumner, 1989; Metz, 1992). Mean annual temperatures in this region range from 22°C to 38°C, with an overall mean of about 26°C (Government of Nigeria, 1953; Urama, 2005).

Forest surveys were conducted preferentially in areas that represent the largest tracts of forest in the range of Sclater's monkey: Stubbs Creek Forest Reserve (310 km²) in Akwa Ibom State, Emago community forest in the Edumanom Forest Reserve (87 km²) in Bayelsa State and Okolamade community forest in the Upper Orashi Forest Reserve (90 km²) in Rivers State. All are relatively degraded habitats and are affected to varying degrees by oil-industry and logging operations.

Situated along the coast in the Gulf of Guinea, Stubbs Creek is a freshwater *Raphia* (*Raphia spp.*)-dominated swamp forest that seasonally floods. Diurnal primates present include Sclater's monkey, mona monkey (*Cercopithecus mona*), putty-nose monkey (*Cercopithecus nictitans* cf. *insolitus*, per Grubb *et al.*, 2000) and red-capped mangabey (*Cercocebus torquatus torquatus*). Chimpanzees (*Pan troglodytes*) were locally extirpated by the end of the Biafran War (1970) (Gadsby, 1989). The Edumanom Forest Reserve is a freshwater swamp forest in the eastern Niger Delta. Diurnal primates known to be present include Sclater's, mona and putty-nose monkeys. Edumanom also harbours a relict population of chimpanzees, unknown to outsiders until the early 1990s (Powell, 1995). Red-capped mangabeys formerly occurred here, but are now considered locally extirpated, or nearly extirpated (Bocian, 1999;

Baker, 2005). The Upper Orashi Forest Reserve, also a freshwater swamp forest in the eastern Niger Delta, harbours Sclater's, mona and putty-nose monkeys. Both the chimpanzee and red-capped mangabey are thought to have been locally extinct in this reserve for 20 years (Powell, 1995).

Hunter interviews

We visited 84 communities in eight states, including six that had been identified in previous studies as locations where Sclater's monkey occurs. The other previously known sites were not visited again due to limited time and access, and likelihood of the continued presence of the species at these sites. Sites ranged in elevation from sea level to 400 m.

We conducted 117 interviews predominantly with hunters. We sought the best known hunters in each community and asked each to identify the number of different monkeys and apes that occur in the forests near and around their village. Hunters were asked to provide each primate's local name and describe each by size, physical features, sound, abundance and behaviour. To better understand local bushmeat economies, we also asked hunters to estimate selling prices they would normally receive for a recently killed adult male of each species they reported as present. Photos were occasionally used at the end of interviews to further confirm hunters' identifications. Interviews that resulted in ambiguous descriptions or sounds of primates were deemed unreliable and thus are not included herein.

Forest surveys

Within the broader study area, we conducted forest surveys ($n = 24$ sites) where reliable hunter interviews indicated that Sclater's monkeys were present, where it was determined safe for us to work and where we could gain permission to enter the forest. Encounter rates (detections per kilometre) were used as an index of abundance and compared against the influence of potential human threats and disturbance factors.

Surveys involved walking through the forest at an average pace of $3\text{--}4 \text{ km h}^{-1}$, using a local hunter as a guide, and often following hunter trails or other paths (reconnaissance sampling) (Walsh & White, 1999). Surveys were conducted during times when primates are usually most active: 05.30–11.00 and 15.30–18.30.

When primates were sighted or heard, the following data were recorded: time, geo-coordinates, microhabitat, species and mode of observation (visual sightings, audio detections or branch displacement). When possible, we also recorded sighting distance, height in canopy, group size and composition and any notable behaviour. To determine presence or absence in three highly deforested areas, surveys were conducted by boat along a main river or creek where local people said primates were commonly sighted.

Human disturbance factors were assessed via the following measures (per kilometre): number of gunshots heard or fired gun-shells found ('hunting indicators'), number of stacked planks of sawn wood encountered ('logging indicators') and the presence/absence of chain-saw noise during the survey. We used these factors as predictor variables in generalized linear models (having a Poisson probability distribution and logarithmic link function); the natural log of distance (in km) walked per survey was the offset variable, and number of encounters of primate species was the dependent variable. These analyses were conducted for the most commonly sighted diurnal primates, *C. sclateri* and *C. mona*.

Results

We located Sclater's monkeys in 27 previously unconfirmed sites (Fig. 1). This finding was based on two audio and ten visual detections and fifteen reliable hunter reports. The species was confirmed in a new most northerly and easterly site ($N6^{\circ}16'$, $E8^{\circ}11'$), roughly 15 km north and 100 km east of the previously known most northerly site. Circumscribing the area using previously known locations plus our new locations, the species' extent of occurrence is $28,500 \text{ km}^2$. However, its area of occupancy (Gaston, 1991) is likely a small portion of this.

Species determined as present in adjacent or nearby community forests may belong to the same population. However, this remains unclear because many areas within the study region are densely populated by people and heavily farmed, and so forests are fragmented; the species' ranging ability in such landscapes is not known.

Hunter interviews

We did not encounter any sites where hunters recalled or described Sclater's monkey, but indicated it no longer

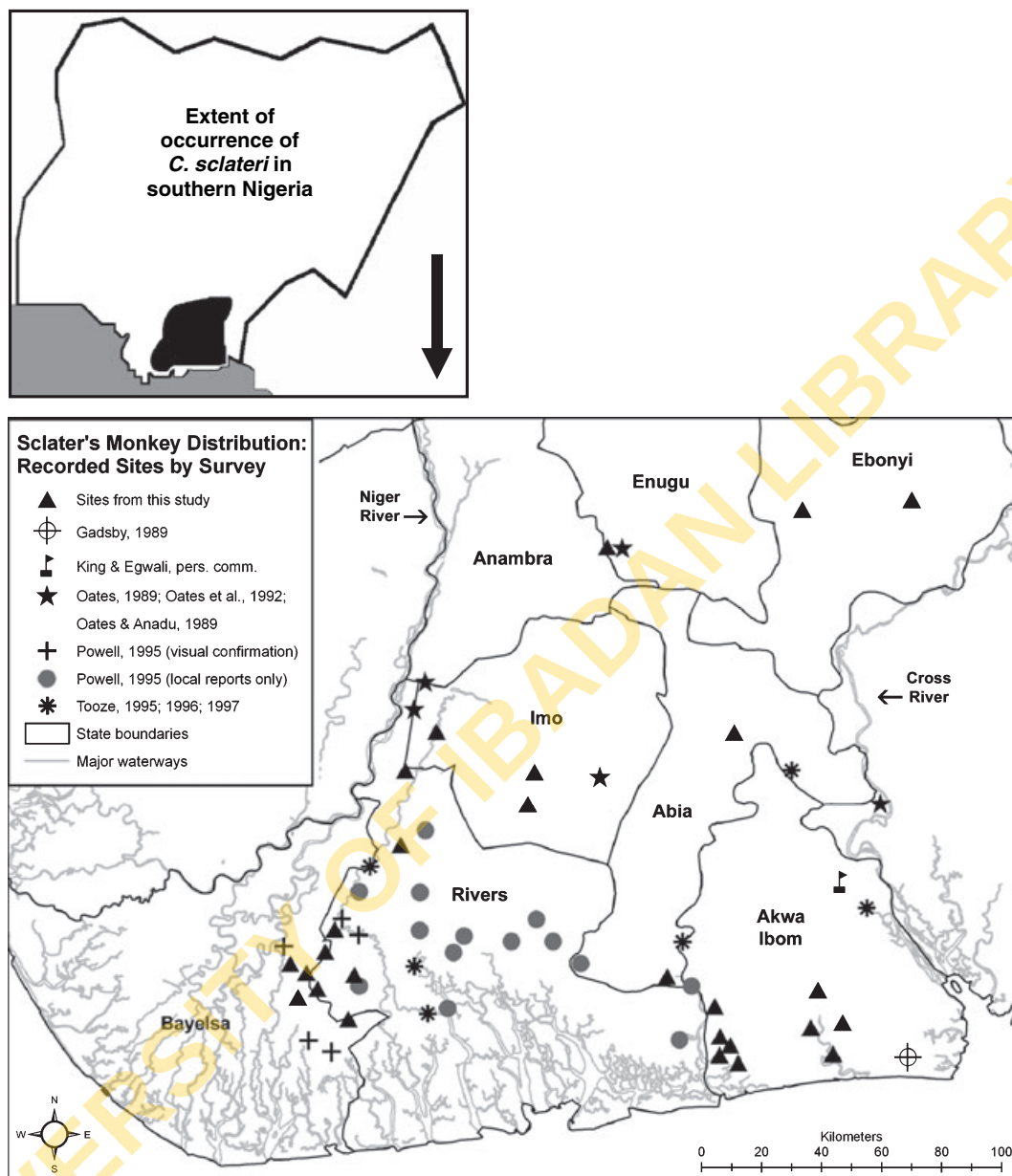


Fig 1 Current known distribution of the Sclater's monkey in Nigeria. Extent of occurrence is 28,500 km². Localities are reported by survey. Monkeys located in adjacent or nearby community forests may belong to the same population, but it is unclear if or how much the species will move through severely human-altered landscapes. 'Local reports' from Powell (1995) are provided with some caution due to discrepancies with localities reported for a closely related primate and inability to clarify some methodological issues with the author

occurred there. The species was recorded at sites between sea level and 130 m in elevation, whereas the mona monkey was recorded across the entire study region – up to 400 m. The putty-nose monkey and red-capped mangabey were nearly always located nearer the coast, pre-

dominantly in swamp forest, at less than 50 m in elevation.

Sclater's monkey may be more widespread than can be determined from interview-based surveys. We found that a number of hunters could not easily describe this species

or mimic its vocalizations. Both the male loud call of Sclater's monkey and, to a lesser extent, the alarm call are not easily reproduced by the human voice. As such, in sites where we did not conduct foot surveys, we needed to rely on other information from hunters, such as descriptions of physical features, behaviour or size. This is in contrast to mona and putty-nose monkeys, which were more readily described by the loud calls of adult males and by their conspicuous white body patches (the nose of putty-nose and rump of mona). In 63 of the 70 cases (90%) where hunters indicated the presence (or likely presence) of mona monkeys, they correctly reproduced or identified mona calls, often in addition to providing physical descriptions. In 23 of these 63 cases (37%), hunters were unable to physically describe the mona, but could accurately reproduce the species' vocalizations.

During interviews in 23 sites, hunters indicated that the smaller-sized Sclater's monkey is often not worth pursuing because the selling price of its meat is too low compared with the cost of a bullet. They also noted that this species is more difficult to kill due to its size and cryptic nature. Sclater's and white-throated monkeys, being the smallest diurnal species encountered in the study region, provide hunters the lowest profit (Fig. 2).

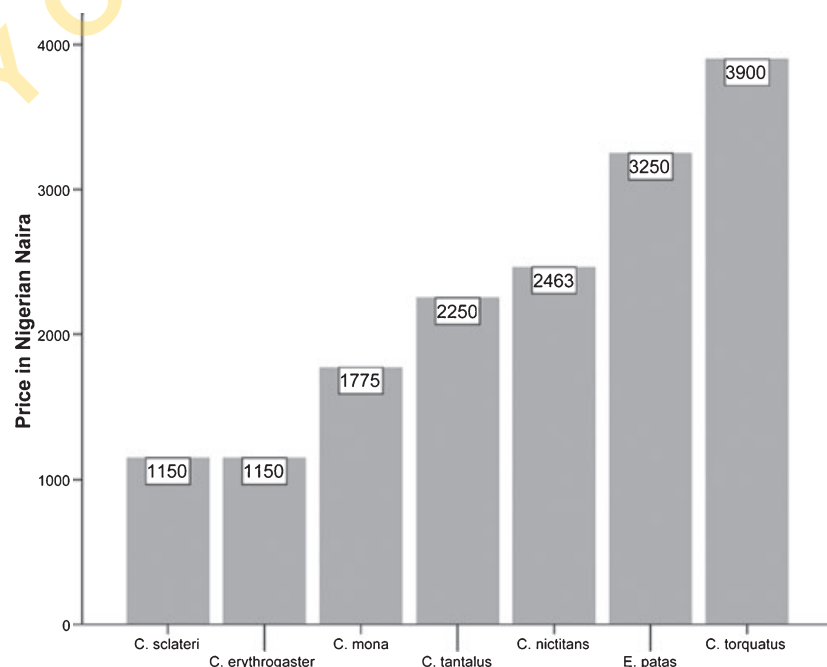
Forest surveys

Sclater's and mona monkeys were the most frequently encountered primates at the 24 forest sites surveyed (Sclater's: 0.18 detections per kilometre; mona: 0.19 detections per kilometre). Sclater's groups were sighted most often in mid to lower canopy levels; mean height in canopy was 11.5 m (SD = 5.1, range 6–21 m, $n = 14$), and mean height of trees in which sightings occurred was 15.4 m (SD = 4.6, range 10–22 m).

In Stubbs Creek Forest Reserve, Sclater's monkeys and red-capped mangabeys were sighted just once, in a mixed group with *C. mona*. Putty-nose monkeys were neither seen nor heard; hunters reported them as very rare. Sclater's monkey was the most commonly encountered primate in the Edumanom and Upper Orashi reserves, while the mona was most common in Stubbs Creek (Table 1). In the Edumanom and Upper Orashi forests, red-capped mangabeys were never detected. Bocian (1999) also did not detect mangabeys during surveys in and near Edumanom, supporting the assumption that this species may be extirpated from this site.

Using generalized linear models, we looked at encounter rates versus threat indices for species for which there were sufficient detections, *C. sclateri* and *C. mona* ($n = 19$;

Fig 2 Mean maximum prices that hunters said they could earn for an adult male of the primate species listed. Sample is from 23 villages in the study region; not all species occur in each community forest. Exchange rate at the time: 132 Naira = \$1 U.S. Bullet price: 150–250 Naira (Only one hunter gave a selling price for chimpanzee: 8000 Naira)



	Stubbs Creek Forest Reserve	Emago (Edumanom Forest Reserve)	Okolamade (Upper Orashi Forest Reserve)
Distance (km walked)	54.4	44.6	41.4
Detection rate (detections per km)			
<i>Cercopithecus sclateri</i>	0.02	0.22	0.27
<i>Cercopithecus mona</i>	0.18	0	0
<i>Cercopithecus nictitans</i>	0	0	0.14
<i>Cercocebus torquatus</i>	0.04	0	0
Unidentified	0.04	0.05	0.07
Threat indices			
Hunting indicators per km	0.04	0.13	0.27
Logging indicators per km	0.22	0.24	0.10
Chainsaw activity (noise)	Common	Uncommon	None

Table 1 Field detections of diurnal primates and threat indices in areas that represent the largest tracts of forest within Sclater's monkey range in southern Nigeria

	β	SE	Wald χ^2	df	Sig.	Model deviance
<i>Cercopithecus sclateri</i>						
Hunting indicators	0.323	0.1150	7.887	1	0.005	14.954
Logging indicators	-0.198	0.0981	4.060	1	0.044	
Chainsaw noise (=0)	1.114	0.6550	2.891	1	0.089	
Logging $\times$ chainsaw	-0.701	0.3023	5.371	1	0.020	
Constant	-2.425	0.5852	17.174	1	0.000	
<i>Cercopithecus mona</i>						
Hunting indicators	-1.132	0.5088	4.953	1	0.026	21.179
Logging indicators	0.192	0.0906	4.488	1	0.034	
Constant	-1.630	0.3246	25.227	1	0.000	

Table 2 Parameter coefficient estimates for threat indices in Poisson regressions, with encounter rates of Sclater's and mona monkeys as dependent variables (n = 19 forest surveys)

Offset variable is Ln (distance in km covered per survey). Only significant interactions are reported. Final models include covariates significant at the 0.10 level.

Table 2). Because three surveys were conducted along waterways and two in communities where Sclater's monkey is locally protected, these five sites were excluded from the analysis as they are not directly comparable to the other nineteen surveys.

Logging activity and chainsaw noise, and the interaction between these two, were negatively related to encounter rates of Sclater's monkey, while encounter rates were positively related to hunting activity (Table 2). In contrast, encounter rates of mona monkeys were negatively related to hunting activity and positively related to logging and showed no relationship with chainsaw noise. Because the mona is considered an adaptable species, being found in a variety of habitats including coastal mangroves (Struhsaker, 1969; Matsuda-Goodwin, 2007), the presence of logging activity may not deter this

species or cause a behavioural change in terms of vigilance, unless there is also active hunting.

Discussion

Sclater's monkey has long been considered endangered, was even once thought extinct, and has a restricted range. To some extent, its presumed rarity can be attributed to a limited number of surveys and a focus on less degraded forests in those surveys. Our study shows that Sclater's monkey is not as rare as was thought and occurs in a variety of habitats, including highly deforested and degraded sites. Additionally, we did not encounter any localities of recent extirpation – sites where populations of Sclater's monkeys have likely been extirpated although viable habitat remains. We attribute this persistence to the

preferential hunting of larger-bodied primate taxa and the species' small size, shy nature and adaptability.

Current knowledge of wild guenons suggests that they can be highly flexible in their behaviour and movement strategies (McGraw, 2002). Among the guenons, the *cephus* group, to which Sclater's monkey belongs, comprises smaller-bodied, arboreal and generally cryptic species known to adapt to a variety of forest types (Oates, 1988; McGraw, 2002). Other *cephus* species include *Cercopithecus erythrogaster*, *C. erythrotis*, moustached monkey (*Cercopithecus cephus*), red-tailed monkey (*Cercopithecus ascanius*) and lesser spot-nosed monkey (*Cercopithecus petaurista*).

In Gabon, *C. cephus* was the only primate able to subsist in a 9-ha forest fragment surrounded by savannah (Tutin, 1999). In a study of 20 forest fragments, *C. ascanius* was found to be the only diurnal primate present in nearly all of the fragments and that regularly moved among them; no other primate showed such flexibility in its use of habitat (Onderdonk & Chapman, 2000). *Cercopithecus ascanius* was also located in many nonprotected, variable-sized forest fragments around Kampala, Uganda, and was considered abundant in most of these sites (Baranga, 2004). Similarly, *C. erythrotis* was found to be the only diurnal primate to occur in most forest types across Bioko Island, Equatorial Guinea, making it the most abundant and widespread primate there (Gonzalez-Kirchner, 1996).

We found Sclater's monkey to be a quiet species compared with other diurnal, sympatric primates. Oates (1985:31) found the same of the closely related *C. erythrogaster pococki*, noting that the species was 'rarely detected by the characteristic crashing sound that accompanies leaping in the canopy.' Hunters remarked that the species is difficult to kill because the monkeys quickly spot humans and are 'very clever,' as well as being small, which makes them less profitable as bushmeat (Oates, 1985); very similar reports regarding *C. sclateri* were common in this study. In polyspecific associations, *cephus* monkeys, being highly visually oriented, often alert other primate species to danger (Kingdon, 1997). Consequently, the negative association of logging activity and chainsaw noise with encounter rates of *C. sclateri* may be related more to reduced detectability than to species presence. That is, the monkeys may not move away from areas with active logging and chainsaw activity, but instead may become more vigilant and thus more difficult to detect.

Preferential hunting of larger-bodied primate taxa in southern Nigeria may also help explain the persistence of

Sclater's monkey. A decrease in abundance or loss of larger-bodied primates, preferred by hunters, may allow a Sclater's population to expand from competitive release (Peres & Dolman, 2000). This would explain the positive regression coefficient for hunting in the Sclater's model (Table 2). As such, overhunting of larger species may work in favour of smaller, adaptable primates, by allowing these populations to increase and fill newly depleted or vacant ecological niches.

The general nonfavoured status of Sclater's monkey among hunters and its ability to adapt to fragmented and degraded habitats are important factors in the long-term persistence of the species because there are no protected areas throughout its range. Sclater's monkey is protected by national and international laws (CITES Appendix II and Nigerian Endangered Species Decree No. 11 of 1985), but there is very little or no awareness and enforcement of these laws by government and local people. Sclater's monkey is known to receive protection at only four sites: three deforested communities where it is not hunted due to local cultural beliefs and at one zoological facility where it occurs freely on the site's forested grounds (Oates *et al.*, 1992; Baker, 2005). If not for its size, cryptic nature, adaptability and nonpreferred status among hunters relative to other monkeys, the conservation status of Sclater's monkey would certainly be more ominous. Consequently, it will be important to better understand local bushmeat economies and monitor whether hunters increasingly target smaller-bodied species that offer lower profit-per-effort when larger species become rare or extirpated (Ling & Milner-Gulland, 2006).

In several sites visited during the survey, Sclater's monkey was considered the most abundant primate by local people – often the only monkey a hunter could regularly find in the forest. Although globally more endangered than the red-capped mangabey, mona monkey and putty-nose monkey, *C. sclateri* is locally the most common or second-most common primate in many locations throughout its range. As such, attempts to establish or enforce any special anti-hunting measures for this species would likely make little sense to local residents. Improved protection of Sclater's monkey will be most effective by employing a combination of approaches, such as establishment of protected areas that are also biologically significant for other reasons (i.e. Edumanom Forest Reserve), increasing awareness among local people of the monkey's status as uniquely Nigerian and establishment of local ecotourism and research programmes in the few sites

where the species is not hunted and thus relatively easy to observe and study.

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References

- BAKER, L.R. (2005) *Distribution and Conservation Status of the Sclater's Guenon (Cercopithecus sclateri) in Southern Nigeria*. Report to Margot Marsh Biodiversity Foundation, Rufford Small Grants, Lincoln Park Zoo Department of Conservation and Science, American Society of Primatologists, Sigma Xi, National Science Foundation, and Stanford Bay Area Charities.
- BARANGA, D. (2004) Forest fragmentation and primates' survival status in non-reserved forests of the 'Kampala area,' Uganda. *Afr. J. Ecol.* **42**, 70–77.
- BARBOUR, K.M., OGUNTOYINBO, J.S., ONYEMELUKWE, J.O.C. & NWAFOR, J.C. (1982) *Nigeria in Maps*. Hodder and Stoughton, London.
- BOCIAN, C. (1999) *A Primate Survey of the Okoroba Community Forest, Edumanom Forest Reserve*. Report to the A.G. Leventis Foundation and the Nigerian Conservation Foundation, Lagos.
- CARBONE, M. (2003) Morte di un delta. *Airone* **260**, 52–60.
- FA, J.E., SEYMOUR, S., DUPAIN, J., AMIN, R., ALBRECHTSEN, L. & MACDONALD, D. (2006) Getting to grips with the magnitude of exploitation: bushmeat in the Cross-Sanaga rivers region, Nigeria and Cameroon. *Biol. Conserv.* **129**, 497–510.
- FASONA, M.J. & OMOJOLA, A.S. (2005) Climate change, human security and communal clashes in Nigeria. *Human Security and Climate Change*, an international workshop, Asker, Norway, unpublished conference paper.
- GADSBY, E.L. (1989) *Cross River Basin Primate Survey: Stubbs Creek Forest Reserve*. Report to Wildlife Conservation International, New York, and Akwa Ibom State Government, Nigeria.
- GASTON, K.J. (1991) How large is a species' geographic range? *Oikos* **61**, 434–438.
- GONZALEZ-KIRCHNER, J.P. (1996) Notes on habitat use by the Russet-eared guenon (*Cercopithecus erythrotis* Waterhouse 1838) on Bioko Island, Equatorial Guinea. *Trop. Zool.* **9**, 297–304.
- GOVERNMENT OF NIGERIA (Ed.) (1953) *The Nigeria Handbook*. Crown Agents for Oversea Governments and Administrations, on behalf of the Federal Government of Nigeria, London.
- GRUBB, P., OATES, J.F., WHITE, L.J.T. & TOOZE, Z. (2000) Monkeys recently added to the Nigerian faunal list. *Nigerian Field* **65**, 149–158.
- IUCN (2007) IUCN Red List of Threatened Species. www.iucnredlist.org (Downloaded on 16 September 2007).
- KINGDON, J. (1997) *The Kingdon Field Guide to African Mammals*. Princeton University Press, Princeton and Oxford.
- LING, S. & MILNER-GULLAND, E.J. (2006) Assessment of the sustainability of bushmeat hunting based on dynamic bioeconomic models. *Conserv. Biol.* **20**, 1294–1299.
- MATSUDA-GOODWIN, R. (2007) *Behavior and Ecology of the Mona Monkey in the Seasonally Dry Lama Forest, Republic of Benin*. PhD Thesis, The City University of New York.
- MCGRAW, W.S. (2002) Diversity of guenon positional behavior. In: *The Guenons: Diversity and Adaptation in African Monkeys* (Eds M. E. GLENN and M. CORDS). Kluwer Academic/Plenum Publishers, New York.
- METZ, H.C. (Ed.) (1992) *Nigeria: A Country Study*. Federal Research Division, Library of Congress, Washington, DC.
- MOFFAT, D. & LINDEN, O. (1995) Perception and reality: assessing priorities for sustainable development in the Niger River Delta. *Ambio* **24**, 527–538.
- NATIONAL POPULATION COMMISSION (2007) Schedule II. *Fed. Repub. Nigeria Official Gazette* **94**, B179–B198.
- OATES, J.F. (1985) The Nigerian guenon, *Cercopithecus erythrogastrus*: ecological, behavioral, systematic and historical observations. *Folia Primatol.* **45**, 25–43.
- OATES, J.F. (1988) The distribution of *Cercopithecus* monkeys in West African forests. In: *A Primate Radiation: Evolutionary Biology of the African Guenons* (Eds A. GAUTIER-HION, F. BOURLIERE, J.P. GAUTIER and J. KINGDON). Cambridge University Press, Cambridge.
- OATES, J.F. (1989) *A Survey of Primates and other Forest Wildlife in Anambra, Imo and Rivers States, Nigeria*. Report to National Geographic Society (USA), Nigerian Conservation Foundation, Nigerian Federal Department of Forestry, and Governments of Anambra, Imo and Rivers States.
- OATES, J.F. & ANADU, P.A. (1989) A field observation of Sclater's guenon (*Cercopithecus sclateri* Pocock, 1904). *Folia Primatol.* **52**, 93–96.
- OATES, J.F., ANADU, P.A., GADSBY, E.L. & WERRE, J.L. (1992) Sclater's guenon-A rare Nigerian monkey threatened by deforestation. *Nat. Geogr. Res. Explor.* **8**, 476–491.
- OATES, J.F., BERGL, R.A. & LINDER, J.M. (2004) *Africa's Gulf of Guinea Forests: Biodiversity Patterns and Conservation Priorities*. Conservation International, Center for Applied Biodiversity Sciences, Washington, DC.
- OLANIRAN, O.J. & SUMNER, G.N. (1989) A study of climatic variability in Nigeria based on the onset, retreat, and length of the rainy season. *Int. J. Climatol.* **9**, 253–269.

- ONDERDONK, D.A. & CHAPMAN, C.A. (2000) Coping with forest fragmentation: the primates of Kibale National Park, Uganda. *Int. J. Primatol.* **21**, 587–611.
- PERES, C.A. & DOLMAN, P.M. (2000) Density compensation in neotropical primate communities: evidence from 56 hunted and nonhunted Amazonian forests of varying productivity. *Oecologia* **122**, 175–189.
- POCOCK, R.I. (1904) Description of a new species of spot-nosed monkey of the genus *Cercopithecus*. *Proc. Zool. Soc. Lond.* **1**, 433–436.
- POWELL, C.B. (1995) *Wildlife Study I*. Report to Environmental Affairs Department, Shell Petroleum Development Company of Nigeria Ltd, Port Harcourt, Nigeria.
- STRUHSAKER, T.T. (1969) Correlates of ecology and social organization among African cercopithecines. *Folia Primatol.* **11**, 80–118.
- TOOZE, Z. (1995) Update on Sclater's guenon *Cercopithecus sclateri* in Southern Nigeria. *Afr. Primates* **1**, 38–42.
- TOOZE, Z. (1996) *Bridging Report LNG EIA: The Actual Status of Primates of the Niger Delta*. Report to Aquater/TSKJ, Port Harcourt, Nigeria.
- TOOZE, Z. (1997) *Survey and Census of Sclater's Guenon (Cercopithecus sclateri) in South-East Nigeria, and Recommendations for Conservation Initiatives*. Report to the Wildlife Conservation Society and Primate Conservation Inc, Charlestown, RI, USA.
- TUTIN, C.E.G. (1999) Fragmented living: behavioural ecology of primates in a forest fragment in the Lope Reserve, Gabon. *Primates* **40**, 249–265.
- URAMA, K.C. (2005) Land-use intensification and environmental degradation: empirical evidence from irrigated and rain-fed farms in south eastern Nigeria. *J. Environ. Manage.* **75**, 199–217.
- WALSH, P.D. & WHITE, L.J.T. (1999) What it will take to monitor forest elephant populations. *Conserv. Biol.* **13**, 1194–1202.

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