*Primate Conservation* 2017 (31): 37-48

# The Conservation Status of Two Threatened Primates in the Korup Region, Southwest Cameroon

K. Serge Bobo[1,2], C. Bonito Ntumwel[1], F. Florence Aghomo[1] and K. G. Aurele Ayemele[1]

[1]*Department of Forestry, Faculty of Agronomy and Agricultural Sciences, University of Dschang, Dschang, Cameroon*
[2]*School for the Training of Wildlife Specialists Garoua, Ministry of Forestry and Wildlife, Garoua, Cameroon*

**Abstract:** Primary users of wildlife have only rarely been considered in determining the status of threatened species. There is no recent information on the status of *Piliocolobus preussi* (Critically Endangered) and *Cercocebus torquatus* (Vulnerable) in southwestern Cameroon. This study documents the status of both primates using data collected in Korup National Park (KNP), Banyang-Mbo Wildlife Sanctuary (BMWS), and Nkwende-Hills (NHFR), Nta-Ali (NAFR) and Rumpi-Hills (RHFR) forest reserves, referred to as the Korup region (KR). The study area is an important portion of both species' ranges in the West Africa Biodiversity Hotspot. We were specifically interested in confirming the presence/absence of each species per site, identifying threats, evaluating trends in abundance and, using the International Union for the Conservation of Nature (IUCN) classification categories and criteria in assessing the conservation status for both species. We interviewed 178 hunters from 31 peripheral villages, and collected data on 286.9 km of recce walks in the Korup region. Statistical comparisons of mean perceptions of hunters showed *P. preussi* to be significantly present in KNP (88.9%), but not in NHFR (65.6%) and BMWS (57.7%), and *C. torquatus* to be significantly present in NHFR (100%) and BMWS (96.7%), but not in KNP (77.8%). According to 54.9% and 53.9% of the hunters interviewed, poaching is the main threat to the respective species. Habitat loss is also important. Data from the last ten years shows a proportional decline in relative abundance of 83.4% and 53.4% for *P. preussi* and *C. torquatus*, respectively. We suspect a decline in the extent of occurrence and/or habitat quality in the Korup Region. In order to ensure awareness of the needs for their conservation, we recommend that *C. torquatus* be classified as Endangered (A2bc), and *P. preussi* be maintained as Critically Endangered (A2bc) because of the estimated declines of ≥50% and 80%, respectively, based on encounter rate, and suspected decline in the extent of occurrence and habitat quality.

**Keywords:** Conservation status, hunters' interviews, Korup Region, Cameroon, red-capped mangabey, Preuss's red colobus, threatened species

## Introduction

In 2002, the Convention on Biological Diversity, recognizing its impact on human well-being, adopted the target of achieving a significant reduction in the current rate of biodiversity loss (UNEP 2002). However, despite growing investment in nature conservation, and a global increase in the area under protection since 2002, key habitats for threatened species are still not adequately protected (UN 2010), leading to the observed extinction of species.

Cameroon's forests are essential for the conservation of African biodiversity (Doumenge *et al.* 2001), and those of the Korup Region are especially important, not only in Africa (Oates *et al*. 2004), but also globally (Myers *et al*. 2000). These forests along the Cameroonian-Nigerian border represent the largest remaining tracts in the entire West African Biodiversity Hotspot (Myers *et al.* 2000). With 15 species, eight of them diurnal, they are of special importance for the conservation of African primates (Waltert *et al.* 2002). In spite of the conservation measures that have been developed in West Africa, poaching there and throughout the Congo basin, and particularly in Cameroon, remains the biggest threat to more than 80 species and subspecies of mammals, including 17 primates (WWF 2008). Large-scale habitat conversion for industrial oil palm plantations is also imminent (IUCN 2010; Kupsh *et al.* 2014).

These threats have grown and intensified, and there are fewer primates now than ever before (Mittermeier *et al.*

2005). Relatively low population densities of primates, paired with intensive hunting (Photo 1) beyond sustainable rates of extraction, have been observed since the 1990s (Pollard 1997; Usongo 1997). To inform of threats to primates worldwide, the Species Survival Commission (SSC) of IUCN regularly updates information on their status through the Red List. No recent information exists, however, on the status of two of the most threatened large primates occurring in the Korup Region of southwest Cameroon and Ebo National Park of Littoral Cameroon: Preuss's red colobus *Piliocolobus preussi*[1] (CR A2cd) and the red-capped mangabey *Cercocebus torquatus* (VU A2cd) (IUCN 2010). These have been classified as such due to assumed declines of 80% and 30% in their abundance over the past three generations, as well as being continually impacted by overexploitation in the bushmeat trade (Linder, 2008; IUCN 2010). Older reports also reveal that both species face imminent local extinction (Waltert *et al.* 2002). In the study area, little consideration has been given to the use of information from the primary users of wildlife in determining the status of a species; however, local hunters have a vast knowledge of their abundance, distribution and threats in the forests where they hunt. Here we report on data collected from interviews of hunters and from surveys on hunter trails to help determine the status of *P. preussi* and *C. torquatus* in the Korup region.

**Photo 1.** Carcass of a red-capped mangabey in Osselle village (periphery of Nkwende hills forest reserve).

## Methods

*The Korup region*

The Korup region is the core of the ranges of *Piliocolobus preussi* and *Cercocebus torquatus* in the Gulf of Guinea forests (Waltert *et al.* 2002; Willcox and Nambu 2007; Linder 2008; Oates *et al.* 2008). Red-capped mangabeys range patchily from southwest Nigeria, west of the Niger River, through the southwest of Cameroon and Equatorial Guinea, to Gabon and south Congo (Ehardt 2013). Preuss's red colobus is believed to have had a similar range in the past, from the Cross River in Nigeria south to the Ebo Forest, just north of the Sanaga River (Butynski and Kingdon 2013). Its range today is largely restricted to the Korup Region. In 2001 it was recorded in the Ebo National Park, in the littoral region of Cameroon (Dowsett-Lemaire and Dowsett 2001).

The Korup region is in the southwest of Cameroon, from 05°36'32.9" to 09°10'50.1"N and from 05°14'50.0" to 08°42'44.8"E, in UTM Zone 32N. It encloses five protected areas—the Korup National Park (126,000 ha), Nkwende Hills Forest Reserve (40,982 ha), Rumpi Hills Forest Reserve (45,675 ha), Nta-Ali Forest Reserve (27,835 ha) and the Banyang-Mbo Wildlife Sanctuary (66,220 ha) (Fig. 1). Korup National Park (KNP) is situated within the Ndian and Manyu divisions, and the northeastern part of the park is continuous with the Nkwende Hills Forest Reserve (NHFR). It lies to the West of Nguti − Mamfe road and the base of these hills is in Mgbegati village. Part of Nkwende Hill extends to Okoroba village at 705 m above sea level, with rock faces commonly called "chimpanzee stone," alleged to be a refuge for chimpanzees. The Nta-Ali Forest Reserve (NAFR) is located in the Manyu division and the Rumpi Hills Forest Reserve is in the Ndian division. Lastly, the Banyang-Mbo Wildlife Sanctuary (BMWS) is situated between Kupe-Manengouba and Manyu divisions. The forest around the sanctuary has been converted into secondary vegetation due to logging and agricultural activities around surrounding villages. Intact primary forests, however, can still be found in the higher elevations in Nkwende Hills Forest Reserve (Ndeh *et al.* 2002) and around Mount Rata in the Rumpi Hills Forest Reserve (Fomete and Tchanou 1998). Nta-Ali Forest Reserve is a relatively degraded forest and has recently been reclassified as Forest Management Unit 11-006 (Cameroon, MINEF 2002). In this study, 31 villages were selected, all close to these protected areas. Details on climate, geological conditions, topography, vegetation and fauna are found in the management plans of the protected areas (Cameroon, MINEF 2001, 2002; Ndeh *et al.* 2002; Cameroon, MINFOF 2008).

Because most of the villages around these PAs are remote and inaccessible, they tend to be quite small (Vabi 1999). They are headed by chiefs assisted by regent chiefs. Local institutions involved in wildlife conservation issues are the Forest Management Committees, Ekpe Society, and the traditional council.

*Data collection*

From August to October 2011 and April to September 2012, data were collected by addressing questionnaires to 178 resident male bushmeat hunters, all of whom agreed to be interviewed. We gave preference to hunters who hunted primates, and asked questions on presence/absence (P/A), sites where they occurred, and threats faced by both species. Informal discussions and observations were also noted. Before

1 Taxonomy follows Groves (2007).

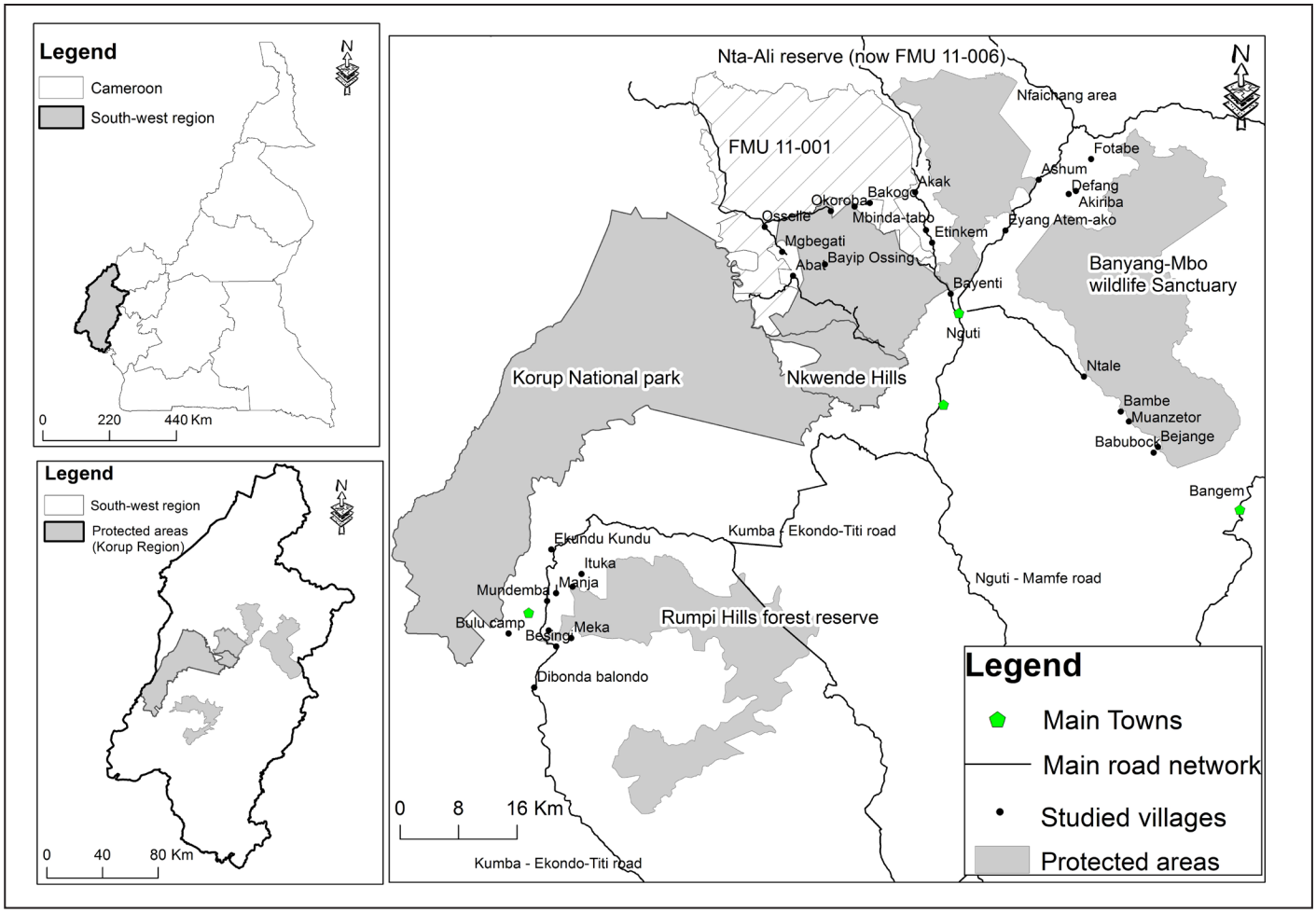


**Figure 1.** Study area.

interviews, we showed them pictures of each of the primates. If the hunter recognised the species, we asked them for the local name and a brief description of the species behavior to ensure correct identification. Guided by hunters, we also visited sites where both species had been observed recently. We walked a total of 286.9 km of hunter trails along sites where the species were recently observed, noting direct observation and indirect evidence (calls) of the primates, and signs of human activities (hunter camps [Photo 2], gun cartridge shells, traps, gunshots, hunter tracks, etc.).

*Data analysis*

Presence/absence, opinions on trends in abundance, and records of both species were evaluated based on the strength of the statistical differences between the mean proportions of hunter's opinions. Kruskal-Wallis Analysis of Variance (ANOVA) was used to compare perceptions between protected areas; Mann-Whitney U and Wald-Wolfowitz Runs Tests were used to compare the hunters' opinions in the protected areas. No correction factor was applied to the p-values for paired tests. Alpha levels were set at 0.05 (95%).

For each site, when the mean proportion of opinions of presence was greater than or equal to 50% and significantly higher than the mean proportion of opinions of absence, the species was considered "present." When the difference was not significant, the species was considered as "could be present." When the mean proportion of absence opinions was greater than 50% and significantly higher or not than

**Photo 2.** One of the many hunter camps and local guns used during hunting expeditions.

presence opinions, the species was considered as "could be absent." Temporal trends were based on the statistical differences between hunters opinions on P/A status 30 years ago and P/A status today, and categorized as either "significant decline," "suspected decline," "probable decline," "or stable" on a trend map.

Encounter rates (ER = number of group sightings and vocalizations/km) were computed for both species per site and used as an index for evaluating trends according to IUCN species classification criteria (IUCN 2011). Here, declines are measured over a period of 10 years or three generations (criteria A) using an index of abundance appropriate to the taxon (e.g. ER for primates as in Waltert *et al.* 2002; Flinkerbusch 2011), which can be used to satisfy criteria A2b. Suspected changes in ER of both species were estimated by comparing current ER with those recorded 10 years ago in all sites where data were available despite the difference between both survey approaches (present and historical) used in the same sites.

## Results

*Red-capped mangabey: Presence/absence and trend of abundance*

Using a Wald-Wolfowitz Runs Test (Table 1), we found that the number of hunters indicating presence was significantly higher than those indicating the absence of *C. torquatus* in Nkwende Hills Forest Reserve and Banyang-Mbo Wildlife Sanctuary. Although more hunters indicated that red-capped mangabeys were present in Korup National Park (77.8%) and Nta-Ali Forest Reserve (73.5%) than those who indicated they were absent, the difference was not statistically significant. For the Rumpi Hills Forest Reserve the number of hunters indicating that the mangabeys were absent was significantly higher than the number who said they were present. According to hunters, therefore, *C. torquatus* is present in the Nkwende Hills Forest Reserve and the Banyang-Mbo Wildlife Sanctuary, could be present in Korup National Park and Nta-Ali Forest Reserve, and could be absent from the Rumpi Hills Forest Reserve. Perceptions of hunters on the presence of *C. torquatus* 30 years ago reveal that the species was previously abundant in Nkwende Hills Forest Reserve and Korup National Park, and to a lesser extent in Banyang-Mbo Wildlife Sanctuary and Nta-Ali Forest Reserve, but was already very scarce or near extinction in the Rumpi Hills Forest Reserve (Fig. 2).

*Preuss's red colobus: Presence/absence and trend of abundance*

According to Table 1, we found that the number of hunters indicating presence was significantly higher than those indicating the absence of *P. preussi* in Korup National Park. Although more hunters indicated that Preuss's red colobus were present in the Nkwende Hills Forest Reserve (65.6%) and Banyang-Mbo Wildlife Sanctuary (58.7%) than those who indicated they were absent, the differences were not statistically significant. In Nta-Ali Forest Reserve and the Rumpi Hills Forest Reserve the number of hunters indicating that *P. preussi* was absent was higher (70.6% and 64.7%) than the number who said they were present, but the differences were not significant. According to the hunters, therefore, *P. preussi* is present in Korup National Park, could be present in the Nkwende Hills Forest Reserve and Banyang-Mbo Wildlife Sanctuary, and could be absent in the Rumpi Hills Forest Reserve and Nta-Ali Forest Reserve. Perceptions of hunters on the presence status of *P. preussi* 30 years ago reveal that the species was previously abundant in the Nkwende Hills Forest Reserve and Korup National Park and, to lesser extent in Banyang-Mbo Wildlife Sanctuary and Nta-Ali Forest Reserve, but was already very scarce or near extinction in the Rumpi Hills Forest Reserve (Fig. 3).

*Hunters' perceptions on the sites of location of both species*

The main site where both species can be encountered is Korup National Park as revealed by 34.4% and 35.3% of all interviewed hunters for *P. preussi* and *C. torquatus*, respectively (Fig. 4). Other sites where both species can be encountered, according to hunters, include Banyang-Mbo Wildlife

**Table 1.** Confirmation of hunters on P/A of *Cercocebus torquatus* and *Piliocolobus preussi* in the study area.

| Species | Site | Proportion of presence opinion | Proportion of absence opinion | Z-value | *p*- value |
|---|---|---|---|---|---|
| *Cercocebus torquatus** | NHFR (61) | 100 | 0 | -3.33 | 0.000 |
| | BMWS (60) | 96.7 | 3.3 | -3.88 | 0.000 |
| | KNP (9) | 77.8 | 22.2 | -0.76 | 0.445 |
| | NAFR (34) | 73.5 | 26.5 | 1.34 | 0.179 |
| | RHFR (14) | 14.3 | 85.7 | -2.81 | 0.016 |
| *Piliocolobus preussi*** | NHFR (61) | 65.6 | 34.4 | 2.24 | 0.065 |
| | BMWS (60) | 58.7 | 41.3 | 0.88 | 0.377 |
| | KNP (9) | 88.9 | 11.1 | 2.165 | 0.030 |
| | NAFR (34) | 29.4 | 70.6 | -1.46 | 0.143 |
| | RHFR (14) | 35.3 | 64.7 | -1.28 | 0.200 |

* hunters' opinions compared using Wald-Wolfowitz Runs Test: ** hunters' opinions compared using Mann-Witney U Test. NHFR = Nkwende Hills Forest Reserve; BMWS = Banyang-Mbo Wildlife Sanctuary; KNP = Korup National Park; NAFR = Nta-Ali Forest Reserve; RHFR = Rumpi Hills Forest Reserve. In parentheses: the sample size or the number of hunters interviewed around each protected area.

Sanctuary, the Nkwende Hills Forest Reserve and the Forest Management Unit (FMU) 11-001.

*Encounter rates compared with those 10 years ago*

Over 286.9 km covered, *P. preussi* was encountered only in Korup National Park (ER = 0.02 groups/km), while *C. torquatus* was encountered in Korup National Park (ER = 0.01 groups/km), Banyang-Mbo Wildlife Sanctuary (ER = 0.03 groups/km) and Nkwende Hills Forest Reserve (ER = 0.05 groups/km).

*Cercocebus torquatus* is suspected to have undergone a decline in ER of 97.7% in Banyang-Mbo Wildlife Sanctuary, between 2000 and 2012 (Table 2). In Korup National Park, from 2001−2003 to 2012, the species' trend has been stable. In the Nkwende Hills Forest Reserve, the negative but minor change suggests that the species is stable or fluctuating. Nta-Ali Forest Reserve showed a decline of 100%.

The ER of *P. preussi* has declined by 66.7% in Korup National Park (Table 2). The species was not encountered in previous surveys of Banyang-Mbo Wildlife Sanctuary and the Nta-Ali Forest Reserve. It is believed absent in the Nkwende Hills Forest Reserve, suggesting an estimated decline of 100% (Table 2).

Altogether, in the Korup region, *P. preussi* has undergone a mean decline of 83.4% and *C. torquatus* has undergone a mean decline of 53.4%. Based on the perceptions of hunters, ER, and field observations, we also suspect a decline in the extent of occurrence and or habitat quality of both species in the Korup region.

*Threats to the red-capped mangabey and Preuss's red colobus in the Korup region*

Our data reveal that overhunting, habitat destruction, trapping, disease, predation, and hunting with dogs are the main threats to both species. There are significant differences between the hunters' perceptions on threats to *C. torquatus* and *P. preussi* (Kruskal-Wallis ANOVA: H (7, N = 40) = 25.469; $p < 0.00$). Hunting is the main threat for *C. torquatus* and *P. preussi* according to 53.9% and 54.9% of the hunters, respectively, ranking significantly higher than habitat destruction for *C. torquatus* (Z = -2.68; $p = 0.007$) and *P. preussi* (Z = -2.68; $p = 0.007$). In general, overhunting was significantly higher than other threats in all sites ($p < 0.05$).

Habitat destruction is the second most salient threat according to 29.8% and 28.7% of hunters for *C. torquatus* and *P. preussi*, respectively.

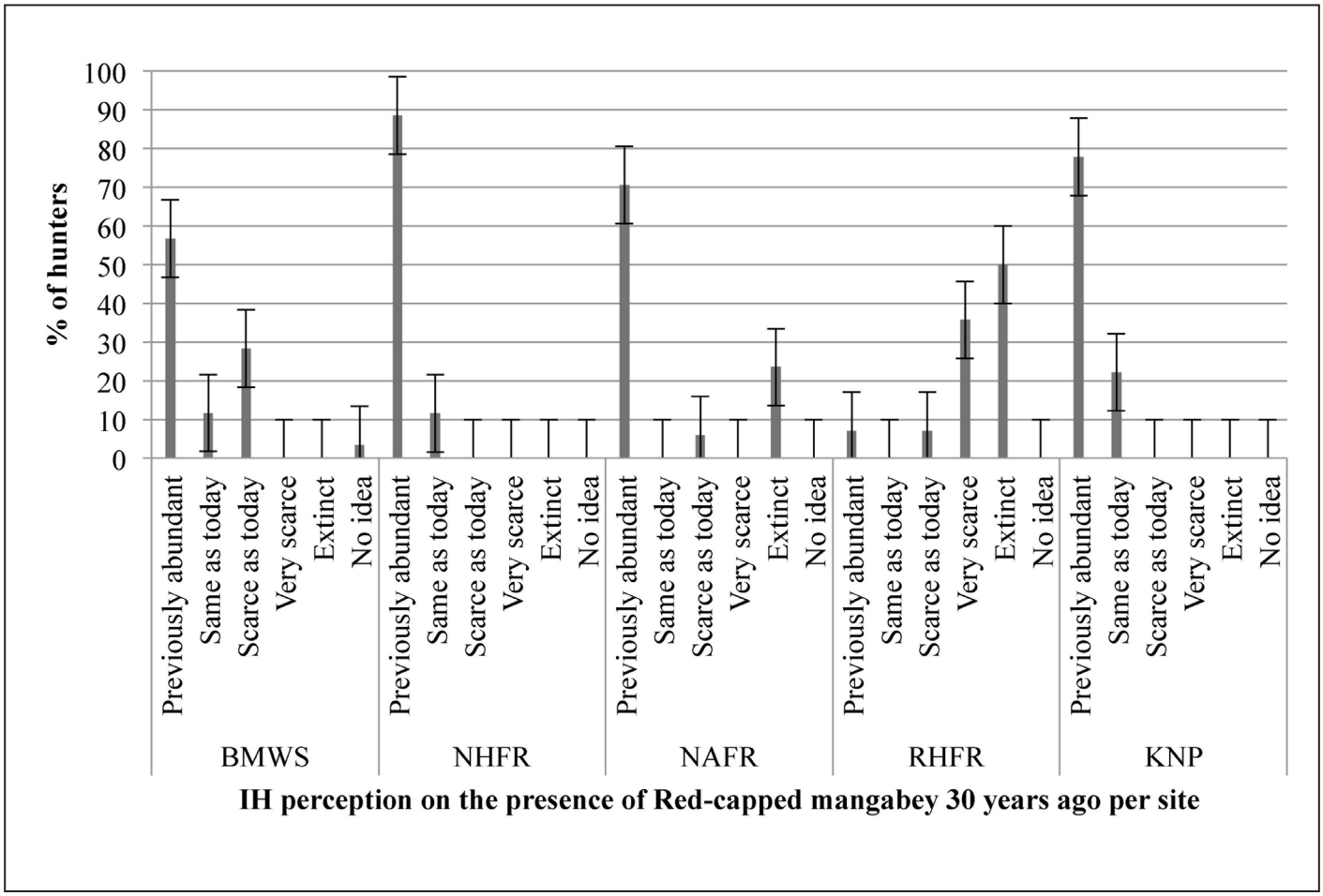


**Figure 2.** Perception of hunters on the trend of abundance of red-capped mangabey in the Korup region. KNP = Korup National Park; BMWS = Banyang-Mbo Wildlife Sanctuary; NHFR = Nkwende Hills Forest Reserve; NAFR = Nta-Ali Forest Reserve; RHFR = Rumpi Hills Forest Reserve. The error bars represent the standard error of the mean.

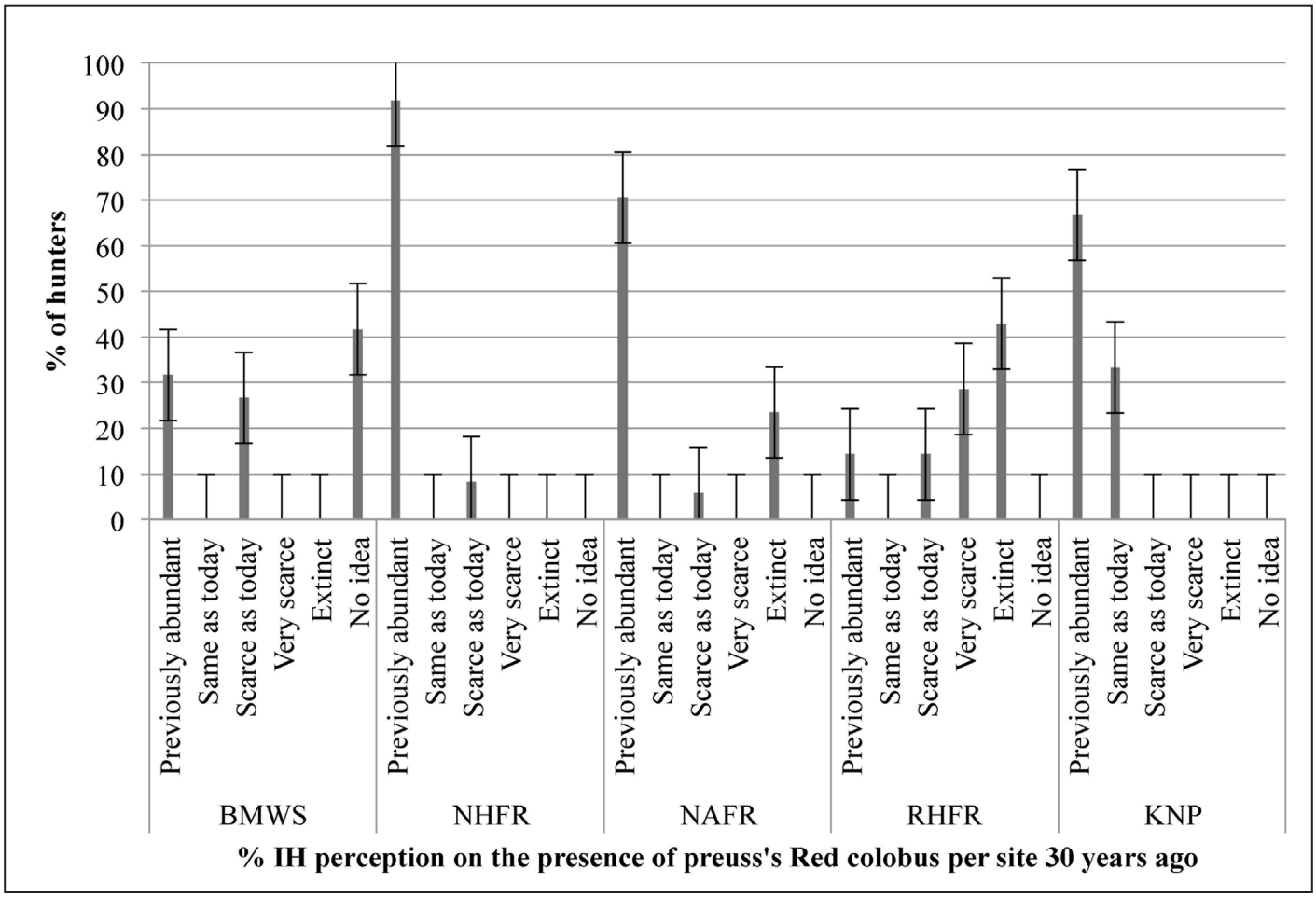


**Figure 3.** Perception of hunters on the trend of abundance of Preuss's red Colobus in the Korup region. KNP = Korup National Park; BMWS = Banyang-Mbo Wildlife Sanctuary; NHFR = Nkwende Hills Forest Reserve; NAFR = Nta-Ali Forest Reserve; RHFR = Rumpi Hills Forest Reserve. The error bars represent the standard error of the mean.

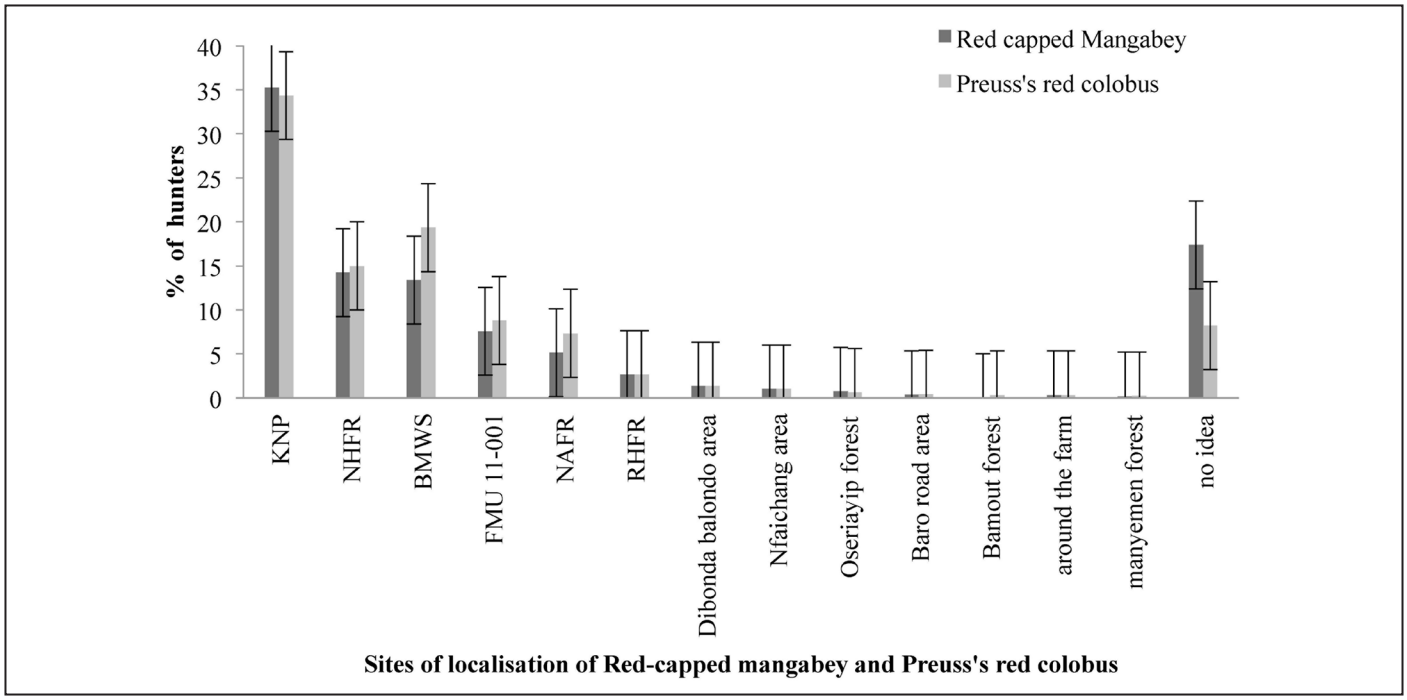


**Figure 4.** Perception of hunters on the possible sites of localisation of both species in the Korup region. KNP = Korup National Park; BMWS = Banyang-Mbo Wildlife Sanctuary; NHFR = Nkwende Hills Forest Reserve; NAFR = Nta-Ali Forest Reserve; RHFR = Rumpi Hills Forest Reserve. The error bars represent the standard error of the mean.

In the study area, high ER for human activities were recorded in all sites except in Korup National Park where it was relatively lower. Accordingly, negative, but low, correlation coefficients were recorded between ER of human activities and ER of *C. torquatus* and *P. preussi* per site (Table 3).

## Discussion

*Presence/absence and trends in abundance of red-capped mangabey and Preuss's red colobus*

Information from hunters' perceptions (Figs. 5 and 6), and ER (Fig. 7), suggest that *C. torquatus* has declined significantly in the Rumpi Hills Forest Reserve, and is probably declining in Nta-Ali Forest Reserve. It is suspected that remaining populations of the species in Nta-Ali Forest Reserve may have crossed to the hilly areas of Banyang-Mbo Wildlife Sanctuary. The species abundance is also suspected to have declined in Korup National Park. In the Nkwende Hills Forest Reserve and Banyang-Mbo Wildlife Sanctuary, its abundance is probably stable, but low (Fig. 8). Both Banyang-Mbo Wildlife Sanctuary and the Nkwende Hills Forest Reserve may have served as important sites for remaining fragmented groups of this species. Between 1999 and 2002, a bushmeat market survey indicated relatively low offtakes for *C. torquatus* in the Banyang-Mbo area (Willcox and Nambu 2007). This suggests that the species was then already rare, or that the remaining population had been fragmented by excessive hunting. Oates (2011) confirmed that the species occurs in Banyang-Mbo Wildlife Sanctuary and Korup National Park, although management and anti-poaching systems are ineffective. The decreasing occurrence of the species in Korup National Park is of major concern, and ongoing threats may force fragmented populations into nearby forests such as the Nkwende Hills Forest Reserve. Populations in these areas are unlikely to survive, however, if the threats persist.

Regarding *P. preussi*, hunters perceive that it has declined significantly in the Rumpi Hills Forest Reserve and Nta-Ali Forest Reserve, and is probably declining in the Nkwende Hills Forest Reserve, and is suspected to have declined in Banyang-Mbo Wildlife Sanctuary (Figs. 9 and 10). The same conclusion is supported by encounter rate during our surveys (Fig. 11). The species is probably stable only in Korup National Park (Fig. 12). Willcox and Nambu (2007) recorded no carcasses of *P. preussi* around the Banyang-Mbo area between 1999 and 2002. Korup National Park remains the primary area where this species can still be encountered. Oates (2011) attributes declines in Korup National Park to ineffective anti-poaching systems. In the Nkwende Hills Forest Reserve, this

**Table 2.** Classification of *C. torquatus* and *P. preussi* using ER according to IUCN (2011) species classification criteria.

| Zone | Species | Source | Survey period | ER ≥ 10 years ago | ER today | Change | % Change | Status | % Decline (IUCN) | IUCN category |
|---|---|---|---|---|---|---|---|---|---|---|
| KNP | *C. torquatus* | Dunn and Okon (2003) | 2001−2003 | 0.01 | 0.01 | 0.00 | 0.00 | Stable | 53.43 | EN A2b |
| BMWS | | Nchanji (2002) | 2002 | 1.32 | 0.03 | - 1.29 | 97.72 | Decline | | |
| NHFR | | Forboseh *et al.* (2007) | 2002−2003 | 0.06 | 0.05 | - 0.01 | 16.66 | Decline | | |
| NAFR | | Waltert *et al.* (2002) | 1999−2002 | 0.23 | 0.00 | - 0.03 | 100.00 | Decline | | |
| KNP | *P. preussi* | Dunn and Okon (2003) | 2001−2003 | 0.06 | 0.02 | - 0.04 | 66.70 | Decline | 83.40 | CR A2b |
| BMWS | | Nchanji (2002) | 1999−2002 | 0.00 | 0.00 | 0.00 | 0.00 | Absent | | |
| NHFR | | Waltert *et al.* (2002) | 1999−2002 | 0.01 | 0.00 | -0.01 | 100.00 | Decline | | |
| NAFR | | Waltert *et al.* (2002) | 1999−2002 | 0.00 | 0.00 | 0.00 | 0.00 | Absent | | |

% Change = [(ER today – ER 10 years ago)/ER 10 years ago] * 100. KNP = Korup National Park; BMWS = Banyang-Mbo Wildlife Sanctuary; NHFR = Nkwende Hills Forest Reserve; NAFR = Nta-Ali Forest Reserve. There is no previous or recent data on ER for either species for the Rumpi Hills Forest Reserve. Data for NAFR are from surveys located very close to the reserves and in the support zone of KNP for *P. preussi* in NHFR.

**Table 3.** Encounter rates and correlations between ER of human activities and ER for both species.

| Zone | Survey effort (km) | ER *C. torquatus* | ER *P. preussi* | ER Human activities | Correlation between ER for human activities and for *C. torquatus* | Correlation between ER for human activities and for *P. preussi* |
|---|---|---|---|---|---|---|
| KNP | 124.23 | 0.01±0.04 | 0.02±0.06 | 0.46±1.19 | 0.00 | -0.12 |
| BMWS | 55.11 | 0.03±0.09 | 0 | 2.36±0.68 | -0.26 | 0.00 |
| NHFR | 36.58 | 0.05±0.17 | 0 | 4.23±2.65 | -0.46 | 0.00 |
| NAFR | 70.99 | 0 | 0 | 2.07±0.88 | 0.00 | 0.00 |

KNP = Korup National Park; BMWS Banyang-Mbo Wildlife Sanctuary; NHFR = Nkwende Hills Forest Reserve; NAFR = Nta-Ali Forest Reserve. ER = Encounter rate (number of groups encountered per kilometer). Human activities = cartridges, harvesting of NTFPs, trapping and illegal timber exploitation.

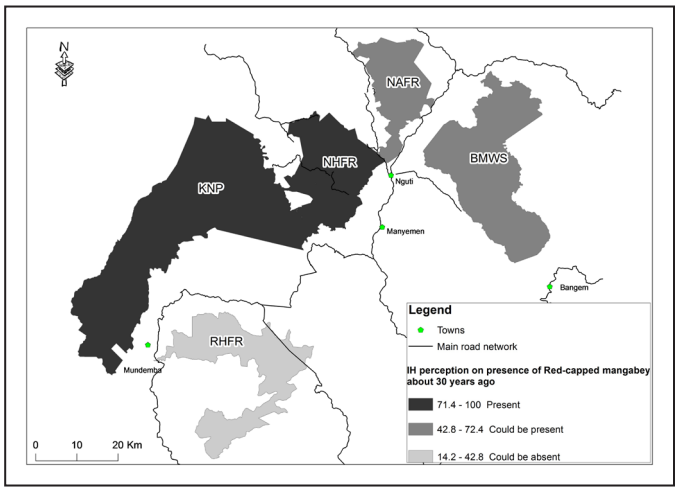


**Figure 5.** Hunters perception on the presence of red-capped mangabey 30 years ago.

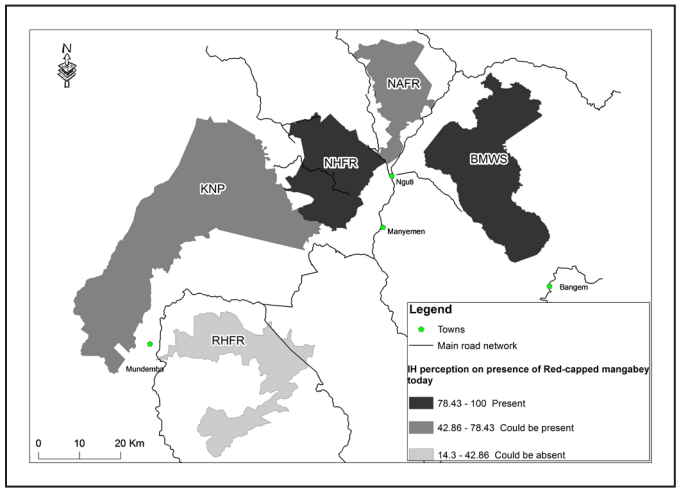


**Figure 6.** Hunters perception on the presence of red-capped mangabey today.

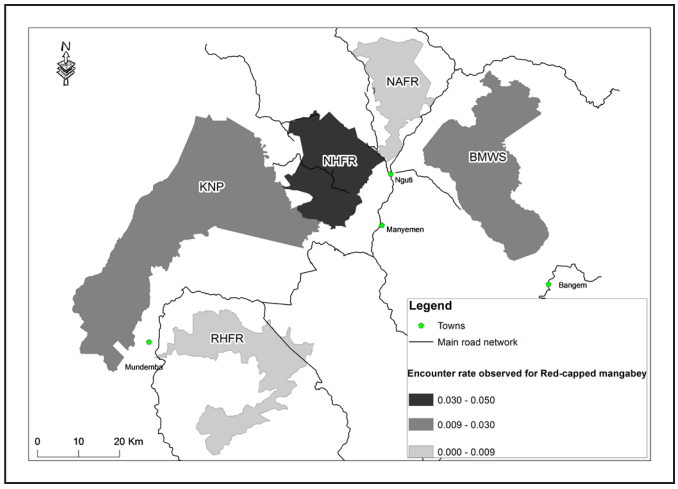


**Figure 7.** Relative abundance of red-capped mangabey today.

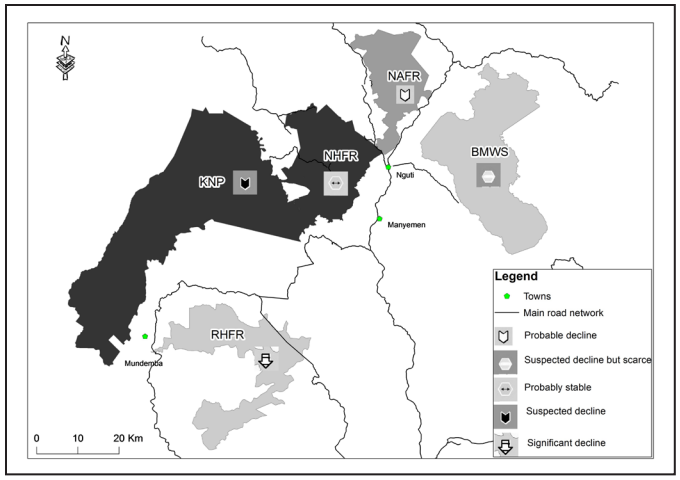


**Figure 8.** Temporal changes in red-capped mangabey abundance based on hunters perceptions.

species has probably declined because of its vulnerability to hunting and habitat disturbance (Oates 2011).

Loss of primate diversity, especially in high priority conservation areas, has already been discussed (Myers *et al.* 2000). *Piliocolobus preussi* was for long known to occur primarily in Korup National Park (Struhsaker 2005), but the species has been documented to occur in the proposed Ebo National Park, Littoral, Cameroon (Dowsett-Lemaire and Dowsett 2001). If it begins to decline in these main strongholds, it is probable that it may go extinct in the wild. However, it is not only *P. preussi* that is threatened in these high priority conservation areas. Some hunters still have the opinion (not significant) that the species can be encountered in NHFR and BMWS even though, if nothing is done to enhance the effective management of these protected areas, both species may become very rare or even go extinct in the near future. A recent survey of wildlife uses around the Nkwende Hills Forest Reserve, Korup National Park and Banyang-Mbo Wildlife Sanctuary confirmed that *P. preussi* and *C. torquatus* are very scarce and represent only 1.8% and 0.8% of mammals used for food, medicines and income (Aghomo 2011). Similarly, recent wildlife surveys in FMU 11005, Korup National Park, Banyang-Mbo Wildlife Sanctuary and the proposed concession for the development of oil palm plantations by Herakles Farms confirm that both *P. preussi* and *C. torquatus* are uncommon in these areas (Bobo *et al.* 2013, 2014a, 2014b; Kupsh *et al.* 2014).

*Occurrence of red-capped mangabey and Preuss's red colobus*

Aside from Korup National Park, few hunters confirm that Banyang-Mbo Wildlife Sanctuary and the Nkwende Hills Forest Reserve are sites where both species can be found (though not significant). Forest Management Unit (FMU) 11-001, located between Korup National Park and the Nkwende Hills Forest Reserve (see Fig. 1), may also temporarily contain the species (see also Usongo 1995), but logging will certainly destroy the habitats preferred by both species, while facilitating access of these areas to poachers (Waltert *et al.* 2002).

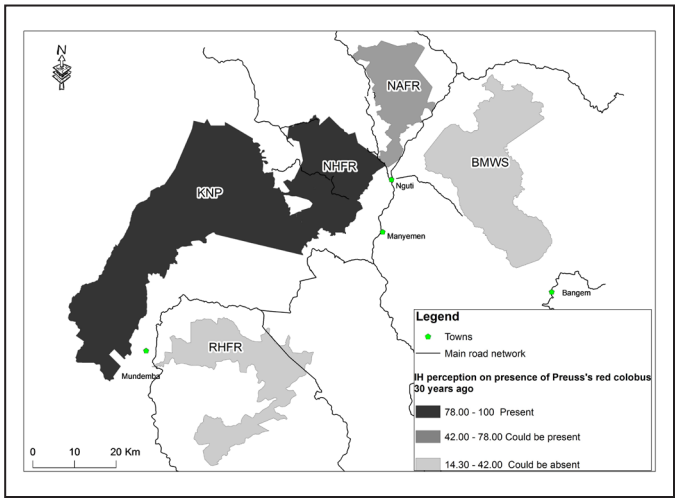


**Figure 9.** Hunters perception on the presence of Preuss's red colobus 30 years ago.

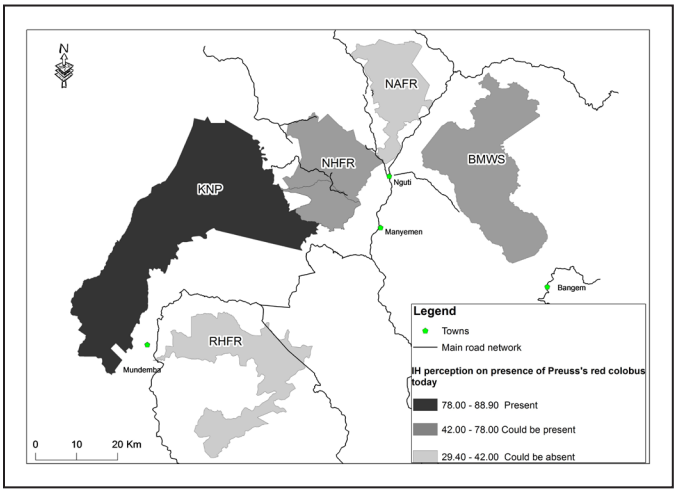


**Figure 10.** Hunters perception on the presence of Preuss's red colobus today.

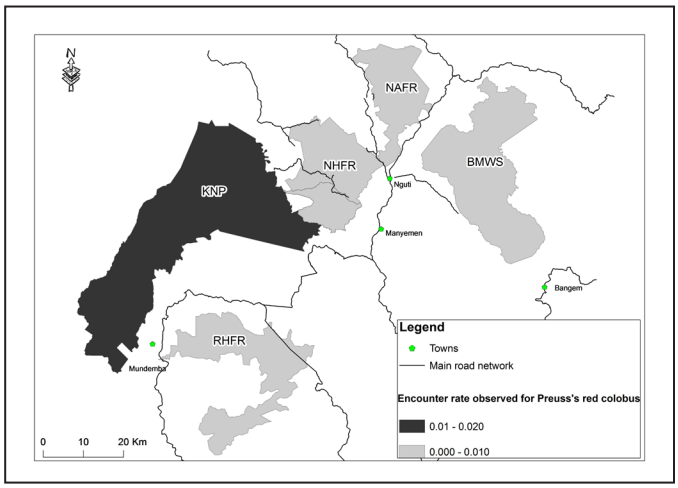


**Figure 11.** Relative abundance of Preuss's red colobus today.

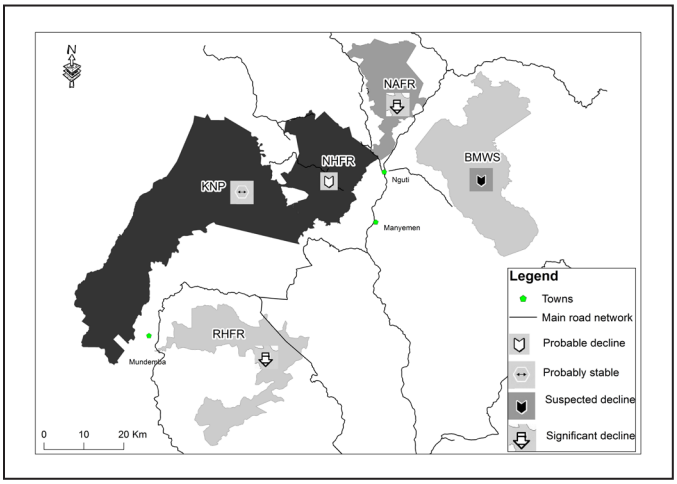


**Figure 12.** Temporal changes in Preuss's red colobus abundance based on hunters perceptions.

*Estimation of suspected changes in ER of red-capped mangabey and Preuss's red colobus*

The situation of *C. torquatus* in Banyang-Mbo Wildlife Sanctuary is explained by the fact that estimated offtakes between 1999 and 2002 (Willcox and Nambu 2007) were very high for a species already vulnerable (125 kg/person/year). In Korup National Park, an ER of 0.01 group/km was recorded in 2004−2005 (Linder 2008). The former suggests a stable ER for *C. torquatus* in the area over time. The negative but low change recorded in the Nkwende Hills Forest Reserve suggests that it may still harbor this species thanks to the inaccessible nature of many parts of the reserve and its strategic position at the northeast of Korup National Park (Ndeh *et al.* 2002). The sharp decline in abundance of *C. torquatus* recorded in Nta-Ali Forest Reserve is likely a result of the degraded nature of the reserve and intensive human activities there. In addition, the reserve was recently converted into a logging unit (FMU 11006) which may further threaten the species (see also Waltert *et al.* 2002); giving more reason to infer/suspect a decline in the extent of occurrence and habitat quality of the species in the Korup region.

For *P. preussi*, a lower ER of 0.05 group/km was already recorded in 2004−2005 in Korup National Park (Linder 2008). Meanwhile, no groups at all were encountered in Banyang-Mbo Wildlife Sanctuary and Nta-Ali Forest Reserve in 2001 or 2012, implying that the species is very scarce or has even disappeared from the area. In Nta-Ali Forest Reserve, *P. preussi* was listed as a species still to be confirmed (MINEF 2001). Nonetheless, hunters continue to believe that individuals can still be found occasionally, but not significantly, especially in BMWS. Similarly, in the Nkwende Hills Forest Reserve, a serious decline was recorded for the species implying that the species may be very scarce or even locally extinct.

The mean percentage declines in ER estimated for *P. preussi* and *C. torquatus* satisfy categories CR A2b and EN A2b, respectively (IUCN 2011) for the range of both species in the study area.

From the information provided by the hunters, and the recent conversion of Nta-Ali Forest Reserve into a logging

**Photo 3.** Active snare trap installed by hunters (non-selective harvesting of ground species including red-capped mangabey).

**Photo 4.** Locally affordable cartridge shells used by primate hunters.

concession, we also suspect/infer a decline in the Extent of Occurrence and/or habitat quality in the Korup region, and especially in the Rumpi Hills Forest Reserve and Nta-Ali Forest Reserve (criterion c of IUCN species classification criteria).

*Threats to red-capped mangabey and Preuss's red colobus*

In many tropical forests, hunting for bushmeat is the primary threat to large vertebrates (Fa *et al.* 2002). The alarm bells for threats to wildlife have already rung in previous IUCN publications (Lee *et al.* 1988). In the Korup region, overhunting is the main threat to the survival of the remaining groups of both species (as in IUCN 2008), while habitat destruction is a second order threat. Additionally, trapping is regarded as a growing threat to *C. torquatus* in the study area, because individuals of this species spend most of their time on the ground, hence increasing the possibility of being caught in traps (Photo 3). In the study area, poaching is a result of the lack of regulation of community hunting practices, of the readily available and cheap gun cartridges (Photo 4), and little to no restrictions or effective taboos on hunting for either of the two species (Bobo *et al.* 2012). Habitat destruction is manifested by agricultural expansion (forest clearing and large-scale industrial plantations), and logging, especially around forest reserves. In the study area, both species are easily hunted because of their large size and the fact that they both live in large groups (see also Isaac and Cowlishaw 2004). As in many areas, unrestricted human activities have an overall negative influence on the abundance of both species.

For an effective management of both species, it is recommended that:

- *C. torquatus* be reclassified from VU (A2cd) to EN (A2bc)
- *P. preussi* should be maintained as a critically endangered species;
- Hunting primates with dogs should be considered as a paramount risk to red-capped mangabey;
- At the local level, both species should urgently be reclassified from Class C (species partially protected, their capture or killing are regulated) to Class A (species integrally protected and prohibited from hunting).
- Studies on species/area relationship should be conducted to define clearly the current Area of Occupancy and Extent of Occurrence for both species in the Korup region.
- The conservation importance of hilly and remote areas should be determined in order to create protected areas that are not easily accessible by poachers;
- Guidelines for the use of national or regional Red List categories for species with wide ranges should be developed by IUCN;
- The use of local knowledge could be explored in studying the status of species particularly at this point in time where conservation efforts and research results are disappointing (especially for scarce species).

## Acknowledgments

We are grateful for financial support from the Volkswagen Foundation, under the Africa initiative – Knowledge for Tomorrow: Cooperative Research Projects in Sub-Saharan Africa, through the project "Managing Forest wildlife for Human Livelihoods in the Korup-Oban Hills region, West-Central Africa". Special thanks to Jan Joris Cappelle, Research Coordinator for Greenpeace Belgium, to Diana Lakeland of the Department of Conservation Biology, Georg-August-Universität, Göttingen, Germany, and Nemer Narchi of Universidad Autónoma Metropolitana – Unidad Xochimilco, in revising the manuscript and constructive comments at every stage of the writing process.

## Literature Cited

Aghomo, F. F. M. 2011. Perception des populations riveraines sur la contribution des traditions a la conservation de la faune sauvage chez les Ngunnchang et les Obangs. Rapport de stage. FASA, University of Dschang, Cameroon. 76pp.

Bobo, K. S., B. C. Ntumwel, C. B. B. Bekou, T. J. L. Tene and N. F. Ngouhouo. 2014a. Statut des grands et moyens mammifères et des activités anthropiques dans le Parc National de Korup, Sud-ouest Cameroun. Rapport de

consultation. Programme de Gestion Durable des Ressources Naturels (PSMNR)/MINFOF Sud-ouest, Cameroun. 113pp.

Bobo, K. S., B. C. Ntumwel, C. B. B. Beukou, G. Abba and A. Djoda. 2014b. *Statut des grands et moyens mammifères et des activités anthropiques dans le Sanctuaire de Faune de Banyang-Mbo, Sud-ouest Cameroun*. Rapport de consultation. Programme de Gestion Durable des Ressources Naturels (PSMNR)/MINFOF Sud-ouest, Cameroun. 82pp.

Bobo, K. S., T. O. W.Kamgaing, B. C. Ntumwel, K. Djafsia, A. Djoda and B. Kouda. 2013. Statut des grands et moyens mammifères et des activités Anthropiques dans l'UFA 11-005. Rapport de consultation. Forest Ressource Management, France. 62pp.

Bobo, K. S., C. B. Ntumwel and F. F. M. Aghomo. 2012. Hunter's perception on uses of Preuss's red colobus *Procolobus preussi* and red-capped mangabey *Cercocebus torquatus,* and related conservation issues, in the Nkwende Hills area, southwest Cameroon. *Life Sciences Leaflets* 8: 28−34.

Butynski, T. M. and Kingdon, J. 2013. *Procolobus preussi* Preuss's red colobus. In: *The Mammals of Africa*, Vol. 2, T. M. Butynski, J. Kingdon and J. Kalina (eds.), pp.134–136. Bloomsbury Publishing, London.

Cameroon, Ministry of Environment and Forestry. 2001. *Management Plan of the Nta-ali Forest Reserve*. MINEF, Cameroon. 110pp.

Cameroon, Ministry of Environment and Forestry. 2002. *The Rumpi Hills Wildlife Sanctuary Draft Management Plan, 2003−2008.* GTZ, Cameroon. 69pp.

Cameroon, Ministry of Forestry and Wildlife. 2008. *Management Plan for the Korup National Park and its Peripheral Zone (2009−2013).* MINFOF, Cameroon. 138pp.

Denis, K., K. S. Bobo, M. Waltert, B. C. Ntumwel, C. G. B. Beukou, A. Djoda and K. Djafsia. 2014. Biodiversity, carbon stock and market value assessment for the SGSOC project area, Southwest region, Cameroon. Consultation report. Greenpeace International and World Wide Fund for Nature, Germany. 41pp.

Doumenge, C., J. E. García, S. Gartlan, O. Langrand and A. Ndinga. 2001. Conservation de la biodiversité forestière en Afrique centrale Atlantique: Le réseau d'aires protégées est –il adéquat? *Bois et forêts tropiques* 268: 5–27.

Dowsett-Lemaire, F. and R. J. Dowsett. 2001. A new population of gorillas *Gorilla gorilla* and other endangered primates in western Cameroon. *Afr. Primates* 5: 3−7.

Dunn, A. and D. Okon. 2003. Monitoring the abundance of diurnal primates and duikers in Korup National Park, Cameroon 2001−2003. Unpublished report, Korup Project, Mundemba, Cameroon.

Ehardt, C. L. 2013. *Cercocebus torquatus* red-capped mangabey (white-collared mangabey). In: *The Mammals of Africa*, Vol. 2, T. M. Butynski, J. Kingdon and J. Kalina (eds.), pp.186–189. Bloomsbury Publishing, London.

Fa, J. E., C. A. Peres and J. Meeuwig. 2002. Bushmeat exploitation in tropical forests: an intercontinental comparison. *Conserv. Biol.* 16: 232–237.

Fomété, T. and Z. Tchanou. 1998. La gestion des écosystèmes forestiers du Cameroun à l'aube de l'an 2000. (Monographies des sites critiques et annexes). *IUCN* 2: 105−264.

Forboseh, P. F., M. Eno-Nku and T. C. H. Sunderland. 2007. Priority setting for conservation in southwest Cameroon based on large mammal surveys. *Oryx* 41: 255−262.

Flinkerbusch, S. 2011. The Conservation Status of Forest Dwelling Cercopithecidae and Bovidae Species in the Cross-Sanaga-River Region in Cameroon and Nigeria: A Review Based on Monitoring Reports and Scientific Publications. MSc thesis, Georg-August-University, Göttingen, Germany. 53pp.

Groves, C. P. 2007. The taxonomic diversity of the Colobinae of Africa. *J. Anthropol. Sci.* 85: 7–34.

IUCN. 2010. *IUCN Red List of Threatened Species v. 2010.4.* Http://www.iucnredlist.org [accessed 19 March 2011].

IUCN. 2011. *Guidelines for using the IUCN Red List Categories and Criteria v. 2011.9*. Prepared by the standards and petitions subcommittee of the IUCN Species Survival Commission. Http://www.iucnredlist.org/documents/RedListGuidelines.pdf.

Isaac, N. J. B. and G. Cowlishaw. 2004. How species respond to multiple extinction threats. *Proc. Roy. Soc. Ser. B* 271: 1135–1141.

Lee, P. C., J. Thornback and E. L. Bennett. 1988. *Threatened Primates of Africa: The IUCN Red Data Book.* IUCN, Gland, Switzerland, and Cambridge, UK.

Linder, J. M. 2008. The Impact of Hunting on Primates in Korup National Park, Cameroon: Implications for Primate Conservation. PhD thesis, The City University of New York, New York. 376pp.

Mittermeier, R. A., C. V. Pádua, A. B. Rylands, A. A. Eudey, T. M. Butynski, J. U. Ganzhorn, R. Kormos, J. M. Aguiar and S. Walker. 2005. *Primates in peril: The World's 25 Most Endangered Primates 2004−2006*. IUCN/SSC Primate Specialist Group. 48pp.

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.

Ndeh, A. D. R., B. Mbah and G. Dzikouk. 2002. *Ornithological surveys of Nkwende hills, Bakossi Mt. FMU (11-001 and 11-002); For biodiversity conservation and priority settings in the Cameroon-Nigeria Transboundary*. Birdlife International, Cambridge, UK. 44pp.

Nchanji, C. A. 2002. Large Mammal Populations and Human Impact Assessment in the Banyang-Mbo Wildlife Sanctuary. Unpublished Report. Wildlife Conservation Society – Takamanda Mone Landscape Project, Limbe, Cameroon.

Oates, J. F. 2011. *Primates of West Africa: A Field Guide and Natural History.* Conservation International, Arlington, VA. 556p.

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., R. A. Bergl and J. M. Linder. 2004. Africa's Gulf of Guinea Forests: Biodiversity patterns and conservation priorities. *Adv. Appl. Biodiv. Sci.* 6: 1−90.

Oates, J. F., T. T. Struhsaker, B. Morgan, J. Linder and N. Ting. 2008. *Procolobus preussi*. The IUCN Red List of Threatened Species 2008: e.T41026A10389905. <http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T41026A10389905.en>. Downloaded 07 March 2016.

Pollard, E. H. B. 1997. Effect of Logging Operations and Economic Decline on Hunting and Trapping in the Northern End of the Korup Project Support Zone. Report, Korup Project, Cameroon.

Struhsaker, T. T. 2005. Conservation of red colobus and their habitats. *Int. J. Primatol.* 26: 525−538.

UN. 2010. *The Millennium Development Report 2010*. United Nations Department of Economic and Social Affairs (DESA), New York. 76pp.

UNEP. 2002. Strategic Plan for the Convention on Biological Diversity. In: *Decisions VI/26 of the COP to the Sixth Meeting (COP 6)*. United Nations Environmental Program (UNEP), Nairobi.

Usongo, L. 1997. Zoological Inventory of Korup National Park, Cameroon. Unpublished report, CEU and Korup Project, Cameroon.

Vabi, M. 2000. Development of a Management Plan for KNP. Report of a Community-Based Stakeholder Workshop. Mundemba, South-west, Cameroon.

Vabi, M. 1999. Socio-economic Surveys of Human Use Inside and Within 3 kilometres of Korup National Park. WWF-CPO Activities Report. South-west, Cameroon.

Waltert, M., Lien, N. Faber. and Mühlenberg, M. 2002. Further declines of threatened primates in the Korup project area, South-west Cameroon. *Oryx* 36: 257−265.

Willcox, A. S. and Nambu, D. M. 2007. Wildlife hunting practices and bushmeat dynamics of the Banyangi and Mbo people of southwestern Cameroon. *Biol. Conserv.* 134: 251–261.

World Wide Fund for Nature. 2008. Un avenir incertain pour la faune sauvage en Afrique Centrale ? *CARPO FOCUS* 12: 24.

*Authors' addresses:*
**K. Serge Bobo**, Department of Forestry, Faculty of Agronomy and Agricultural Sciences, University of Dschang. P.O. Box 222, Dschang, Cameroon, and School for the Training of Wildlife Specialists Garoua, Ministry of Forestry and Wildlife, P.O. Box: 271 Garoua, Cameroon, **C. Bonito Ntumwel**, **F. Florence Aghomo**, and **K. G. Aurele Ayemele**, Department of Forestry, Faculty of Agronomy and Agricultural Sciences, University of Dschang. P.O. Box: 222 Dschang, Cameroon. *Corresponding author:* K. Serge Bobo, e-mail: <bobokadiris@yahoo.com>.

*Submitted for publication: 29 July 2015*
*Revised: 30 March 2017*