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Local depletion of two larger Duikers in the Oban Hills Region, Nigeria

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Abstract

Across West and Central Africa, duikers are important for trade and consumption; their populations are expected to become depleted. Reliable data on their status are scanty in Nigeria. We assessed duiker populations in the Oban Sector of Cross River National Park through diurnal and nocturnal surveys along 32 transects of 2 km each. After 508-km survey effort, only Ogilby's duiker (*Cephalophus ogilbyi*) and blue duiker (*Philantomba monticola*) were recorded. Using habitat as a covariate in modelling detection probability in DISTANCE 6.0, we estimated densities for the blue duiker ranging from 15.5 (95% CI: 7.8–30.9) in the core, 5.8 (CI: 2.6–12.9) in the buffer and 0.9 (CI: 0.09–10.1) km² in farm fallow to no duikers in the plantation. For Ogilby's duiker, densities ranged from 1.6 (95% CI: 0.7–3.7) km² in the core, 2.0 (CI: 0.8–5.1) in buffer to no duikers in farm fallow and plantation. The apparent absence of yellow-backed and Bay duikers may indicate local depletion. We call on all stakeholders to rise up to the challenge of rescuing this biological hotspot in Nigeria from further degradation and species loss through improved funding for well-equipped field staff and institutionalized community wildlife management.

Key words: conservation, densities, depletion, Duikers, land-use, population

Résumé

Dans toute l'Afrique de l'Ouest et l'Afrique centrale, les céphalophes sont importants pour le commerce et la consommation, et l'on s'attend à ce que leurs populations s'effondrent. Les informations fiables sur leur statut sont très rudimentaires au Nigéria. Nous avons évalué les populations de céphalophes dans le secteur d'Oban du *Cross River national Park* lors d'études diurnes et nocturnes le long de 32 transects de 2 km chacun. Après une étude portant sur 508 km, seuls le céphalophe d'Ogilby (*Cephalophus ogilbyi*) et le céphalophe bleu (*Philantomba monticola*) furent relevés. En utilisant l'habitat comme covariante en modélisant la probabilité de détection avec DISTANCE 6.0, nous avons estimé pour le céphalophe bleu des densités allant de 15.5 (95% d'intervalle de confiance, IC: 7.8–30.9) au centre, et de 5.8 (IC: 2.6–12.9) dans la zone tampon, à 0.9 (IC: 0.09 –10.1) km^{-2} dans les zones agricoles en jachères et aucun céphalophe dans la plantation. Pour le céphalophe d'Ogilby, les densités allaient de 1.6 (95% IC: 0.7–3.7) km^{-2} au centre, à 2.0 (IC: 0.8–5.1) dans la zone tampon et aucun dans les jachères et la plantation. L'absence apparente de céphalophes à dos jaune et à bande dorsale noire pourrait indiquer un épuisement local. Nous en appelons à toutes les parties prenantes pour qu'elles relèvent le défi et sauvent ce haut-lieu biologique nigérian de toute nouvelle dégradation et de toute nouvelle perte d'espèces grâce à un meilleur financement d'un personnel de terrain bien équipé et à l'institutionnalisation de la gestion communautaire de la faune.

Introduction

Exploitation of wildlife through hunting has always been an integral part of the African culture – albeit to different degrees in different parts of the continent (Mbotiji, 2002; Abedi-Lartey, 2004). The value of wildlife as a source of

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protein and income in West and Central Africa is well documented (Muchaal & Ngandjui, 1999; Wilkie & Carpenter, 1999; Bennett, 2002; Davis, 2002; Fa, Currie & Meeuwig, 2003; Willcox & Nambu, 2007), and it is accepted knowledge that the intensity of its use as bushmeat has been on the increase over time and is now exceeding sustainable levels (Newing, 2001; Fa & Brown, 2009; Mockrin *et al.*, 2011). According to Van Vliet & Nasi (2007), 84 mammalian species are under threat in the region due to hunting. Wilkie *et al.* (2005) predicted that if patterns of bushmeat consumption do not change, the demand for bushmeat will double in <20 years, and large-bodied species could be hunted to local extinction in many forests by 2020. This extinction of wildlife due to unsustainable uses may have serious consequences. It, therefore, calls for concerted local and international efforts to halt the crisis and work towards sustainability (Mbotiji, 2002).

In the last few decades, there have been some efforts at conserving the wildlife of tropical Africa with increase in the areas earmarked for biodiversity conservation (Struhsaker *et al.*, 2005; FAO, 2010). Despite the various efforts, paucity of reliable biological data on a scale that will enhance a thorough understanding of the problem within the subregion remains one of the greatest challenges associated with the bushmeat crisis in West and Central Africa (Caspary, 2001). The fact that many of the hunted species are now becoming locally extinct (Brashares, Arcese & Sam, 2001; Wilkie *et al.*, 2005) underlines the need to focus more on action/solution-oriented studies, which will address specific issues of sustainability.

Duikers are the most heavily hunted species across forested West and Central Africa (Muchaal & Ngandjui, 1999; Wilkie & Carpenter, 1999; Lwanga, 2006; Bifarin, Ajibola & Fadiyimu, 2008; Fa & Brown, 2009; Kumpel *et al.*, 2010). Just like other animals consumed as bushmeat, they contribute to household nutrition and economy (Fa & Brown, 2009). Duikers – like other ungulates – also play a vital ecological role in the stability of forest ecosystems, as both seed dispersers and prey (Wilson, 2001; Henschel, Abernethy & White, 2005; Jenny & Zuberbühler, 2005; Kortenhoven, 2009). Unfortunately, little is known about their ecology and demography (Happold, 1987; Newing, 2001; Van Vliet & Nasi, 2007; Kortenhoven, 2009; Mockrin, 2009; Van Vliet *et al.*, 2009). This is more particularly so in Nigeria (Happold, 1987; Nicholas, 2004). It is, therefore, necessary to generate useful data on their populations for sustainable management. This study was undertaken to estimate the current level of abundance, density and distribution of duikers in four land-use types within the Oban Sector of Cross River National Park (CRNP), Nigeria.

Materials and methods

The study area

The Oban Sector of Cross River National Park was carved out of Oban group Forest Reserve in 1991. It is located in the Cross River State, Nigeria, within latitudes 05°15′ and 05°25′N and longitudes 08°30′ and 08°45′E. The total area is about 3000 km^2 including: about 2064 km^2 core area, 366 Km^2 buffer and 140 km^2 fallow. The area of farm fallow is not specified as they occur in several locations and in varying sizes at the periphery of the park. The park shares a border with Korup National Park, Cameroon, in the east. Annual rainfall ranges between 2500 and 3000 mm. Altitude ranges from 100 to over 1000 m above sea level. Four vegetation types are distinguishable within the park. These include: high forest, ridge forest, secondary forest (buffer zone) and swamp forest. Patches of oil palm/cocoa plantations and farm fallows exist in various locations at the periphery of the park. Schmitt (1996) identified 1303 species of plants, 141 lichens and 56 mosses within the park. Seventy-seven of these are endemic to Nigeria. Fauna biodiversity includes 134 mammals, 318 birds, 42 snakes and over 1266 butterflies (Schmitt, 1996).

Data collection

The Oban Sector of Cross River National Park is divided into two corridors, the West and East corridors. With the permission of the park authorities, this study was conducted in the two corridors. Four villages were purposefully selected from these corridors viz: Old Netim/Obung (05°21′25″N, 08°26′ 24″E); Old Ekuri (05°53′00″N, 08°7′ 00″E) from the West and Aking/Osomba (05°25′67″N, 08°38′10″E); and Ekang (05°40′0″N, 08°49′00″E) from the East, based on their proximity to the Park (Fig. 1).

Using stratified sampling, 32 transects (2-km length each) were established. Two transects were located in each of the core (2064 km^2), buffer (366 Km^2), farm fallow (140 km^2) and plantation habitats close to each of the four villages. Transects were placed sufficiently far apart to avoid an object from being detected on two neighbouring

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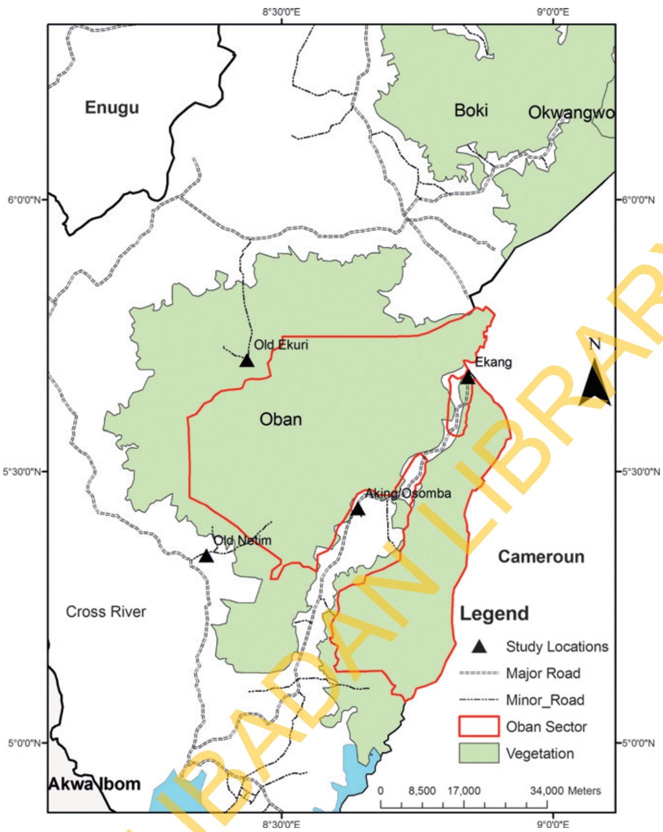

Fig 1 Map of Cross River National Park showing the study area

transects (Buckland *et al.*, 1993; Rovero & Marshall, 2004; Waltert *et al.*, 2006). Transects were allowed to rest for at least 6–7 days before the commencement of census walks on each transect. This was to allow the animals to recover from the disturbance during the cutting of transects. Thereafter, each transect was walked four times, to and fro, for both diurnal and nocturnal surveys, except for two transects, one each in the buffer and farm fallow, which were disturbed by rain on one occasion. This gives a total survey effort of 508 km.

The diurnal surveys were conducted between 6:30 and 10:00 hours and nocturnal surveys between 19:00 and 21:00 hours with the aid of torch light. The survey times between transects were alternated. When a transect was surveyed in the morning, the next survey was in the evening. The transects were walked at a speed of 1–1.5 km h^{-1} (Plumptre, 2000) depending on the topography. Perpendicular distances were measured to the nearest metre(s) from the line to the position of first sighting of each animal of interest (Buckland *et al.*, 1993; Fewster *et al.*, 2009). For each observation, the time, species, number of individuals, perpendicular distance and the position of the observer along the transect were also recorded. All measurements were taken using measuring tape graduated in metres.

The distance data were analysed using DISTANCE 6.0. We used 'stratum' (land-use type) as a covariate in modelling detection probability globally, and calculated density, encounter rate and abundance of each species in each habitat based on model selection criteria (AIC). Using land-use type as a covariate in detection probability, a correct detection probability estimate was generated for each stratum even when using pooled distance data from all strata, thus, avoiding the need to accumulate the usually recommended 60–80 observations.

Results

In spite of the 508-km survey effort, only two of the four species of duikers known in the region were recorded, namely blue duiker (*Philantomba monticola*) and Ogilby's duiker (*Cephalophus ogilbyi*). They were sighted 39 and 9 times, respectively (Table 1). A total of thirty (30) sightings were made in the core zone (close-canopy forest), 26

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Table 1 Number of sightings (N), encounter rate (ER), density (D) and 95% CI of D, for *Philantomba monticola* and *Cephalophus ogilbyi*, in each land-use type in the study area

	Philantomba monticola				*Cephalophus ogilbyi*			
	N	ER	D km^{-2}	CI	N	ER	D km^{-2}	CI
Close-canopy forest	26	0.21	15.5	7.8–30.9	4	0.03	1.6	0.7–3.3.7
Secondary forest	11	0.08	5.8	2.6–12.9	5	0.04	1.95	0.8–5.1
Farm fallow	2	0.02	0.93	0.09–10.1	0	–	–	–
Plantation	0	–	–	–	0	–	–	–
Mean	2.25	0.078	5.56			0.018	0.89	

ER in (sightings km^{-1}), N = number of sightings, D and CI in (individuals km^{-2}).

of these were *Philantomba monticola* and only four were *Cephalophus ogilbyi*. In the buffer zone (secondary forest), sixteen sightings were recorded, *Philantomba monticola* was sighted eleven times, while *Cephalophus ogilbyi* was sighted five times. Only two *Philantomba monticola* were sighted in the farm fallow at Old Ekuri. There were no sightings in the oil palm and cocoa plantations. The two larger duiker species previously reported in the region (yellow-backed, *C. sylvicultor* and Bay, *C. dorsalis*) were not sighted.

The Mean Encounter Rate (MER) for core zone was 0.21 km^{-1} for *P. monticola* and 0.03 km^{-1} for *C. ogilbyi*. The respective MER for *P. monticola* and *C. ogilbyi* in the buffer zone were 0.08 and 0.04 km^{-1}, while the MER for *P. monticola* in the farm fallow was 0.02 km^{-1}. The pooled MER for the four strata is 0.078 km^{-1} for blue duiker and 0.018 km^{-1} for Ogilby's duiker.

For blue duiker, estimated densities ranged from 15.5 in the core zone, 5.8 in buffer zone and 0.9 individuals km^{-2} in farm fallow to nil in the plantation. For Ogilby's duiker, estimated densities ranged from 1.6 individuals km^{-2} in the core zone, 2.0 in the buffer zone to nil in farm fallow and plantation. Based on these estimates, population sizes were estimated at a minimum of 16 000 individuals (lower bound of the 95% CI) for the blue duiker and 1600 individuals (lower bound of the 95% CI) for the Ogilby's duiker in the 2866 km^2 study area, with highest population estimates in the 2064 km^2 core area of the Park (lower bound of CI: 16 100 blue and 1400 Ogilby's duikers). The mean estimated density for blue duiker was 5.56 and 0.89 km^{-2} for Ogilby's duiker.

Discussion

According to Happold (1987), the Oban Sector of CRNP harbours four of the eight duiker species recorded in Nigeria. However, only two species were recorded in this study: the blue and the Ogilby's duikers. Two other large duiker species known to exist (bay and yellow-backed duikers) in the area were not recorded. Previous accounts of the status of these two species suggest that although present, they were already rare in the area (Happold, 1987). The absence of recent records of these two species could mean that both species might now be locally extinct because other studies (Oates, Bergl & Linder, 2004; Fa *et al.*, 2006; Eniang, Eniang & Akpan, 2008) in the area also failed to record them. Other protected areas in Africa seem to exhibit similar declines of larger duikers: Van Vliet *et al.* (2007) also found in Ipassa Reserve, Gabon, that one (bay duiker) of the three duiker species was being locally depleted. Rovero & Marshall (2004) and Nielsen (2006) in their separate studies in Udzungwa Mountains, a protected area in Tanzania, also reported that the Abbott duiker, although previously recorded, was no longer found in the area. This study may therefore provide some further empirical evidence of wildlife population depletion in Africa (Brashares, Arcese & Sam, 2001; Western, Russell & Cuthill, 2009; Craigie *et al.*, 2010). It also confirms that larger duikers are more severely affected by human pressures than the smaller species such as blue duiker. In Loma mountains non-hunting Forest Reserve, Sierra Leone, Kortenhoven (2009) recorded four duiker species: bay, black, Maxwell and yellow-backed duikers, with bay and yellow-backed duikers having MER of 0.89 and 0.13 km^{-1}, respectively, in this area also being an indication of declining populations.

It seems obvious that in the study area, blue duikers are more abundant than Ogilby's in all three habitat types, where duikers were recorded. This agrees with the observation of Viquerat *et al.* (2012), who also reported

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a slightly higher density for blue duiker (6.8–8.3 km^{-2}) than the Ogilby's duiker (6.5–4.3 km^{-2}) in Korup National Park, Cameroon. However, the density of blue duiker found in this study, particularly in the core of the park, seems to be higher than what was obtained for similar studies in the region: 10.5 km^{-2} (Noss, 1998), 9.7 km^{-2} (Lannoy *et al.*, 2003), 1.8–8.2 km^{-2} (Waltert *et al.*, 2006) and 6.8–8.3 km^{-2} (Viquerat *et al.*, 2012). This may be attributed to the fact that most of the sightings were made at Obung/Old Netim (Erokut Gate, which is closest to the Park Headquarters), where protection seems to be more effective compared with other sites. This further emphasizes the need and the potential for successes of increased protection efforts in the other parts of the park.

Encounter rates can be used as an index of relative abundance (Rovero & Marshall, 2004). The encounter rate of 0.02–0.21 animals km^{-1} for blue duiker in this study is close to the values obtained using line transects in other rainforest regions in Africa. For instance, Lannoy *et al.* (2003) recorded 0.33 km^{-1} in the rainforest of Gabon; Waltert *et al.* (2006) recorded 0.06–0.34 km^{-1} in Korup, Cameroon. However, the blue duiker's overall MER of 0.078 km^{-1} is much lower than the value obtained in Gabon (Lannoy *et al.*, 2003). The encounter rate for Ogilby's duiker (0.03–0.04 km^{-1}) was lower than the 0.28 km^{-1} obtained by Lannoy *et al.* (2003) and the 0.16 km^{-1} by Rovero & Marshall (2004). This agrees with the suggestion that the blue duiker is capable of maintaining its population under high hunting intensity due to a rapid growth rate (Lwanga, 2006). Although we did not estimate hunting pressure in the current study, our observation on the field indicates widespread hunting. In the course of the study, we encountered several hunters, many hunting trails and spent cartridges.

The relatively high MER obtained for blue duiker in this study may suggest that the current level of blue duiker population in the study area, especially in Obung/Old Netim, is moderate compared with other studies in similar forest formations in Africa (Lannoy *et al.*, 2003; Rovero & Marshall, 2004; Lwanga, 2006; Waltert *et al.*, 2006).

The density of Ogilby's duiker in this study is lower than those recorded in other regions of Africa (Noss, 1998; Muchaal & Ngandjui, 1999; Lannoy *et al.*, 2003). The result suggests that this species may be at risk in the area, probably due to hunting and land-use pressures, and if steps are not taken to control the level of off-take of the species in the area, the species may go the way of the other two species previously recorded.

When abundance of duikers was compared among the four land-use types, duikers were more frequent in the close-canopy forest (core of the Park) than in the secondary forest (buffer zone), farm fallow and plantation. Our expectation at the beginning of this study was that the density and abundance of blue duiker in the close-canopy and secondary forests might be similar because they share similar ecological characteristics. The high density and abundance of *P. monticola* in the close-canopy forest is contrary to the findings of Lwanga (2006), and Remis & Kpanou (2010) that secondary forests have greater potential for sustaining higher duiker populations than primary forest. Lwanga (2006) supports his view with the work of Wilkie and Finn (1990). However, our results suggest that the effect of habitat on duiker populations may have been masked by hunting pressure, which is higher in the secondary forest (buffer zone). This probably explains the higher density of *P. monticola* in the close-canopy forest. If this theory holds, then, it calls for increased efforts at sustainable management of secondary forest (buffer zone) in the Oban Sector of Cross River National Park.

The study shows that the Park still harbours reasonable duiker populations; however, as predicted by Wilkie *et al.* (2005), their populations seem to be on the decline and two species, bay and yellow-backed duiker, are suspected to be locally extinct. It is therefore imperative that awareness campaigns and protection efforts be improved upon in the Cross River National Park, particularly in areas farther away from the Park Headquarters.

We also recommend the introduction of community wildlife management as a strategy for strengthening conservation efforts in the study region while improved funding, well-equipped and adequately trained field staff are urgently required to save this remnant of the biologically diverse gulf of Guinea forest in Nigeria.

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