

Camera Traps Confirm the Presence of the White-naped Mangabey *Cercocebus lunulatus* in Cape Three Points Forest Reserve, Western Ghana

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Abstract: The white-naped mangabey *Cercocebus lunulatus* is severely threatened by logging, mining, and hunting. In the last decade, wild populations have been confirmed in just three forested areas in Ghana and a handful of sites in neighboring Côte d'Ivoire and Burkina Faso. Sightings of this species were recently reported in a fourth area in Ghana, the Cape Three Points Forest Reserve, a forest patch in western Ghana, 60 km from the nearest recorded wild population, which is in the Ankasa Conservation Area. We deployed 14 camera traps across 21 different locations throughout the reserve, with the intention of confirming the presence of this species. Images of the white-naped mangabey were captured at four locations, consolidating recent evidence for a fourth sub-population of this species in Ghana and providing only the second-ever photograph of a wild member of this species in the country. We observed evidence of numerous illegal anthropogenic activities in the reserve, which threaten these mangabeys, and we make recommendations for the protection of the reserve, essential for the conservation of this highly endangered species.

Key words: Africa, camera trap, conservation, guenon, primate, rain forest

The White-naped Mangabey and its Forests

The white-naped mangabey *Cercocebus lunulatus* (Temminck, 1853) is endemic to the Upper Guinean rain forest of West Africa (Oates *et al.* 2016). Listed as a biodiversity hotspot, the rainforest is regarded as one of the world's top priority areas for conservation (Myers *et al.* 2000; Bakarr *et al.* 2004; Mittermeier and Rylands 2017); however, around 10 million hectares of rainforest have been lost during the last century through anthropogenic activities (Norris *et al.* 2010). Around 80% of the original forested area is now an agriculture-forest mosaic—a socio-ecological system of over 200 million people living adjacent to countless, small and diminished rainforest patches (Tallis and Kareiva 2006; Norris *et al.* 2010).

Forest fragmentation and degradation, along with hunting for bush meat, threaten the remaining populations of the white-naped mangabey and the species is now believed to be absent from several reserves and national parks with historical records of its presence (Oates 2006). Whilst currently listed as Endangered by the IUCN (Oates *et al.* 2016),

a potential upgrade to Critically Endangered status is currently being considered by the IUCN SSC Primate Specialist Group and the IUCN Red List Programme. Sightings of the white-naped mangabey, though rare, have been reported in Ghana and south-eastern Côte d'Ivoire within the last decade (Gatti 2010; Gonodele Bi *et al.* 2013; Osei *et al.* 2015; Danquah and Tetteh 2016). A recent camera-trap study resulted in the discovery of a new sub-population of this species in Atewa Forest and the first photographic evidence of the species in Ghana (A Rocha International 2017). This brought the total number of confirmed sub-populations of this species to nine; three in Ghana (Ankasa Conservation area – Gatti 2010; Atewa Forest – A Rocha International 2017; Kwabre forest – Osei *et al.* 2015), five in Côte d'Ivoire (McGraw 1998; McGraw and Oates 2002; Kone 2004; Galat and Galat-Luong 2006; McGraw *et al.* 2006) and one in Burkina Faso (Galat and Galat-Luong 2006).

There have been a number of primate surveys in the Cape Three Points Forest Reserve in recent years. The reserve is more than 60 km from the nearest known population of white-naped mangabeys (in the Ankasa Conservation Area), but the

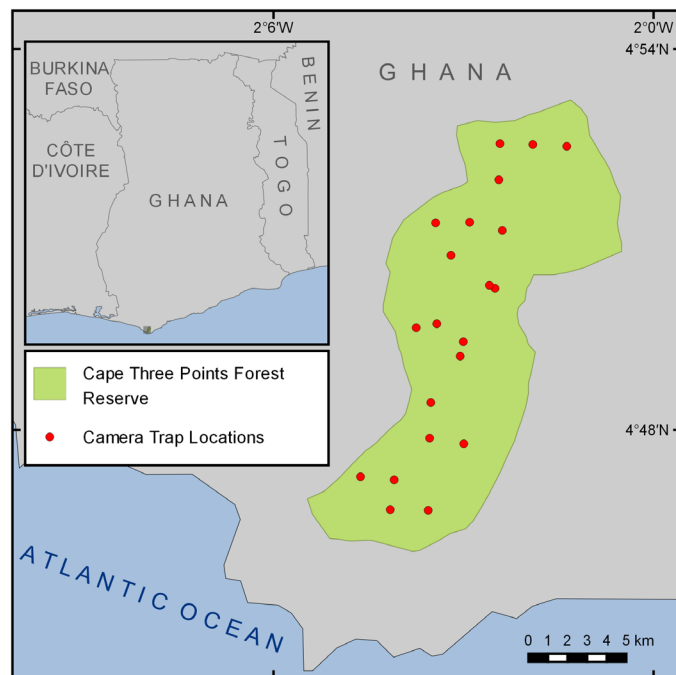


Figure 1. Locations of the camera traps deployed to confirm the existence of white-naped mangabeys in Cape Three Points Forest Reserve.

Cape Three Points Forest Reserve is within the historic range of the species. After a three-day survey with John F. Oates in 1987 (10 km walked in 11 hr and 45 minutes), Abedi-Lartey (1998) was able to report only that hunters indicated that it was still present (and reportedly the second most abundant monkey in the reserve). Abedi-Lartey (1998) saw evidence of heavy hunting and noted that the forest reserve was easily accessible, under intense pressure from local communities and itinerant illegal mineral prospectors, and that old and new farms cultivating oil palm ran right up to the reserve boundary. A survey by Gatti (2010) covered 50 km (36 hours and 30 minutes) and yet failed to see this species, but he noted that an ornithologist, Ben Phalan, had heard a group calling (see Holbech *et al.* 2018), that a captive juvenile had been confiscated in a nearby village, and that his team had seen them prior to his survey. However, an unpublished survey carried out in September/October 2011, organised by the NGO West African Primate Conservation Action (WAPCA) and led by David Osei, did record white-naped mangabeys in the reserve (WAPCA, WD & CRC, 2011). It was observed six times in groups of between eight and 25 individuals. In addition, an unpublished survey carried out in the reserve in August 2017 by Edward Wiafe, and covering 101 km, resulted in the sighting of a group of around five white-naped mangabeys (Wiafe 2017). The aim of our survey was to confirm the presence of this species in this reserve by using camera traps.

The Cape Three Points Forest Reserve and the Camera-trap Survey

The study took place between 25th January and 19th April 2018 in Cape Three Points Forest Reserve, an isolated forest fragment in the Western Region of Ghana (4°49'46.6"N,

2°02'58.5"W; Fig. 1.). The 51-km² reserve is an area of seasonal tropical forest that lies in the moist evergreen zone near the coast of Ghana (Hawthorne and Abu-Juam 1995; Gatti 2010). It has been designated as a Globally Significant Biodiversity Area (GSBA) by the Forestry Commission of Ghana and as an Important Bird and Biodiversity Area (IBA) by BirdLife International. The reserve is characterized by a series of irregular hills with elevations ranging from 90–150 m. Annual rainfall in the area is around 1400 mm (Abedi-Lartey 1998; Gatti 2010; BirdLife International 2018). The reserve is surrounded by small communities, farms and extensive rubber plantations, with some farms located in the reserve itself (Gatti 2010).

For the survey, the reserve was split into three, approximately equal-sized areas (north, central and south) where we placed the camera traps during non-overlapping time periods. Using a 1.2-km² grid system, each of the three areas was split into 14 grid squares. Of these 14 grid squares, seven were randomly selected as camera trap locations, yielding a total of 21 camera trap locations across the reserve (Fig. 1). Two camera traps were deployed at each sampling location; one camera trap was set at 50 cm above ground and one as close to the tree canopy as possible. This positioning ensured that both the arboreal and terrestrial movement of the white-naped mangabey could be sampled (McGraw *et al.* 2006). Ground camera traps were placed facing areas where vegetation did not obstruct their view, and canopy cameras were placed either in the same tree or on a neighboring tree large enough for a trained tree climber to reach the canopy. Canopy cameras were placed between 7.8 m and 18.1 m above the ground (mean = 14.1 m, SD \pm 2.9; Table 1), and were directed towards branches or vines that arboreal mammals may use as routes

Table 1. Camera trap locations, heights and the dates they were active during the survey of Cape Three Points Forest Reserve, Ghana.

Location	Dates trap was active	Height (m)	Notes
North			
1	25 February – 18 March	11.8	
2	25 February – 18 March	11.3	
3	25 February – 18 March	13.0	
4	25 February – 18 March	19.8	
5	26 February – 19 March	12.2	
6	26 February – 19 March	12.9	
7	26 February – 19 March	18.0	
Central			
1	3 February – 23 February	15.9	Canopy camera malfunctioned 3 February – 17 February
2	3 February – 23 February	18.1	
3	3 February – 23 February	14.9	Ground and canopy cameras malfunctioned 3 February – 17 February
4	3 February – 23 February	7.8	
5	4 February – 24 February	14.1	
6	4 February – 24 February	14.3	Canopy camera malfunctioned 4 February – 14 February
7	4 February – 24 February	12.0	Ground camera malfunctioned 4 February – 14 February
South			
1	20 March – 9 April	17.6	
2	20 March – 9 April	15.7	
3	20 March – 9 April	15.9	
4	20 March – 9 April	17.4	
5	21 March – 10 April	12.4	
6	21 March – 10 April	12.9	
7	21 March – 10 April	17.9	

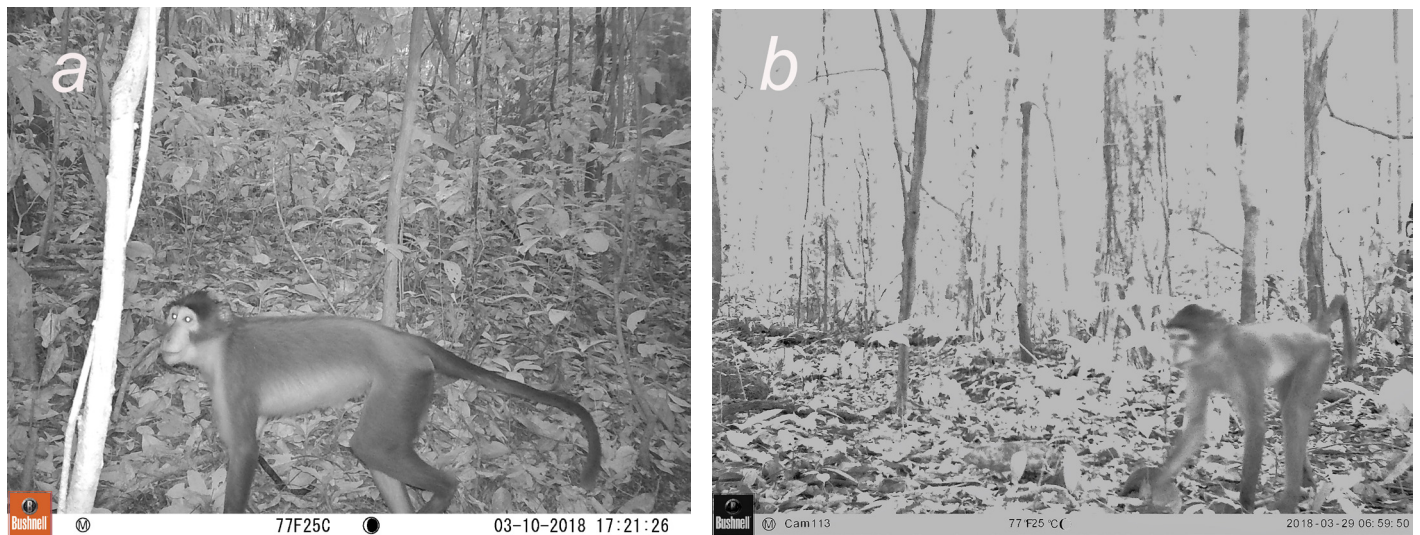


Figure 2. Camera trap images of white-naped mangabey *Cercocebus lunulatus* captured in the North (a) and South (b) areas of Cape Three Points Forest Reserve, Ghana.



Figure 3. Images of illegal anthropogenic activity observed in Cape Three Points Forest Reserve, Ghana, during this study; (a) a hunting snare and (b) an active logging site.

through the canopy (Bowler *et al.* 2007). Once set up, camera traps were left undisturbed for 20 days, with the exception of four locations in the central area where some cameras had to be reset once due to malfunctions (Table 1). Camera traps (Bushnell Trophy Cam HD, #119677) were programmed to take bursts of three pictures, with an interval of 60 seconds between bursts, once triggered by any movement within their detection range. Captures of species were considered independent events when a minimum of 30 minutes had elapsed between three-photograph bursts.

In total, camera traps were deployed for 778 camera trapping days. During this time, images of the white-naped mangabey were captured on four separate occasions, once each in the north and south areas and twice in the central area of the reserve (Fig. 1). In the images captured in the north and south of the reserve, one individual can be seen passing in front of the camera in the foreground (Figs. 2a and 2b). Numerous pieces of evidence of illegal anthropogenic

activity were observed in the reserve whilst conducting the study, including bullet shells and snares (Fig. 3a) for hunting, as well as active logging sites (Fig. 3b) and illegal galamsey mines (the Ghanaian term for gold mines). Although camera traps captured images of the white-naped mangabey's terrestrial behavior, no images of primates were captured by the canopy cameras. This was despite visual and audible evidence of the presence of other primate species in the reserve. In order to survey arboreal primates, it is important that cameras are placed as close to the canopy as possible as detection probabilities increase with height of placement (Bowler *et al.* 2017); in practice, however, this was not possible due to the limited height our tree climber could safely reach.

Surveys in the late 1990s failed to obtain sightings of monkeys (only Bosman's potto *Perodicticus potto*) in the reserve (Abedi-Lartey 1998; Oates *et al.* 2000). A more recent survey by Gatti (2010) resulted in sightings of Lowe's monkeys *Cercopithecus lowei* and spot-nosed monkeys *Cercopithecus*

petaurista, but again only reports of black-and-white colobus *Colobus vellerosus* and white-naped mangabeys. Another survey, in 2011, obtained sightings of white-naped mangabeys, along with olive colobus *Procolobus verus* and black-and-white colobus (WAPCA, WD & CRC 2011), and a 2017 survey recorded observations of spot-nosed monkeys, Lowe's monkeys, black-and-white colobus, olive colobus and a group of white-naped mangabeys (Wiafe 2017). Ours is the first published survey confirming the presence of the white-naped mangabey in Cape Three Points Forest Reserve by providing camera trap photographs as evidence. As is the case in other Ghanaian forests (for example, Atewa forest, A Rocha International 2017) this primate sub-population is threatened by significant anthropogenic activity.

We recommend that further protection should be considered immediately. This could include upgrading the forest reserve to a national park or conservation area (Oates 2006), thereby increasing protection of the forest through a greater authoritative presence (ranger patrols are currently required under the reserve's GSBA and IBA statuses, but are infrequent) and reducing illegal activities. Community-based initiatives could also be adopted as these have been found to be extremely successful in other areas of high biodiversity in Ghana (for example, reforestation activities, patrols and green value chains in the Tano-Ankasa Community Forest Project; Osei *et al.* 2015; WAPCA 2019). Community Resource Management Areas (CREMAs) are frequently deployed by the Wildlife Division of the Ghana Forestry Commission to manage natural resources; these involve the development of a constitution, bylaws and a natural resource management plan with local communities, giving them the authority to apprehend those conducting illegal activities (WAPCA 2019). Although a CREMA was previously set up for the Cape Three Points Forest Reserve, this is no longer operational; one approach could be to reinstate this agreement. In addition, this sub-population's extreme isolation from other breeding populations should be considered in any conservation plans. Dispersal corridors are unlikely to be feasible due to the distance from other populations, meaning translocations could be required to maintain genetic diversity.

Author Contributions

All authors contributed to the study design and provided feedback on the manuscript. Writing the article: RN and CS; fieldwork: RN and AW; camera trap image analysis: AW; assistance with fieldwork: JM, DO and AD; obtaining funding: MH.

Ethical Standards

Prior to conducting the study, ethical approval was granted by The University of Chester Faculty of Medicine, Dentistry and Life Sciences Research Ethics Committee (1373/17/RN/BS), and research permits were obtained from the Forestry Commission of Ghana (FCWD/GH-01 18/01/18).

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Literature Cited

- A Rocha International. 2017. Critically Endangered primate discovered in bauxite-threatened Atewa Forest Ghana. Press Release. URL: <<http://www.arocha.org/wp-content/uploads/2017/12/Press-release-15-Dec-2017-Critically-endangered-primate-discovered-in-bauxite-threatened-Atewa-Forest-Ghana.pdf>>. Accessed 2 November 2018.
- Abedi-Lartey, M. 1998. Survey of Endangered Forest Primates in Western Ghana. Unpublished report. Wildlife Department, Accra, Ghana. URL: <http://www.primatesg.org/storage/pdf/Abedi-Lartey_survey_report_1998.pdf>.
- Bakarr, M. I., J. F. Oates, J. Fahr, M. P. E. Parren, M. O. Rödel and R. Demey. 2004. Guinean forests of West Africa. In: *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions*, R. A. Mittermeier, P. Robles Gil, M. Hoffman, J. Pilgrim, T. Brooks, C. G. Mittermeier, J. Lamoreux and G. A. B. da Fonseca (eds.), pp.123–130. CEMEX, Agrupación Serra Madre, SC, Mexico.
- BirdLife International. 2018. Important Bird Areas fact-sheet: Cape Three Points Forest Reserve. URL: <<http://datazone.birdlife.org/site/factsheet/cape-three-points-forest-reserve-iba-ghana>>. Accessed 2 November 2018.
- Bowler, M. T., M. W. Tobler, B. A. Endress, M. P. Gilmore and M. J. Anderson. 2017. Estimating mammalian species richness and occupancy in tropical forest canopies with arboreal camera traps. *Remote Sens. Ecol. Conserv.* 3: 146–157.
- Danquah, E. and E. H. Tetteh. 2016. Logging activity adversely impacts primate diversity and density in the Kwabre Rainforest of Ghana. *Int. J. Ecol.* 2016: 1–8.
- Galat, G. and A. Galat-Luong. 2006. Hope for the survival of the Critically Endangered white-naped mangabey *Cercocebus atys lunulatus*: a new primate species for Burkina Faso. *Oryx* 40: 355–357.
- Gatti, S. 2010. Status of Primate Populations in Protected Areas Targeted Under The Community Forest Biodiversity Project. CFBP Report. West African Primate Conservation Action and Ghana Wildlife Division/Forestry Commission, Accra, Ghana. URL: http://www.primatesg.org/storage/pdf/Gatti_Prim_Pop_in_PAs_CFBP_Report_2010.pdf.

- Gonodele Bi, S.G., I. Koné, J.-C. K. Béné, A. E. Bitty, B. K. Akpatou, Z. Goné Bi, K. Ouattara and D. A. Koffi. 2008. Tanoé Forest, south-eastern Côte-d'Ivoire identified as a high priority site for the conservation of Critically Endangered primates in West Africa. *Trop. Conserv. Sci.* 1(3): 265–278.
- Hawthorne, W. and M. Abu-Juam. 1995. Forest protection in Ghana: with particular reference to vegetation and plant species. IUCN in collaboration with the Overseas Development Administration (ODA) and the Forest Department Republic of Ghana, Gland, Cambridge.
- Holbech, L. H., N. N. D. Annorbah, B. Phalan and N. Arcilla. 2018. Uncontrolled hunting and habitat degradation delineate and extirpate hornbills in Ghana, West Africa. *Biol. Conserv.* 223: 104–111.
- Koné, I. 2004. Report on Recent Primate Surveys in the Southeast of Ivory Coast. Unpublished report, Conservation des Espèces et des Populations Animales (CEPA), Schlierbach, France.
- McGraw, W. S. 1998. Three monkeys nearing extinction in the forest reserves of eastern Côte d'Ivoire. *Oryx* 32: 233–236.
- McGraw, W. S. and J. F. Oates. 2002. Evidence for a surviving population of Miss Waldron's red colobus. *Oryx* 36: 223–226.
- McGraw, W. S., L. Magnuson, R. Kormos and W. R. Konstant. 2006. White-naped mangabey, *Cercocebus atys lunulatus* (Temminck, 1853), in: *Primates in Peril: The World's 25 Most Endangered Primates, 2004–2006*, p.7, R. A. Mittermeier *et al.* (eds.), *Primate Conserv.* (20): 1–28.
- Mittermeier, R. A. and A. B. Rylands. 2017. Biodiversity Hotspots. In: *Encyclopedia of the Anthropocene. Volume 3: Biodiversity*, T. E. Lacher Jr. (ed.), pp.67–75. Elsevier Inc., New York.
- Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. B. da Fonseca and J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858.
- Norris, K., A. Asase, B. Collen, J. Gockowksi, J. Mason, B. Phalan and A. Wade. 2010. Biodiversity in a forest-agriculture mosaic – the changing face of West African rainforests. *Biol. Conserv.* 143: 2341–2350.
- Oates, J. F. 2006. Primate Conservation in the Forests of Western Ghana: Field Survey Results, 2005–2006. Unpublished Report. Forestry Commission, Accra, Ghana. URL: <http://www.primate-sg.org/storage/pdf/JFOsurveyReport_FINAL_16Sep2006.docx.pdf>.
- Oates, J. F., M. Abedi-Lartey, W. S. McGraw, T. T. Struhsaker and G. H. Whitesides. 2000. Extinction of a West African red colobus monkey. *Conserv. Biol.* 14: 1526–1532.
- Oates, J. F., S. Gippoliti and C. P. Groves. 2016. *Cercocebus lunulatus*. In IUCN Red List of Threatened Species 2016. <<http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T4206A92247225.en>> Accessed 2 November 2018.
- Osei, D., R. H. Horwich and J. M. Pittman. 2015. First sightings of the roloway monkey (*Cercopithecus diana roloway*) in Ghana in ten years and the status of other endangered primates in southwestern Ghana. *Afr. Primates* 10: 25–40.
- Tallis, H. and P. Kareiva. 2006. Shaping global environmental decisions using socio-ecological models. *Trends Ecol. Evol.* 21: 562–568.
- WAPCA. 2019. *Tano-Ankasa Community Forest Project*. West African Primate Conservation Action, Accra, Ghana (WAPCA). URL: <<https://www.wapca.org/field>>. Accessed 29 March 2019.
- WAPCA, WD & CRC. 2011. Primate Survey – Cape Three Points Forest Reserve. Unpublished report. West African Primate Conservation Action (WAPCA) Ghana and Wildlife Division (WD), with support from the Coastal Resources Center (CRC), Accra, Ghana.
- Wiawe, E. 2017. Survey of Endangered Primates in Three Forest Reserves in Ghana. Unpublished report. Presbyterian University College, Abetefi, Ghana and BirdLife International, Cambridge, UK.

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