

Short Communication

Field surveys for the Endangered pygmy hippopotamus *Choeropsis liberiensis* in Sapo National Park, Liberia

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Abstract Conservation of a threatened species is reliant upon good quality monitoring information to provide population estimates and trends to inform management practices. Surveying to establish such data can be costly and difficult, particularly for cryptic species in forest habitats. We therefore used remotely triggered cameras to survey for the presence of the pygmy hippopotamus *Choeropsis liberiensis* in Sapo National Park in Liberia. In 1,247 trap days we obtained seven camera-trap photographs, the first photographic records of the species in Liberia. Habitat destruction, principally from illegal gold mining, is the greatest threat to the persistence of the pygmy hippopotamus within the Park. A range-wide survey of the pygmy hippopotamus is required to establish a robust baseline from which future conservation efforts can be developed. Understanding how this species is able to cope with the effects of habitat fragmentation across its range, and controlling commercial hunting, will dictate how it is able to survive the ongoing pressures of land conversion in West Africa.

Keywords Abundance, camera trap, *Choeropsis liberiensis*, Liberia, monitoring, pygmy hippopotamus, Sapo National Park, West Africa

Endemic to the Upper Guinean Forests of West Africa, the pygmy hippopotamus *Choeropsis liberiensis* has lost an estimated 75% of its former range and now occurs in seven remnant fragments across Sierra Leone, Guinea, Côte d'Ivoire and Liberia (Lewison & Oliver, 2008; Fig. 1). The species is categorized as Endangered on the IUCN Red List and the most recent population estimate, of c. 3,000, was made in the early 1990s (Lewison & Oliver, 2008). The main threats to the species include habitat fragmentation, land conversion and hunting (Roth et al., 2004). Its threatened

status, long independent evolutionary heritage, and ongoing threats make the pygmy hippopotamus a candidate for priority conservation attention (Isaac et al., 2007).

Conservation of the pygmy hippopotamus is hampered by a lack of basic biological knowledge, including details of distribution, population trends and ecology. Observational records of the species are scant because of its cryptic nature but the most acute period of range decline (inferred from habitat loss) has been over the past 3 decades (Lewison & Oliver, 2008). The largest fragment of the species' former range is the contiguous Upper Guinea forest in Liberia and Côte d'Ivoire and this area probably harbours the majority of the remaining population (IUCN Hippo Specialist Group, 2008). Priorities for the conservation of the pygmy hippopotamus include establishing a reliable method for assessing the sizes of the various populations, and monitoring the species in protected areas using census techniques (Lewison & Oliver, 2008).

Cost effective and accurate monitoring of rare and cryptic species is problematic. Transect methods using spoor and droppings must deal with differences in skill levels of those conducting the survey, and decay and defecation rates, all of which contribute to inaccuracy and increased variance in abundance estimates (Plumptre, 2000). Although the use of cameras triggered by the animals themselves is not new (Champion, 1927) it is only since the development of camera traps for wildlife monitoring in the early 1990s that their use has become more widespread. Camera-trap monitoring is rapidly gaining acceptance (Rowcliffe & Carbone, 2008) and new standardized camera-trap methods have been advocated for landscape-scale monitoring (O'Brien et al., 2010).

To begin to address conservation priorities for the pygmy hippopotamus we carried out camera-trap monitoring in Sapo National Park (Fig. 1), a stronghold of the species (IUCN Hippo Specialist Group, 2008). During the Liberian civil wars (1989–1996 and 1999–2003) many hundreds of hunters and gold miners inhabited the Park. Although the amount of wildlife killed was not recorded, pygmy hippopotamuses were reported anecdotally to be targets. A recent government led initiative has resulted in an estimated several thousand miners leaving the protected area. Their presence had resulted in habitat destruction, pollution of water courses, and commercial and subsistence hunting by the miners and their families.

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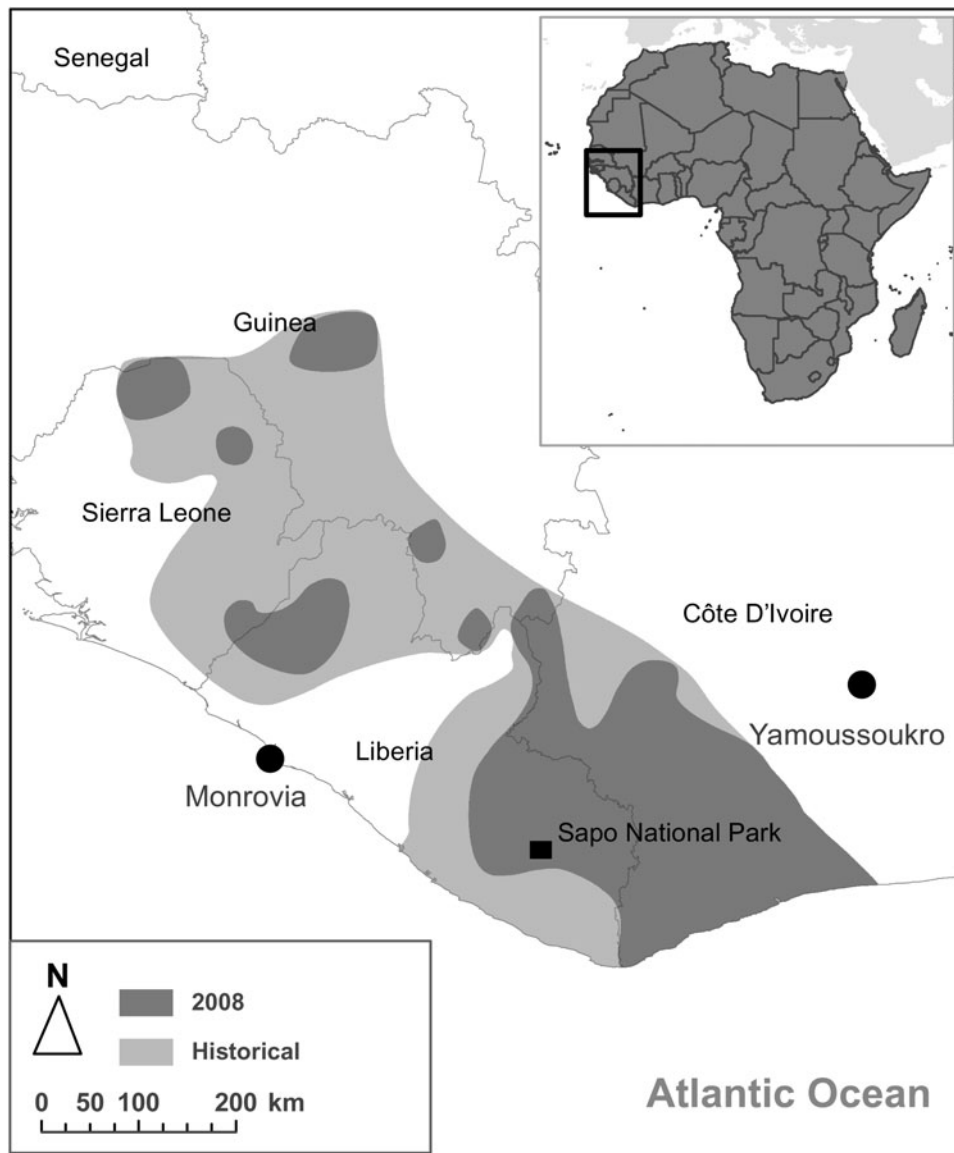


FIG. 1 The 2008 (dark grey) and historical (light grey) range of the pygmy hippopotamus *Choeropsis liberiensis*. This map excludes the Nigerian subpopulation, which is thought to be extinct (Lewison & Oliver, 2008). Inset indicates the location of the main figure in West Africa.

Although logging has ceased within Sapó National Park it continues elsewhere in the pygmy hippopotamus's range. The forests of Liberia declined by 2.9% between 1986 and 2000 (Christie et al., 2007) but rates were higher in Côte d'Ivoire. Land conversion continues at a rapid pace, principally because of agricultural expansion, wood extraction and infrastructure development (Norris et al., 2010).

We conducted a survey using infrared heat and motion triggered digital camera traps from 24 January to 23 March 2008. The survey was designed to detect wide ranging and cryptic species. Cameras were spaced at 2-km intervals (O'Brien et al., 2010) in Zone 1 of the Park (the Park has three administrative zones). We used 32 cameras set 40 cm from the ground (O'Brien et al., 2010). The centre of each grid square was located using a global positioning system, and cameras secured in an optimal location (e.g. recently

used animal trail), in a 100-m radius from the centre of the grid square. A total of 1,247 camera trap days were achieved.

Seven camera-trap events provided photographic records of pygmy hippopotamuses (Plate 1). All records were from the same camera trap station, in seasonally inundated primary forest on the inside of a river meander, just inside the 2005 boundary extension to the Park. Footprint and scat signs of the species were recorded in two further locations, both of which were in similar habitat. Lack of photographs from the other cameras could be because other cameras were located in different habitat (higher altitude, secondary forest). Although methods to estimate absolute density without the need for individual recognition continue to be developed (Rowcliffe et al., 2008) the number of trap events in this study were not sufficient to employ such methods. A more targeted survey, rather than the general scheme used here, is required.



PLATE 1 Camera-trap photograph of *Choeropsis liberiensis* in Sapo National Park (Fig. 1).

To optimize survey design for estimation of change in occupancy, or to calculate density of the pygmy hippopotamus, the grid size used should maximize the likelihood of encounter. An ideal grid to track changes in occupancy would have cells with an area approximately equal to home range size, such that changes in the population would generate changes in the proportion of area occupied (MacKenzie et al., 2002). Average home range for *C. liberiensis* is estimated to be 0.4–0.5 km² for females and 1.5 km² for males (Roth et al., 2004). Confirmation of pygmy hippopotamus home range sizes using radio telemetry would help guide the optimal grid size for measuring change in occupancy, which would provide an index of any change in abundance (O'Brien et al., 2010). If cells are smaller than average home range then the measure is a measure of intensity of habitat use (Royle & Nichols, 2003).

Refining and developing this camera trapping technique, in combination with sign surveys, could yield information on the status of the pygmy hippopotamus and on any population trends in Liberia and across its other range states, thus addressing the recommendations of the IUCN Hippo Specialist Group. A range-wide survey of the pygmy hippopotamus is required to establish a robust baseline from which future conservation efforts can be developed. It is important to gain an understanding of whether this species is able to cope with the long-term effects of habitat fragmentation across its range. Repeat surveys are now underway in Sapo National Park, and an extension of the survey area to other key sites across the species' range will begin in 2011.

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References

- CHAMPION, F.W. (1927) *With a Camera in Tiger Land*. Chatto and Windus, London, UK.
- CHRISTIE, T., STEININGER, M.K., JUHN, D. & PEAL, A. (2007) Fragmentation and clearance of Liberia's forests during 1986–2000. *Oryx*, 41, 539–543.
- ISAAC, N.J.B., TURVEY, S.T., COLLEN, B., WATERMAN, C. & BAILLIE, J.E.M. (2007) Mammals on the EDGE: conservation priorities based on threat and phylogeny. *PLoS One*, 2, e296. DOI: 210.1371/journal.pone.0000296
- IUCN HIPPO SPECIALIST GROUP (2008) *Hippo Specialist Group of the World Conservation Union*. <http://moray.ml.duke.edu/projects/hippos/> [accessed 11 November 2010].
- LEWISON, R. & OLIVER, W. (2008) *Choeropsis liberiensis*. In *IUCN Red List of Threatened Species v. 2010.4*. <http://www.iucnredlist.org> [accessed 11 November 2010].
- MACKENZIE, D.I., NICHOLS, J.D., LACHMAN, G.B., DROEGE, S., ROYLE, J.A. & LANGTIMM, C.A. (2002) Estimating site occupancy rates when detection probabilities are less than one. *Ecology*, 83, 2248–2255.
- NORRIS, K., ASASE, A., COLLEN, B., GOCKOWSKI, J., MASON, J., PHALAN, B. & WADE, A. (2010) Biodiversity in a forest–agriculture mosaic—the changing face of West African rainforests. *Biological Conservation*, 143, 2341–2350.
- O'BRIEN, T.G., BAILLIE, J.E.M., KRUEGER, L. & CUKE, M. (2010) The Wildlife Picture Index: monitoring top trophic levels. *Animal Conservation*, 13, 335–343.
- PLUMPTRE, A.J. (2000) Monitoring mammal populations with line transect techniques in African forests. *Journal of Applied Ecology*, 37, 356–368.
- ROTH, H.H., HOPPE-DOMINIK, B., MUHLENBERG, M., STEINHAEUER-BURKART, B. & FISCHER, F. (2004) Distribution and status of the hippopotamids in the Ivory Coast. *African Zoology*, 39, 211–224.
- ROWCLIFFE, J.M. & CARBONE, C. (2008) Surveys using camera traps: are we looking to a brighter future? *Animal Conservation*, 11, 185–186.
- ROWCLIFFE, J.M., FIELD, J., TURVEY, S.T. & CARBONE, C. (2008) Estimating animal density using camera traps without the need for individual recognition. *Journal of Applied Ecology*, 45, 1228–1236.
- ROYLE, J.A. & NICHOLS, J.D. (2003) Estimating abundance from repeated presence–absence data or point counts. *Ecology*, 84, 777–790.

Biographical sketches

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