

PERSPECTIVE

To conserve African tropical forests, invest in the protection of its most endangered group of monkeys, red colobus

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Abstract

Forest loss and overhunting are eroding African tropical biodiversity and threatening local human food security, livelihoods, and health. Emblematic of this ecological crisis is Africa's most endangered group of monkeys, the red colobus (genus *Piliocolobus*). All 17 species, found in forests from Senegal in the west to

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Red colobus, the most endangered group of African monkeys, are overlooked animals that should serve as flagships for African tropical forest conservation.

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the Zanzibar archipelago in the east, are threatened with extinction. Red colobus are among the most vulnerable mammals to gun hunting, typically disappearing from heavily hunted forests before most other large-bodied animals. Despite their conservation status, they are rarely a focus of conservation attention and continue to be understudied. However, red colobus can act as critical barometers of forest health and serve as flagships for catalyzing broader African tropical forest conservation efforts. We offer a plan for conservation of red colobus and their habitats and discuss conservation and policy implications.

KEYWORDS

African tropical forests, conservation action plan, flagship taxa, hunting, indicator taxa, red colobus

1 | INTRODUCTION

Hunting of wild animals and habitat loss from agricultural expansion, logging, charcoal and fuelwood production, infrastructure development, and mining are the major threats to African tropical forest biodiversity (Abernethy et al., 2016). Together, habitat loss and hunting have resulted in significant wildlife population declines, local extirpations, and extinctions, potentially leading to significant long-term changes to ecosystem structure and function (Ceballos et al., 2017). This ecological crisis is also a human one as tropical deforestation and defaunation contribute acutely to local food insecurity, global climate change, and an increased risk of regional and global zoonotic infectious disease outbreaks (Edwards et al., 2019).

Most emblematic of this African tropical forest biodiversity crisis are animals that the public has largely never heard of—red colobus monkeys (genus *Piliocolobus*). Here, we argue that red colobus, Africa's most imperiled group of monkeys that have been largely overlooked and understudied by the conservation community, are ideal surrogates for African tropical forest conservation. Effective surrogate taxa can help conservation scientists identify important conservation areas, monitor impacts of human activities and conservation initiatives, and fundraise for and increase awareness of conservation issues.

Specifically, we demonstrate how red colobus can serve as effective flagships for garnering local and international support for conservation initiatives and act as leading indicators for forest health. We offer a plan for focusing conservation attention on red colobus and their habitats and outline impacts on conservation policy and practice. Our aim is to encourage and support conservation practitioners and organizations, scientists, local communities, and national governments to recognize these monkeys as a priority conservation target that can help maintain

African tropical forest health and reduce the prevalence of unsustainable bushmeat hunting.

2 | WHAT ARE RED COLOBUS?

There are three main kinds of colobus monkeys living in the forests of Africa: the red (*Piliocolobus*), olive (*Procolobus*), and black-and-white colobus (*Colobus*). Red colobus are found in tropical forest habitats from Senegal in the west, to the island of Unguja in Zanzibar in the east (Figure 1). Although the number of species in the genus *Piliocolobus* has fluctuated greatly over the last 50 years and considerable taxonomic uncertainty remains (Oates & Ting, 2015), today, most scientists recognize 17 species of red colobus, with one species, the Western red colobus (*Piliocolobus badius*) divided into two subspecies (*P. b. temminckii* and *P. b. badius*). Although all forms have some red on their body, there is considerable variation in coat color and patterns between species and, sometimes, within a given taxon and social group (Figure 2).

Red colobus are forest specialists, spending most of their time moving, feeding, and socializing high in the forest canopy, often among the forest's oldest and tallest trees. They inhabit a diversity of forests, including rainforest, riparian forest, mangrove swamp, and dry savanna woodland, ranging in altitude from sea level to 2600 m above sea level. As with other colobus monkeys, and, unlike most other primates, red colobus have thumbs that are greatly reduced in size. They also have relatively long tails and hind feet. These features facilitate movement high in the canopy and daring, long distance leaps between trees. Red colobus have multichambered stomachs that house colonies of micro-organisms that aid in digesting leaves and seeds. There is considerable social variability among red colobus taxa, but most live in large multimale,

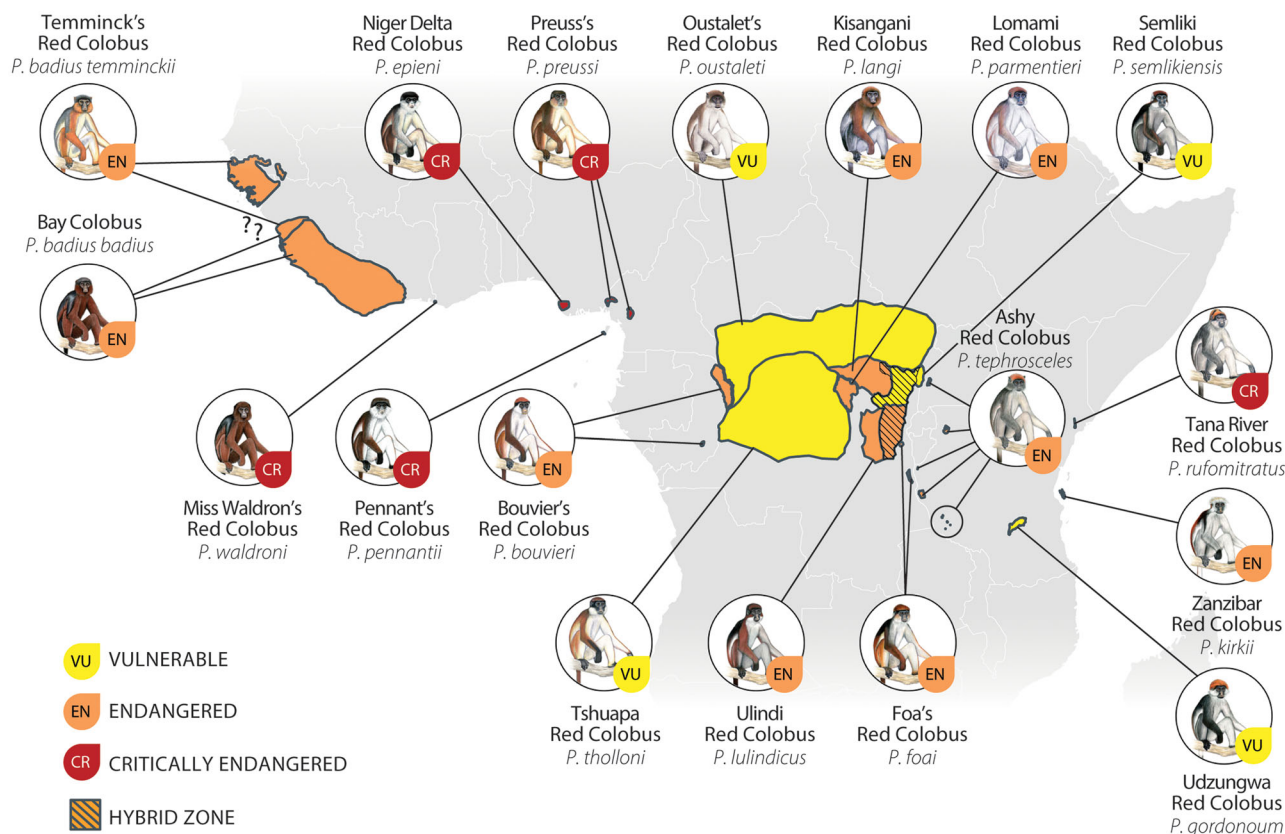


FIGURE 1 Geographic range and IUCN Red List of Threatened Species conservation status of the 17 red colobus (*Piliocolobus*) species. One species, *P. badius*, is divided into two subspecies for a total of 18 taxa. The query marks associated with *P. badius temminckii* and *P. b. badius* indicate the uncertain taxonomic affinity of the red colobus populations found in the Guinea-Sierra Leone border area. The hybrid zone is an area in the Eastern Democratic Republic of Congo incorporating gene flow from at least four red colobus species, making taxonomic classification difficult. Red colobus illustrations by Stephen D. Nash.

multifemale groups, in which females typically outnumber males. Red colobus are often found in association with other primate species, probably as a strategy to reduce the risk from predators, such as leopards, crowned hawk eagles, and chimpanzees.

3 | RED COLOBUS CONSERVATION STATUS

A 2016 reassessment of African primates by the Primate Specialist Group of the International Union for Conservation of Nature (IUCN) Species Survival Commission recognized every form of red colobus species as threatened with extinction, with 14 out of the 18 taxa listed in the Red List of Threatened Species as Critically Endangered or Endangered. Miss Waldron's red colobus from Ghana and Côte d'Ivoire may already be extinct, and would be the first primate species to go extinct in the last 300–500 years (Oates et al., 2000). The only other primate genera with more threatened species are the Madagascan *Lepilemur* and *Microcebus*.

Red colobus conservation efforts have been impeded by a number of factors. They have been neglected in conservation planning due to their particularly unstable taxonomy (Oates & Ting, 2015). Despite their broad geographic range across tropical Africa, only a handful of taxa have been the subjects of long-term research on natural history and population status. The ecological requirements and distributions of several species are still not well known, and few conservation projects have focused on red colobus. Meanwhile, most national authorities and even the international conservation community are largely unaware of these monkeys and their conservation needs. This is due, in part, to the lack of any captive red colobus populations in zoos or wildlife sanctuaries because they do not survive in captivity, and it is therefore impossible to envisage a breeding plan in a zoo. Red colobus are also not exhibited in museums or highlighted in popular nature documentaries. Additionally, several red colobus species, particularly those in the Democratic Republic of Congo, Nigeria, Cameroon, and Kenya occur in remote areas that have persistent problems of insecurity, which complicates research, tourism, and conservation efforts.



FIGURE 2 Examples of red colobus from west, central, and east Africa. From left to right, top: *P. badius badius* in Côte d'Ivoire, *P. pennantii* on Bioko Island, Equatorial Guinea; and bottom: *P. tephrosceles* in Uganda, and *P. kirkii* on Unguja Island, Zanzibar, Tanzania.

4 | RED COLOBUS AS BAROMETERS OF HUNTING PRESSURE

Across most of their range, red colobus populations are declining and disappearing from forests primarily due to hunting—a major threat to all but one species of red colobus (Linder et al., 2021a). Indeed, the ecologically specialized red colobus are among the most vulnerable mammal species to hunting (Struhsaker, 2005). Their large and noisy social groups make them easy to find, and they tend not to flee in response to hunters, allowing several individuals within a group to be killed at once. Their large body size also provides more meat for the price of a shotgun cartridge than most other monkeys. Compared to other forest mammals targeted by hunters, red colobus tend to decline more sharply over time and are typically among the first species extirpated (Table 1), even before the loss of well-known, larger-bodied, charismatic flagship primates such as the gorilla and chimpanzee.

Like the proverbial canary in a coal mine, a declining population of red colobus becomes an important early warning indicator of emptying forests and eroding ecosystem function (e.g., from the loss of seed dispersers). Monitoring and protecting red colobus populations would thus directly contribute to transdisciplinary solutions aimed at reducing gun hunting. Relying on other, more well-known, large-bodied mammal species (e.g., chimpanzees) as a

barometer of the impact of gun hunting and conservation interventions could well result in extirpations of a forest's most vulnerable species. As an example, bushmeat hunting is prevalent throughout the Ebo–Makombe–Ndokbou forests of western Cameroon. Chimpanzee nests are relatively frequently encountered in those forests, but red colobus have not been seen by experts since 2012—despite many hundreds of kilometers of foot surveys (Bowers-Sword, 2020; Whytock et al., 2021). As Oates (2006) concluded, although charismatic species, such as chimpanzee, are in decline and are high priority for conservation, if unsustainable gun hunting and defaunation trends are to be reversed, attention needs to also focus on the species most vulnerable to extinction, such as the red colobus.

5 | RED COLOBUS AS CATALYSTS FOR AFRICAN TROPICAL FOREST CONSERVATION ACTION

The situation faced by red colobus is similar to that of pangolins 15 years ago. Pangolins (*Philodonta*) comprise eight species found in Africa and Asia. All are listed as Threatened with extinction on the IUCN Red List of Threatened Species. Pangolins are killed and illegally traded to supply their meat and scales to international markets, especially in East and Southeast Asia. Like red colobus, pangolins

TABLE 1 Examples of red colobus species that have undergone substantial declines in abundance (relative to other primates) or have been extirpated (while other primate species persist) in hunted forests, illustrating their extreme vulnerability to hunting.

Species	Evidence of hunting vulnerability
<i>P. waldroni</i>	May be extinct (Oates et al., 2000)
<i>P. b. badius</i>	Low red colobus densities (relative to other primates) in parts of Taï National Park, Côte d'Ivoire where hunting pressure is highest (N'Goran et al., 2012)
<i>P. epieni</i>	Recently extirpated from forest fragments within its historical range in the Niger Delta, Nigeria (Ikemeh, 2014)
<i>P. preussi</i>	Severe decline in abundance over the last several decades in and possible extirpation from the Ebo-Makombe-Ndokbou forests (>3000 km ²) in western Cameroon (Linder et al., 2021b)
<i>P. pennantii</i>	Extirpated from most forested areas on Bioko Island, Equatorial Guinea, including Pico Basile National Park and most of the Gran Caldera Scientific Reserve (Cronin et al., 2017)
<i>P. langi</i>	Severe depletion from the Yangambi landscape and local extirpations across its range in Democratic Republic of Congo, relative to other primates (Kaisala & Falay, 2019; van Vliet et al., 2018)
<i>P. gordonorum</i>	Marked decline in abundance over time in the unprotected Uzungwa Scarp Forest Reserve, Tanzania, and extirpated from the western Uzungwa and Mufindi forests, as well as large parts of the Uzungwa Scarp (Rovero et al., 2012, 2015)
<i>P. kirkii</i>	Extirpated from Nungwi, Matemwe, Kichwele, Jendele, and Dunga forests on Zanzibar's main island of Unguja since the late 1990s (Davenport et al., 2019)

were not widely known among the general public and were not the focus of conservation campaigns because they were difficult to see in the wild, poorly studied, not commonly exhibited in zoos, and did not feature in nature documentaries (Heighton & Gaubert, 2021). Today, pangolins are the icon of the illegal international wildlife trade and a global movement has arisen to address the dearth of pangolin conservation research and actions (Thomson & Fletcher, 2020). Conservationists have been able to leverage this newfound “fame” to acquire funding for pangolin conservation, implement targeted conservation interventions, and ultimately influence broader policy on wildlife trade.

As with pangolins, red colobus have immense potential as flagships (Smith et al., 2012) to generate funding and spur interventions that conserve African tropical forests and reduce unsustainable gun hunting. These photogenic, large-bodied primates are likely to strongly resonate with the public given their aesthetically appealing hairdos, coat colors, and color patterns, which vary across species.

A focus on conserving red colobus species would direct conservation resources toward protecting a significant representation of African forest habitats and areas characterized by high endemic species richness. For example, seven red colobus species range across vast zones of forest in the Democratic Republic of Congo that contain some of the least studied biological diversity in Africa. Directing funding to study these and other Central African red colobus species will support White et al.'s (2021) call to action for a \$150 million investment in the scientific study and protection of the Congo Basin rainforest (of which one million Euro has now been raised as a result of the One Forest Summit in early 2023). Simi-

larly, Temminck's red colobus, Niger Delta red colobus, and Tana River red colobus inhabit some of Africa's most important but poorly studied and underprotected coastal deltas (Tana, Niger, Casamance, Sine-Saloum) (Butynski & de Jong, 2019). Increasing efforts to conserve the Bay colobus (*P. badius badius*), Pennant's red colobus, and the Uzungwa red colobus would protect tropical montane forest ecosystems of West and East Africa. Protecting Preuss's red colobus (*P. preussi*) would safeguard the largest, intact forest blocks of the exceptionally biodiverse Gulf of Guinea forests. Lastly, conservation of red colobus monkeys will not only protect African tropical forests but can also lead to forest expansion and connection via targeted community-based reforestation (Ruiz-López et al., 2022). Such actions enhance forest-based ecosystem services, benefitting local human communities and increasing carbon storage potential to offset global climate change.

Elevating red colobus to flagship status has already proven to be a successful strategy for conserving African tropical forests. In Nigeria's Niger Delta, a Memorandum of Understanding has been signed by a local community to establish a community conservation area to protect some of the last remaining groups of the Niger Delta red colobus. Similarly, in collaboration with international scientists, communities in the Sambel Kunda area in The Gambia have organized forest monitoring and ranger teams and have initiated conservation education and ecotourism programs to protect one of the largest remaining populations of Temminck's red colobus. The protection of Zanzibar red colobus was a key impetus in the creation of Zanzibar's only national park, Jozani-Chwaka Bay and the Kidikotundu-Nongwe-Vundwe Reserve, both of which

protect large remnants of indigenous forest on the island. In Kenya, the need to protect the endemic Tana River red colobus (and Tana River mangabey) led to the establishment of the Tana River Primate National Reserve. The presence of Preuss's red colobus in Cameroon's Korup forest led scientists to propose to the government making Korup a national park, which it did in 1986.

6 | A PLAN TO PROTECT RED COLOBUS AND CONSERVE AFRICAN TROPICAL FORESTS

To catalyze red colobus-focused conservation efforts and promote the study and protection of African tropical forests, a group of over 100 authorities from 20 countries ([Supporting Information](#)) has published a Red Colobus Conservation Action Plan under the auspices of the IUCN Species Survival Commission Primate Specialist Group and the African Primatological Society (Linder et al., 2021a). This document, the first of its kind developed for any group of African monkeys, identifies 72 priority sites for intervention across all 17 red colobus species and recommends actions that, if implemented within an appropriate timeframe, will serve as the bedrock for effective and sustained strategies to prevent red colobus extinctions and preserve African tropical forests. The action plan calls for a modest investment of \$20 million over 5 years across the ranges of all species of red colobus. Here, we highlight and expand on several action plan recommendations and discuss their implications for conservation policy and practice.

First, all red colobus must be afforded proper legal protections. Every species of red colobus should be listed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora on Appendix I, which includes the species most threatened with extinction and prohibits the international commercial trade in specimens of those species. Currently, only two red colobus species (*P. kirkii* and *P. rufomitratu*s) are included on Appendix I. Additionally, initiatives to encourage the governments of range countries to invest in red colobus conservation efforts are required, including a review of national legal environmental frameworks to ensure that red colobus are listed among those species receiving the highest level of protection.

Second, effective strategies for conserving red colobus are hindered by lack of information on their distribution, abundance, and ecological requirements. Ecological surveys are a top priority to help identify populations in need of protection. Moreover, monitoring known populations of red colobus is necessary to assess effectiveness of conserva-

tion interventions, especially those designed to reduce gun hunting.

Third, protected areas, including those managed by governmental agencies and communities, are the cornerstones of red colobus conservation. Many of the protected areas that already exist face significant challenges that reduce their effectiveness. These challenges include insufficient human and financial resources, degradation and loss of habitat tied to human pressure and/or climate change inside and immediately outside their boundaries, sociopolitical crises, and lack of support from surrounding communities and/or central or regional governments. One red colobus species (*P. lulindicus*) has no populations at all within protected areas. We call for substantial investment from governments and civil society organizations to strengthen the effectiveness of the current protected area network and establish additional protected areas, including community managed forests.

Fourth, it is critical to engage more effectively with, and invest in, people living in close proximity to red colobus monkeys in order to aid in the establishment and effective maintenance of protected areas and to reduce overexploitation of natural resources. Such “bottom-up,” community-supported approaches require the development of projects that train, employ, and otherwise support (especially in the long term) local people to transition away from unsustainable harvesting of forest resources and to participate in monitoring and conservation activities, and that incentivize communities to take a more active role in preserving forests and protecting endangered species (Estrada et al., 2022; Nana et al., 2022).

In a similar vein, conservation of red colobus and their habitats in the long term is more likely to be successful if experts collaborate with national administrations and civil society to link conservation to public health. Such action at a local level cannot only aid people living adjacent to protected areas, but it can also advance broader global health initiatives. For example, improved access to family health services for people, especially women, living in close proximity to red colobus populations will improve local perceptions of conservation and lead to increased human welfare, gender equity, and sustainable development (Crist et al., 2017). Likewise, measures to mitigate high-risk interactions between humans and wildlife will reduce zoonotic disease transmission, which will fortify local and global health security and support One Health initiatives (Gruetzmacher et al., 2021). This is particularly relevant for red colobus monkeys given the potential zoonotic agents harbored by these animals (e.g., Ghai et al., 2014; Goldberg et al., 2009).

Finally, conservation education and awareness-raising are a key part of the foundation for effective, long-term protection of threatened species and ecosystems (Ardoin

et al., 2020). Investing in local and global education and outreach programs focused on red colobus and their habitats will improve public support for conservation, inspire local people to get involved in conservation activities, influence policies that protect the environment, and elevate red colobus to flagships of African tropical forest conservation efforts.

To facilitate responsible implementation of these recommendations highlighted in the action plan, the IUCN Primate Specialist Group and African Primatological Society have formed a Red Colobus Working Group (RCWG), which consists of experts on red colobus, conservation practitioners, and representatives from conservation organizations. RCWG members review red colobus-focused grant proposals, organize workshops, trainings, and conference gatherings that promote red colobus conservation, initiate projects that support priorities in the action plan, and contribute to the scientific literature on red colobus behavior, ecology, evolution, and conservation science. The RCWG also collaborates with other species specialists and landscape-scale conservation practitioners in search of aligned strategies and funding opportunities. To this end, the RCWG created the Red Colobus Conservation Network (<https://www.redcolobusnetwork.org>) to bring together people interested in the conservation of both red colobus and the landscapes they inhabit. This action plan thus goes beyond a standard taxonomic lens and provides a blueprint for integrating species-focused actions with broader landscape level strategies. Indeed, to promote collaboration and coordination, a forthcoming IUCN conservation action plan for mangabey (*Cercocebus*) and drill and mandrill (*Mandrillus*), another highly threatened group of African monkeys, identifies conservation priority sites and actions in common with the red colobus action plan.

Since the publication of the Red Colobus Conservation Action Plan and creation of supporting structures, over US\$500,000 has been directed to conservation projects focused on protecting red colobus and their habitats. This is only the beginning. Members of the RCWG continue to forge collaborations, explore funding opportunities, and initiate and encourage others to develop projects in support of priorities identified in the red colobus action plan.

7 | CONCLUSION

Red colobus are emblematic of the ecological crisis facing African tropical forests. Their declining populations forewarn the fate of other large-bodied terrestrial vertebrates across African tropical forests and portend a bleak future for Africa's biodiversity if a business-as-usual approach is

followed. We call for scientists, conservation practitioners, civil society organizations, local communities, and governments to rally around this flagship of a healthy biome and invest in red colobus conservation in support of IUCN's call to "Reverse the Red," a global movement to protect wild species and ecosystems (Rodríguez, 2021). Red colobus conservation will not only pay significant dividends for African tropical forests but will also contribute to global initiatives intended to protect biodiversity, mitigate the impacts of climate change, and improve food security and public health (IPBES, 2019).

AUTHOR CONTRIBUTIONS

Conceptualization: JML, DTC, NT, WSM, RAM, TTS. Methodology: JML, DTC, NT. Investigation: JML, DTC, NT, EEA, FA, TRBD, KMD, GG, AGL, JAH, RAI, RAI, SMK, IK, WK, DK, BL, FM, WSM, RAM, TTS. Funding acquisition: JML, DTC, NT, BL, RAM. Project administration: JML, DTC, NT, BL, FA. Writing—original draft: JML, DTC, NT. Writing—review & editing: JML, DTC, NT, EEA, FA, TRBD, KMD, GG, AGL, JAH, RAI, RAI, SMK, IK, WK, DK, BL, FM, WSM, RAM, TTS.

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CONFLICT OF INTEREST STATEMENT

Authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in the Red Colobus (*Piliocolobus*) Conservation Action Plan: 2021-2026 (<https://portals.iucn.org/library/node/49478>), the IUCN Red List (<https://www.iucnredlist.org/>), and the articles cited in the reference list.

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SUPPORTING INFORMATION

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