



# Uncontrolled hunting and habitat degradation decimate and extirpate forest hornbills in Ghana, West Africa



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## ABSTRACT

Tropical forests are on the front lines of the current global extinction crisis. Species with restricted habitat requirements and slow reproductive rates, such as the spectacular hornbills (Bucerotidae) of the Paleotropics, are particularly vulnerable. We present the first long-term quantitative population assessment of nine forest hornbill species in Ghana, part of the Upper Guinea forest biodiversity hotspot in West Africa. From 1990 to 2009, hornbill encounter rates declined with 32–88% across eight species found in the region. Seven separate surveys between 1990 and 2014 indicated declines in at least six of eight species detected, with large-bodied species hardest hit. Depleted remnant populations of large hornbills mainly persist in two large and relatively well-protected wildlife reserves, Ankasa Resource Reserve and Kakum National Park. Contrastingly, the five largest species of the nine hornbills known to Bia Biosphere Reserve, one of Ghana's few forest wildlife reserves, apparently vanished completely since the 1990s, mainly due to uncontrolled hunting. Similarly, several large hornbills have disappeared from forest reserves where hunting is widespread. We conclude that uncontrolled hunting is the major driver of the recent drastic declines and population extirpations of large hornbills, while reductions in small insectivorous species may be related to extensive fragmentation and habitat disturbances of the Ghanaian forest biome. We call for urgent conservation action to prevent further declines and impending extirpations of forest hornbills and other wildlife in West Africa.

## 1. Introduction

Hornbills (Bucerotidae) are spectacular, charismatic paleotropical birds with advanced social behavior and cognitive abilities (Rainey et al., 2004), yet are declining throughout their range due to human impacts (Kemp, 2017). Large frugivorous forest hornbills require extensive tracts of continuous mature forest and seasonal fruit sources (Holbrook and Smith, 2000; Holbrook et al., 2002) and exhibit local migratory behavior (Holbrook et al., 2002; Rainey and Zuberbühler, 2007). Important seed dispersers facilitating forest regeneration (Whitney and Smith, 1998; Sethi and Howe, 2009), hornbills are prime indicators of ecological impacts of forest fragmentation and logging (Cordeiro and Howe, 2001). Hornbills' specialized nesting ecology requires spacious cavities in large, mature trees (Stauffer and Smith, 2004), commonly targeted by loggers (Kemp, 2017). Hornbills are

hunted for food and cultural uses (Holbech, 1998, 2015b), and subject for international trade (Trail, 2007; Collar, 2015). Unsustainable hunting and habitat degradation threaten hornbills in Asia (e.g., Collar, 2015), while detailed knowledge of African population trends is limited (e.g., Deikumah et al., 2014; Kemp, 2017).

West Africa is a region of particular concern for forest hornbills, where deforestation levels rate highest on the African continent (Kemp, 2017). Ghana hosts nine forest hornbill species in the easternmost part of the Upper Guinea forest biodiversity hotspot, where accelerating human impacts severely threaten vulnerable species (Norris et al., 2010; Hackman, 2014; Arcilla et al., 2015). Ghana's four largest forest hornbills are mainly frugivorous; Yellow-casqued Hornbill (*Ceratogymna elata*), Black-casqued Hornbill (*C. atrata*), Brown-cheeked Hornbill (*Bycanistes cylindricus*) and Grey-cheeked Hornbill (*B. subcylindricus*). Three species are medium-sized omnivores or insectivores:

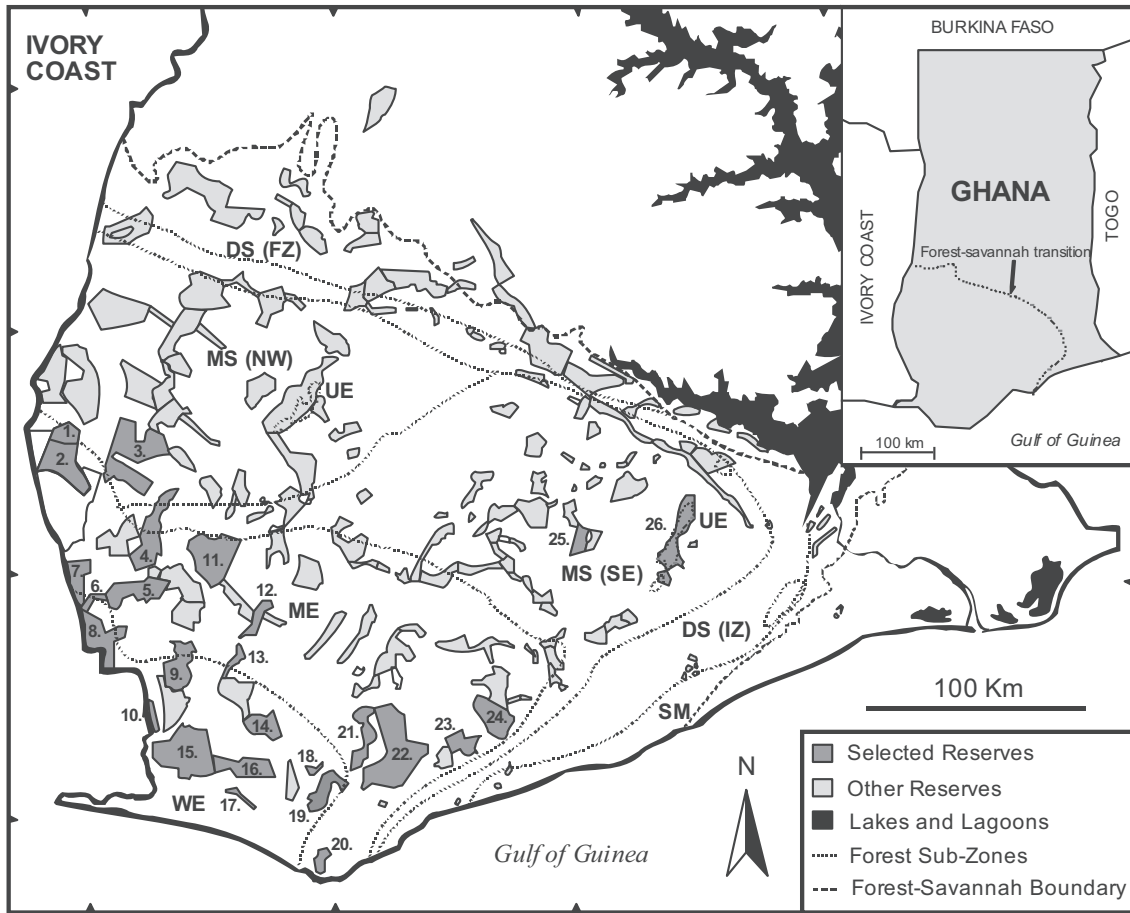
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**Fig. 1.** Map of study areas (dark shaded areas) in south-west Ghana; 1) Bia National Park (NP), 2) Bia Resource Reserve (RR), 3) Krokosua Hills Forest Reserve (FR), 4) Sui River FR, 5) Yoyo River FR, 6) Disue River FR, 7) Dadiaso FR, 8) Boin River FR, 9) Tano Nimri FR, 10) Jema-Assemkrom FR, 11) Suhuma FR, 12) Bura River FR, 13) Mamiri Forest Reserve, 14) Fure River FR, 15) Ankasa RR, 16) Draw River FR, 17) Ebi River Shelterbelt FR, 18) Neung North FR, 19) Neung South FR, 21) Bonsa River FR, 22) Subri River FR, 23) Pra Suhien FR, 24) Kakum NP, 25) Nsuensa FR, 26) Atewa Range FR. For simplicity, the 42 sites surveyed by NNDA are excluded here but appear in [Annorbah \(2016\)](#).

Western Piping Hornbill (*B. fistulator*), West African Pied Hornbill (*Lophoceros semifasciatus*) and Western Long-tailed Hornbill (*Horizoceros albocristatus*). The two smallest species are predominantly insectivores: Western Little Hornbill (*H. hartlaubi*) and Dwarf Hornbill (*L. camurus*). West African Pied Hornbills are superiorly versatile opportunists, frequenting a variety of anthropogenic forest habitats ([Holbech, 2005, 2009](#); [Manu et al., 2006](#); [Annorbah, 2016](#)).

Forest fragmentation disrupts hornbill metapopulations, increasing the vulnerability of particularly large species to logging and human exploitation in areas with poor habitat connectivity ([Beier et al., 2002](#); [Manu et al., 2006](#); [Dowsett-Lemaire and Dowsett, 2014](#)). The highly fragmented Ghanaian forest zone is a salient example, where < 20% of the originally 82,000 km<sup>2</sup> forest remains, mainly as > 200 reserves varying in size from < 5 to ~600 km<sup>2</sup> ([Hawthorne and Abu-Juam, 1995](#)). Ghanaian reserves are legally protected but increasingly impacted by anthropogenic activities ([Norris et al., 2010](#)), and the high edge to core ratio intensifies their vulnerability to habitat disturbances via illegal exploitation (e.g., [Oates et al., 2000](#); [Arcilla et al., 2015](#)). Here, we analyze empirical data on nine Ghanaian forest hornbills from 1990 to 2014, with the purpose of: (1) comparing past and present forest hornbill abundances; (2) estimating current and future population trends; (3) recommending conservation measures addressing threats to hornbills in Ghana's remaining Upper Guinea forests.

## 2. Material and methods

### 2.1. Study area

Our study comprised semi-deciduous and evergreen forests (annual rainfall between ~1500 and ~2000 mm) in southwestern Ghana ([Hawthorne and Abu-Juam, 1995](#)). Protected forests include forest reserves (FRs) and wildlife reserves, including national parks (NPs), wildlife sanctuaries (WSs) and resource reserves (RRs), respectively under the Forestry Commission of Ghana's Forest Services Division and Wildlife Division jurisdictions. In FRs, selective logging is legally permitted, but extensive illegal logging has caused recent forest bird declines ([Arcilla et al., 2015](#)). Logging in wildlife reserves is prohibited, although all RRs underwent past logging. Bia NP with Bia RR constitute a UNESCO biosphere reserve/world heritage site, the latter logged during 1977–1998, initially disturbing maximum ~27% of ground area with ~3% infrastructure-related loss ([Hawthorne, 1993](#)), subsequently intensifying towards 1998. Moderate logging of Ankasa RR (hereafter Ankasa) ceased in 1975. Logging is prohibited in NPs (e.g., Bia NP), though Kakum NP (hereafter Kakum) was logged before its gazettement. Hunting is prohibited in all wildlife reserves and FRs, but poaching is pervasive, critically decimating populations of mammals and birds (e.g., [Oates et al., 2000](#); [Annorbah, 2016](#)). We conducted all research under Forestry Commission permits, using only non-invasive bird census techniques. Bird nomenclature follows Handbook of the Birds of the World Alive ([Kemp, 2017](#)).

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