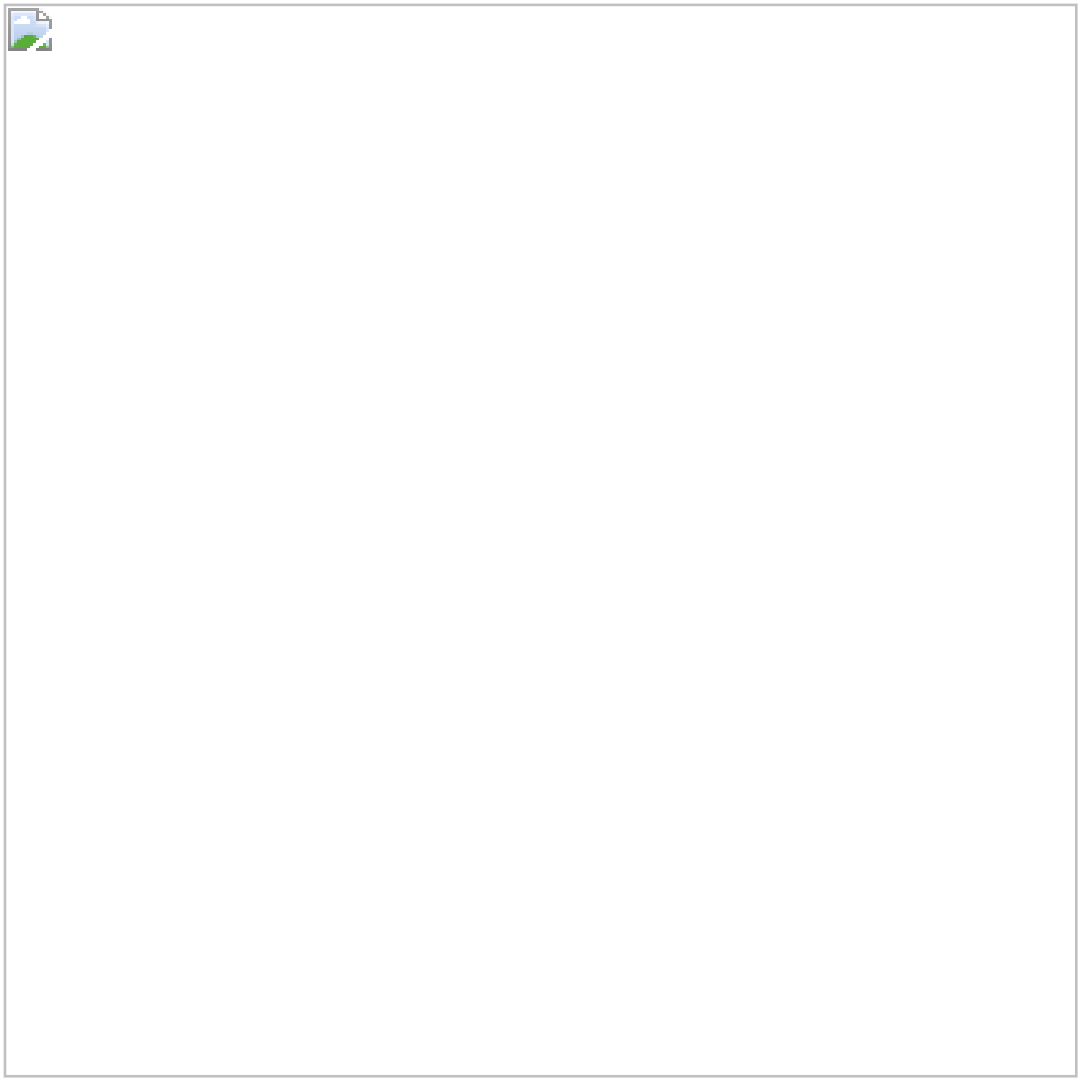

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Assessing the Population Status of the Critically Endangered Niger Delta Red Colobus (*Piliocolobus epieni*)

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Abstract: A survey to assess the conservation status of the Niger Delta red colobus (*Piliocolobus epieni*) was carried out across the species' range in central Niger Delta in 2013. The survey results suggest that the population has declined significantly since it was first assessed in 1996; c. 90% lower than the previous estimate of <10,000 individuals about 20 years ago. Using cumulative observation data, I suggest that the current estimate of the total population surviving in the wild can only number in the hundreds rather than the thousands. The major threats are habitat loss and degradation, but hunting is still a significant threat to the species' survival. Based on spatial analysis of forest cover within the species range over a 22-year period, it is estimated that deforestation occurs at an average of 1.2% annually, thus, suggesting that if the species' decline is primarily driven by habitat loss, it may become extinct in 5 years or less. Only two areas were found where viable populations of the species still persist. The forests in these areas are severely fragmented, but together total approximately 78 km². With no formal protection throughout its range, priorities for conserving remnant populations of the species must include the establishment of effective conservation areas, taking into consideration the needs and livelihoods of local communities, and promulgating laws and policies (both at government and local levels) that fully protect the species throughout its range.

Key Words: Niger Delta, *Piliocolobus epieni*, habitat, population, distribution, red colobus

Introduction

The Niger Delta red colobus *Piliocolobus epieni* (Grubb and Powell, 1999) became known to science in 1993 in the course of wide-ranging wildlife inventory and mapping surveys across the Niger Delta undertaken by the late C. B. Powell (Powell 1993). His unexpected discovery of this primate, supported by the skin of a specimen provided by a native of Gbanraun (in present-day Bayelsa State) (Oates 1994), drew the interest of international primatologists and conservationists. At the time, the monkey was believed to be a close relative of one of the geographically closest red colobus populations—either Preuss's red colobus (*Procolobus preussi*), over 150 miles away along the Nigerian-Cameroon border or of the Bioko red colobus (*Procolobus pennantii pennantii*)—and as such was believed to be a subspecies of *Procolobus badius* (*sensu lato*) in the *pennantii* group (Werre and Powell 1997). In subsequent years, further studies of vocalizations and mitochondrial DNA by Ting (2008) suggested that *epieni* was not closely related to either, and it was consequently considered a distinct species, *Procolobus epieni*. Groves (2001, 2007) placed most of the different forms of red colobus, including *epieni*, *pennantii* and *preussi*, as separate species all in the genus *Piliocolobus*.

Prior to this survey, there has been only one range-wide study of this monkey. The study by Werre (2000), between 1994 and 1997, established that *P. epieni* occurs only in the Niger Delta's freshwater swamp forest, often referred to as marsh forest, which has a year-round, high water table but does not suffer deep flooding or tidal effects (Oates and Werre 2009). The study indicated that the more clumped distribution of food species in these forests was a key factor restricting the monkey to its limited range of about 1,500 km², demarcated by the Forcados River and Bomadi Creek in the northwest, the Sagbama, Osiama and Apoi creeks in the east, and the mangrove belt to the south (Oates and Werre 2009) in the central Niger Delta, Bayelsa State, Nigeria. The Niger Delta red colobus has the most restricted range of any of the Nigerian monkeys (Blench 2007). Reports from local hunters indicated that it was common over much of its range at the time it was first discovered (Powell 1993), and was thought to be in no immediate danger. Conservation scientists soon realized,

however, that the species was gravely threatened, particularly from habitat loss and degradation (see Werre and Powell 1997). Werre (2000) estimated that the total population of *P. epieni* had fallen below 10,000 individuals (Oates 2011), and the status of the species has deteriorated further since then. By the early 2000s, uprisings and conflicts over petroleum and land and human rights had erupted in the Niger Delta, hindering research and conservation activities in the region.

The Niger Delta faces a peculiar combination of social, economic, environmental and political challenges. The largest river delta in Africa, the region supports the second largest swamp forest on the continent and the third largest contiguous mangrove forest in the world. It has played an important role in the Nigerian and global economy since 1600 (Blench 2007). Crude oil in all its forms, from extraction to production, symbolizes the Niger River Delta of today and is the catalyst for major social and political tensions in the region. It is infamous as the chief cause of devastating environmental pollution and forest degradation since the late 1950s when oil was first discovered in the Oloibiri community of Bayelsa State. Road and canal construction have affected especially areas that can be considered as prime habitat for red colobus. Drilling in the Niger Delta opened up the forests for commercial logging and the bushmeat trade (Werre and Powell 1997; Blench 2007; Oates and Werre 2008; Oates 2011), resulting in the loss of important colobus food trees—especially *Hallea ledermannii* (Rubiaceae), locally called *abura*, being felled at a high rate by artisanal loggers (Oates and Werre 2008). Abura has been the most important timber species after *Triplochiton scleroxylon* (Malvaceae) since 1949, and by 1951 export volume had increased more than five times (Blench 2007). Most of the Abura came from the swamp forest between the Nigerian Lowland Forests ecoregion westwards bordering the delta. This source was soon depleted and loggers started to focus more on the delta, where exploitation was at the same time facilitated by increasing oil exploration (Blench 2007). With the national population growth rate at about 3% per annum, the oil industry continues to attract a huge number of migrant job seekers from across Nigeria and internationally, markedly increasing the human population in the delta, now estimated to be over 30 million people with a significant portion living in Port Harcourt, Rivers State (Nigeria National Population Commission Database 2006), about 86 km as the crow flies from Yenagoa, the Bayelsa State capital. These two growing cities are the major commercial centers for the delta's forest resources. A rapidly growing human population depleted commercial fish populations in the delta's rivers (see Blench 2007), which increased the rate of bushmeat hunting in the region.

Due to an assumed major decline in the species' population over the last 30 years and continued pressure from hunting and habitat loss, the Niger Delta red colobus is classified as Critically Endangered on the IUCN Red List (as *Procolobus pennantii epieni*; Oates and Struhsaker 2008), and has been listed as one of the world's 25 most endangered primates (Oates and Werre 2009). The goal of the survey was to gather information to determine the status of remnant populations of *P. epieni* across its range—data that can be used to develop a conservation action plan. I also endeavored to map the current distribution of the red colobus in relation to habitat conditions and threats affecting *P. epieni* (type, distribution, and intensity), in order to identify priority areas for its conservation.

Methods

Survey sites

Werre (2000) indicated 16 communities (forests) where he saw or heard *P. epieni* or obtained reports of its presence from hunters: *[1]Sampou, Azama, *Gbanraun, *Norgbene, Ogboinbiri, Keme-Ebiama, Kokologbene, Ukubie, Egbemo-Angalabiri, Ogbotobo, Lalagbene, Adi-Egbe, Adagbabiri, Eriama, Toru-Ebeni and Bolou-Orua. He visited three other areas—Bomadi, Orobiri and Olota—but there were no reports of red colobus occurring there. Our study sites included all the communities listed in Werre's (2000) report as well as a number of other locations suggested by hunters. The area delineated in Figure 1 (shaded grey) as the range of *P. epieni* is within the present-day Bayelsa State. The 16 communities that were important for the survey are located mostly in Ekeremor, Sagbama and Southern Ijaw Local Government Areas. The range of *P. epieni* according to Werre (2000) is within geographic coordinates 5.31′E and 4.06′E at its northern and southern limits and 5.38′N and 6.27′N at the western and eastern extent. The town of Bomadi (in Delta State) is at the northernmost tip of the species' range, while Sagbama, Ajamabiri and Lobia are located at the eastern, western and southernmost edges of its distribution, respectively. The range of *P. epieni* overlaps areas covered by both the Niger Delta swamp forest and the Central African Mangrove Ecoregions; significantly, much of the range is within the swamp forest zone in the central and eastern parts.

The red colobus range is generally low-lying; between 31 m below and 42 m above sea level. Average altitude in this region is 17 m (DIVA-GIS[2]). One of the most significant features of the Niger River Delta is the hydrology and drainage; the region has an elaborate network of coastal waterways and winding tributaries of the River Niger. *Piliocolobus epieni* occurs mostly in the western central part of this region, an area described by Powell (1993) as the 'marsh forest' zone —freshwater tidal sector, with permanently water-logged ground that does not receive much of the annual Niger flood (Werre and Powell 1997). The major changes in the hydrological regime come from the Atlantic Ocean's tides and the Niger River flood, which begins toward the end of the rainy season in August, peaks in October, and tapers off in December (Blench 2007). Some parts of the species' range are also within the band of mangrove forest close to the Atlantic. In

1 Areas with an asterisk are locations where Werre (2000) saw or heard *P. epieni*.

2 DIVA-GIS is a free computer program for mapping and geographic data analysis. Website: <http://www.diva-gis.org>.

front of the mangrove belt and close to the sea are ephemeral coastal barrier islands often covered in transitional vegetation (Blench 2007).

The delta region has one of the highest mean annual rainfalls in tropical Africa. Given the proximity of the region to the coast, precipitation is very high, receiving rain throughout the year but mostly from March through to October, with

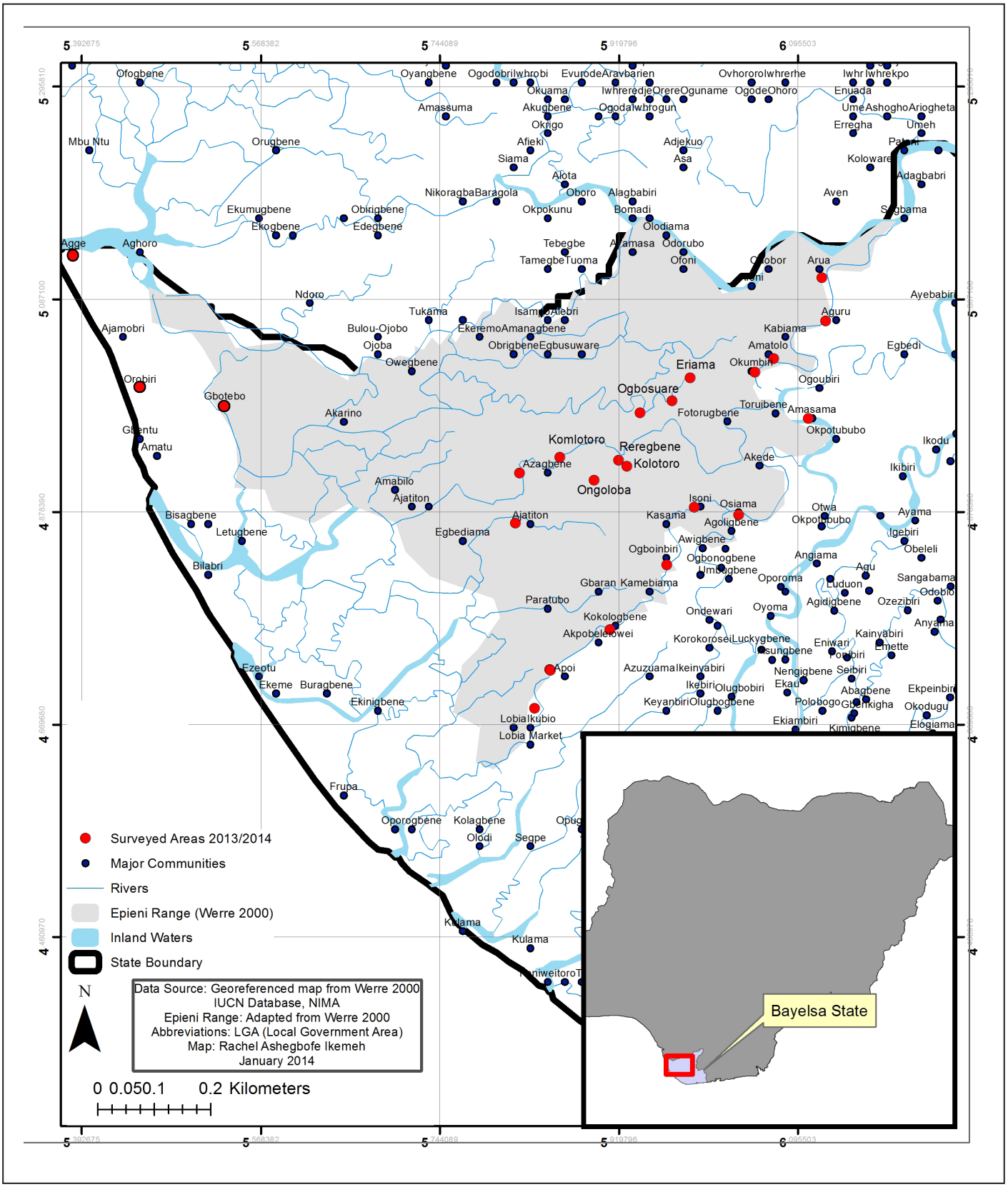

Figure 1. Areas in the Niger Delta surveyed in 2013–2014.

intermittent showers during the other months. According to Blench (2007), mean annual rainfall averages 4,000 mm in areas close to the coast around the species distribution region. Even during the dry season, from January to February, mean monthly rainfall is 150 mm in the delta (Blench 2007). DIVA GIS estimates a mean annual minimum and maximum temperature for the areas where *P. epieni* is found as 22°C and 30°C, respectively.

Survey methods

Our survey focused on areas where natural forests remain and in designated forest reserves indicated on the map within the range of *P. epieni*. Field surveys were generally exploratory, with visits to forests close to the aforementioned locations but also visiting other forest areas when receiving new and reliable information from indigenous people. The swamp forests where *P. epieni* occurs is not easily accessible on foot. During the dry season we were able to carry out surveys following available trails used by hunters and other people. When water levels were too high for us to wade through, surveys were conducted using dug-out canoes along canals created and used by local people.

Encounters with *P. epieni* (sightings and vocalizations) were recorded using the format recommended by White and Edwards (2000)—the generic name of the location, GPS coordinates (waypoint and in the field notes using a Garmin GPS 62s), date, time and type of observation, approximate number of individuals observed, activity and behaviors, and habitat type/condition. All evidence/identifications of other primates and large mammals were also recorded, as well as evidence of human activities. Habitat data were assessed prior to field visits using remote sensing images, and our field surveys provided opportunities for ground-truthing and assessing habitat status.

Data collection was carried out from 14 April to 26 August, 2013. Field surveys were carried out from 07:00 to 12:00 and 16:30 to 18:00; times when the colobus monkeys are most active. We tried to adhere strictly to these time schedules, but sometimes the survey trails were too far from our camp (insecure areas or flooding meant that on some occasions we had to stay in villages some distance from the trails).

Since one of the primary aims of the survey was to determine the population status of *P. epieni* across its range in the central Niger Delta, interviews made up an integral part of our research. Werre (2000) also used a combination of systematic reconnaissance, direct searches, and interviews. Local people were interviewed for information on *P. epieni* populations and asked how they interacted with the species in their respective communities (n = 21; Table 2). Only open-ended questions were used.

Overall, we travelled about 589 km in and around the species' range; 183 km of which were covered on foot in systematic field surveys, and 54 km were surveyed from locally constructed dug-out canoes in shallow creeks/canals where it was not feasible to walk. The rest of the distance travelled was in motor boats or trucks when moving between communities. Figure 2 shows the survey locations and systematic sampling routes.

Table 1. Summary of field observations of *Piliocolobus epieni*.

Locality (major communities or camps nearby)	Forest surveyed (km²)[1]	Encounter rate/ km[2]	Type of observation	No. of individuals counted[3]	Other primates seen with *P. epieni*	Other communities using the forests visited	Notes
Otolo (camp of Kunu Community)	11.8	0.12	Sighting	>25	Putty-nosed, white-throated monkeys, olive colobus	Ogbosuare, Adagbabiri, Eriama, Sampou	Observed troop for 20 minutes before our presence was detected.
Sampou	15.4	0.29	Calls	Unknown	Possibly mona and putty-nosed monkeys	Azama, Kunu	Very Distant
Ongoloba (camp of Azagbene community)	12.6	0.44	Sighting, calls	<30	Putty-nosed monkey, mona monkey	Kolotoro, Reregbene	-
Kolotoro (camp of Aleibiri community)	6.6	0.26	Calls	±70	Putty-nosed, mona, and white-throated monkeys	Ongoloba, Azama, Reregbene, Ogbosuare	Dense tree cover hindered direct observation.
Apoi	10.9	0.07	Sighting	≥40	Putty-nosed monkey, red-capped mangabey	Gbanraun, Kokologbene, Ukubie	Group watched for 15 minutes
Egbemo-Angalabiri	22.8	0.42	Sighting	≥15	Putty-nosed, mona, and white-throated monkeys, olive colobus	Azagbene, Komlotoro	-
Bolou-Orua	27.3	0.03	Calls	Unknown	White-throated monkey	Toru-Orua (northwest), Kaebiama (south), Agoro (east)	The only record for this site. Identity uncertain because the sound was very distant.

[1] Size of forest area is calculated from USGS Landsat Satellite imagery of 2013. This size is only an approximate measurement and should not be construed as the true size of the forests. It should also be noted that we have attempted to use names of communities using a particular forest area but it does not suggest the ownership of a forest area or is conclusive of all communities entitled to that forest area.
[2] Encounter rate was calculated using the sum of observations/total distance surveyed in each site.
[3] Number of individuals indicated on the table is not an absolute figure of the number of individuals present in the group but was estimated based on point counts from the observer's angle of view, guess-estimate from group size appearance and suggestions from the sound of activity and/or shaking on forest branches.

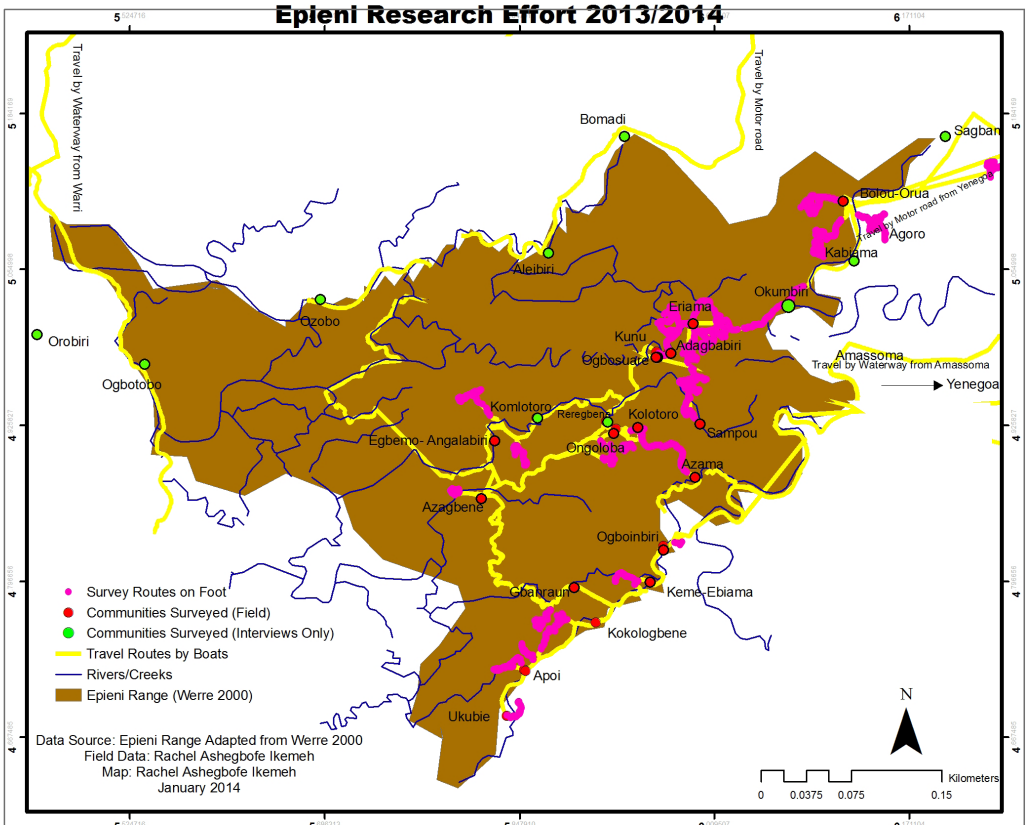

Figure 2. Communities and survey transects.

Table 2. Comparison of two surveys in *Piliocolobus epieni* status across different communities.

Site	Communities with *P. epieni* (Werre 2000)	Extinct (reports and field surveys 2013)	Present (confirmed from field surveys 2013)	Local reports	Comments
1.	Sampou*	-	Yes	No	Interviews were not conducted in this community.
2.	Azama	-	No	Yes	Possible since it shares forests with Kolotoro.and Sampou.
3.	Gbanraun*	-	Yes	Yes	Although we did not see any colobus in the Gbanraun part of the forest, observations from Apoi suggest grousp may travel through the forest cluster shared by both communities where boundaries cannot readily be determined.
4.	Norgbene*	-	No	Yes	Forests surveyed from adjoining Egbemo-Angalabiri but no colobus were observed although a group was recently seen by a hunter in the forests close to the community.
5.	Ogboinbiri	Yes	No	No	-
6.	Keme-Ebiama	Yes	No	No	-
7.	Kokologbene	-	Yes	Yes	Same reason as for Gbanraun.
8.	Ukubie	Yes	No	No	-
9.	Egbemo-Angalabiri	-	Yes	Yes	-
10.	Ogbotobo	Possible	No	Uncertain	Hunters in this community say they have not seen or heard colobus in the last 3 years and are not sure if still present.
11.	Lalagbene	Yes	No	-	-
12.	Adi-Egbe	Yes	No	-	-
13,	Adagbabiri	Yes	No	-	-
14,	Eriama	Yes	No	No	-
15,	Toru-Ebeni	Yes	-	-	-
16.	Bolou-Orua	Possible	Uncertain	No	-

*Areas where Werre (2000) saw *P. epieni*.

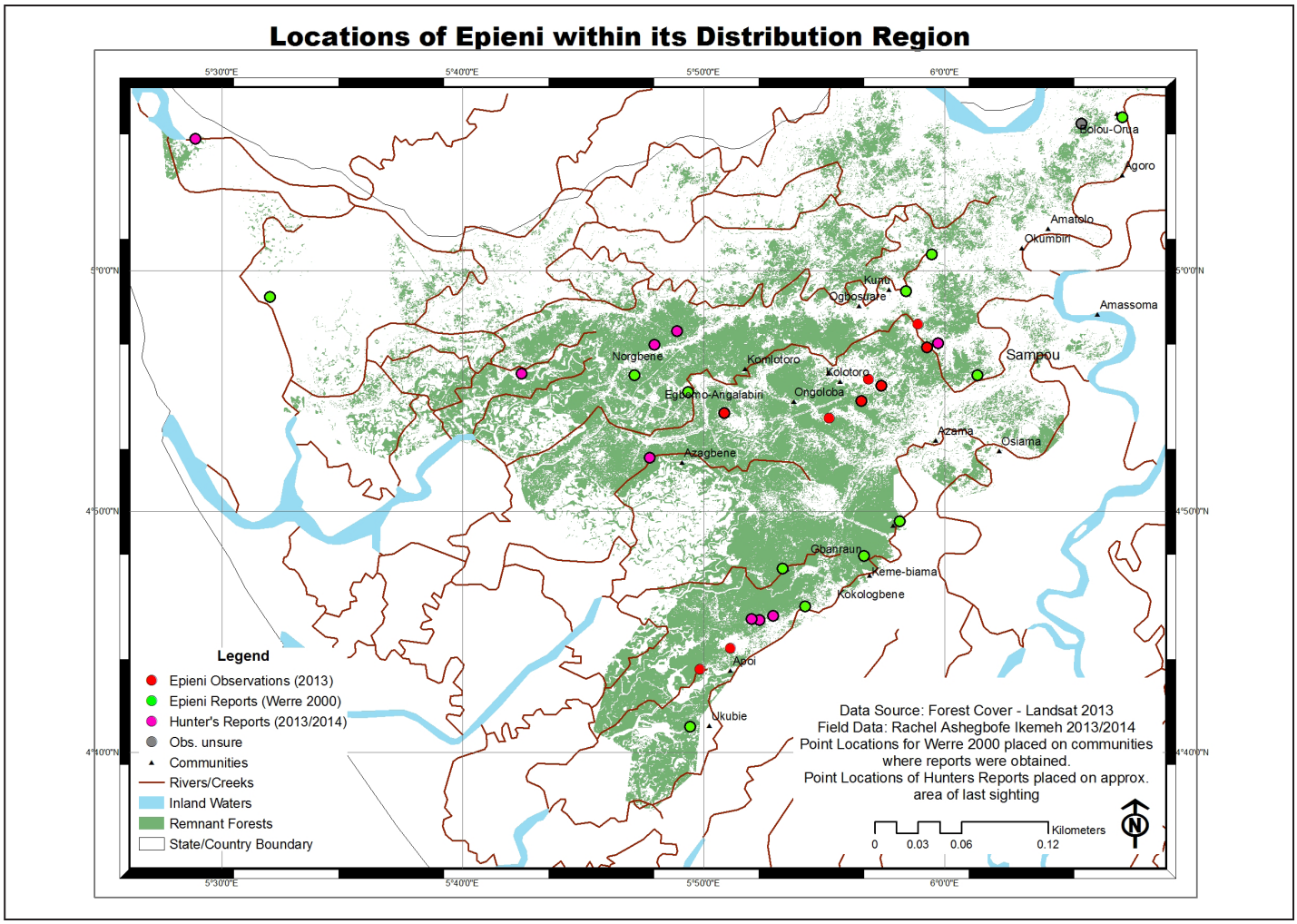

Figure 3. Locations of *P. epieni* observed during this survey and associated reports.

Results

This survey established the continued presence of the Niger Delta red colobus in some parts of its presumed range, specifically in the forests east of the communities of Kunu and Adagbabiri, around the Otolo camp, in the Sampou forest area, less than 2 km from the Kunu forests, in Ongoloba (a camp village of the Azagbene community, in Kolotoro), and another village of the Aleibiri community about 5 km from Ongoloba. *Piliocolobus epieni* was observed in Egbemo-Angalabiri, where the forest is contiguous with the Ongoloba (Azagbene) community forests. *Piliocolobus epieni* was also seen in a relatively large group in the Apoi forests, adjacent to the community forests of Gbanraun and Kokologbene. The record at Bolou-Orua was based on very distant vocalizations and was not absolutely certain. Figure 3 shows the locations of these records.

The occurrence of the Niger Delta red colobus is largely concentrated in two contiguous forest patches, combined covering about 7,896 ha. The first forest cluster covered more than 4,368 ha, extending east from Kunu connecting to forests in Sampou, and then south to Kolotoro and Ongoloba, terminating at the eastern flank of Egbemo-Angalabiri and north of Azagbene. A smaller cluster of about 2,587 ha where the species was relatively common was made up of forest patches from Kokologbene extending west to Gbanraun and southwards to Apoi, terminating at the fringes of forest close to Ukubie.

In the 1990s, visitors to the forests near the town of Gbanraun observed *P. epieni* relatively easily (Oates 1994). During our surveys, however, we failed to find the colobus over two full days of travel in *c.* 500 ha of forests where the species had previously been intensively studied and viewed by several scientists and conservationists. This suggests that the population there had undergone a severe decline. Werre (2000) estimated that the entire population of P. epieni may have fallen below 10,000 individuals. Based on cumulative observations made of c. 200 individuals (see Table 1) during this survey, I suggest that the current population size may now number in the hundreds rather than the thousands. The actual population estimate may be somewhat higher if, for example, the survey effort and area covered were insufficient, and group sizes were poorly counted and significantly larger, and of course if there is a significant population that neither Werre (2000) nor I are aware of. Further surveys are needed. It is evident under any circumstances, however, that the species

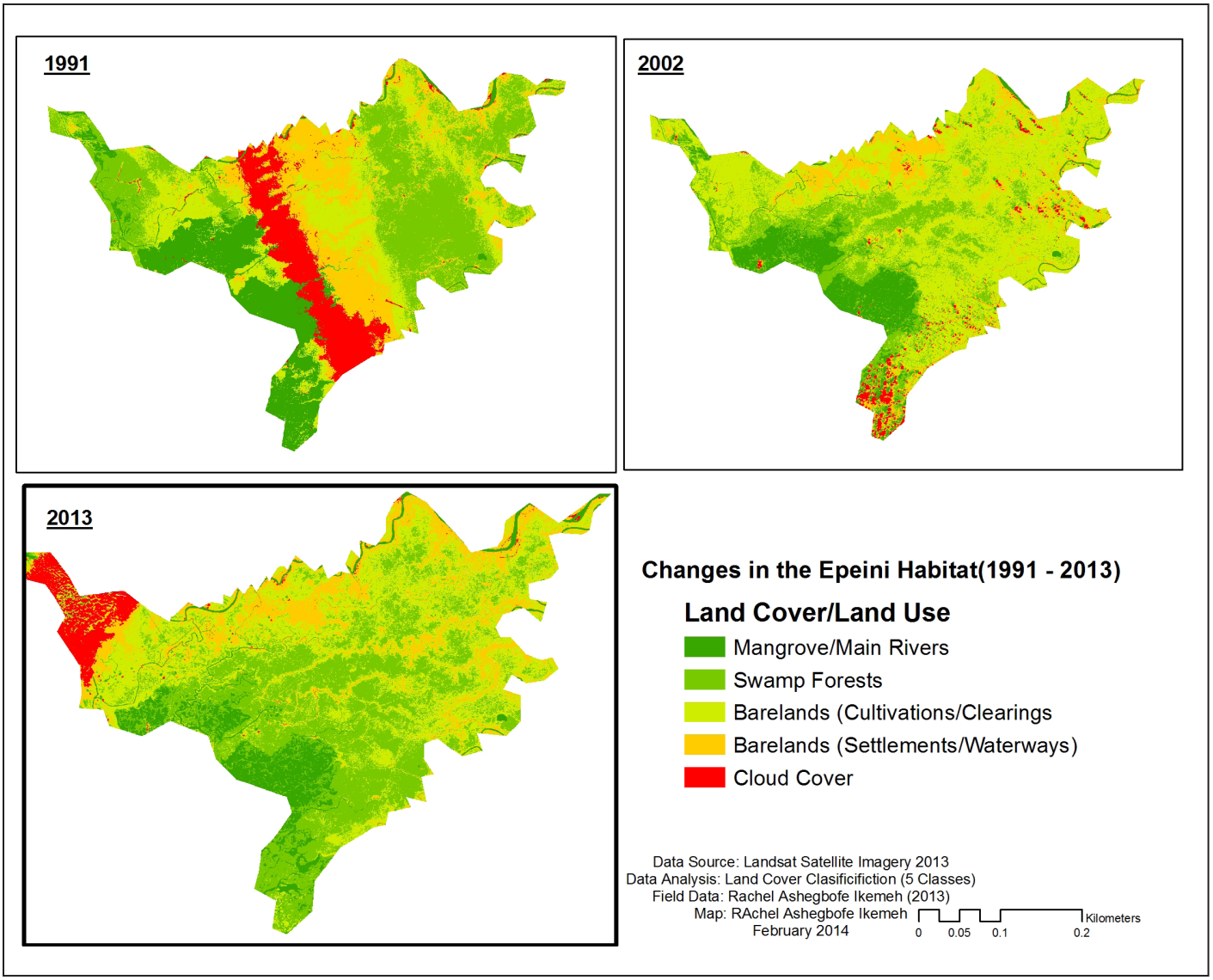

Figure 4. Changes in forest landscape within the range of *P. epieni.*

has been extirpated from much of its range (see Table 2), and even in localities where they had been previously reported present by Werre (2000).

Besides hunting, a major factor that has affected the populations of this species is the degree of habitat loss and degradation over the last 3–5 years. Observations on logging, occurring year-round in the species' habitat, indicate the loss of important food trees over time. By carrying out spatial analysis of available United State Geological Survey (USGS) satellite imagery (Fig. 4) it was possible to assess the rate of deforestation over the last 22 years. The results indicate that 47% of forests was lost between 1991 and 2002, and a further 12.8% of forest cover was lost during the subsequent 11 years from 2002 to 2013. The lower rate during the second period can be attributed to the civil unrest that engulfed the region at this time which dampened activities. Overall, this spatial analysis shows that there is an annual deforestation rate of about 1.2%, equivalent to about 2,200 ha (22 km^2) lost annually.

Discussion and Recommendations

The historical and current range of the species still need further investigation. New and reliable reports of *P. epieni* in the Agge community (Delta State) presents possibilities that the species may occur in the forests of the Delta State northwards, reaching the Forcados and Burutu communities. There were also reports of a monkey that had not been seen for almost 20 years from the Emago-Kugbo community at the border of the Rivers and Bayelsa states in the Edumanom Forest Reserve. This might have been *P. epieni* or another undiscovered monkey. It does, however, warrant investigation, suggesting as it does that the range of *P. epieni* may have extended beyond the limits described by Werre (2000). Presently, the species appears to be concentrated in the central south-eastern region of the range highlighted by Werre (2000), in severely degraded and fragmented habitat totaling about 78 km².

Threats

Deforestation and habitat degradation resulting from excessive logging are the most significant that this species is facing. The number of signs of logging was six times (84% of total observations of threats identified) more than any other observed human activities considered to constitute a threat to red colobus in the region. Most forests surveyed lacked large trees and even medium-sized trees were very hard to find. Even trees not regarded as providing economically-valuable timber products were being cut down. In the north of the species' range, the forest is mostly dry or has areas where there are navigable waterways, and most trees were being cut into planks inside the forest (creating considerably more disturbance than regular logging) before being transported by tractor (in the dry season) and/or on foot (in the wet season). In the south of the species' range, trees are floated out of the forests as logs along canals dug out to connect to larger canals or creeks where the timber can be picked up by large boats and transported to major urban centers. Due to excessive logging, large trees and even medium-sized to small trees important as food sources for red colobus and other wildlife were very scarce. Satellite images analyzed for the species range show a significant loss of forest cover of 2,200 ha each year since 2002. Only in the forests of Eriama and neighboring areas did we observe large 'bush mango' trees *Irvingia gabonensis*. They are locally protected from logging because their seeds are commercially valuable as a soup condiment. They are gathered during the fruiting season between April and July every year and sold in large urban markets for reasonable profits.

The Niger Delta has large reserves of crude oil and gas, and extraction of these highly valuable resources has direct impacts that include deforestation for the construction of roads, drilling, and the construction of platforms and pipelines. Where access by land is difficult, as is the case in much of the range of *P. epieni*, canals are opened up and expanded, altering the hydrological regime of the ecosystems. These canals serve as waterways for motorized boats and allow for the installation of pipelines and other activities related to drilling and the transport of the crude oil. However, although oil extractive activities compromise the ecosystems, it is the indirect impact of these activities that is most devastating and large-scale. The infrastructure required to support petroleum extraction (roads, power lines, and towns) facilitates further human expansion into formerly unoccupied areas. This increased accessibility to remote areas by way of new oil roads and pipeline routes is the primary cause of excessive logging leading to severe deforestation, agricultural development, and the unsustainable harvest of wild animals as bushmeat. Another consequence of petroleum extraction (whether by bunkering [theft] or by corporate activities) is oil spillage that pollutes the riparian habitats so important for the survival of both people and the wild fauna and flora. Bunkering was on the rise in many parts of the areas surveyed, and this illegal activity raises new concerns on how to regulate oil spillage and avoid the environmentally destructive consequences of oil spills. Records show that 50% of oil spills are due to corrosion of poorly maintained pipelines, 28% from bunkering, and 21% from oil production operations (Nigeria, Federal Ministry of the Environment 2012).

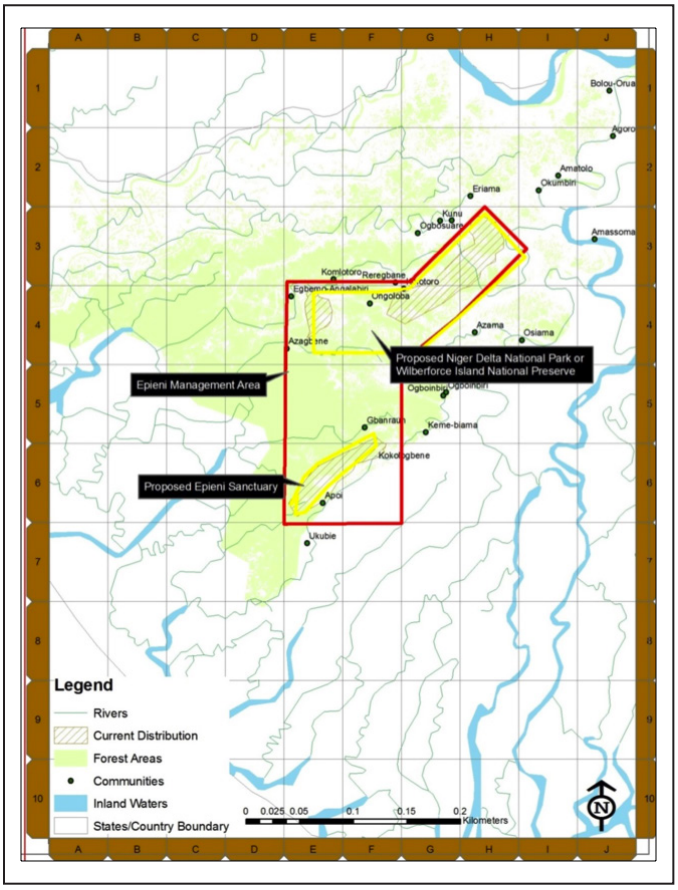

Figure 5. Proposed areas for conservation and suggested management regimes.

Results from this survey indicate that hunting of colobus is very rare and almost non-existent in many areas surveyed, and the predominant threats come from logging and other socio-economic activities. Although it seems that levels of hunting correspond with the occurrence of wildlife found in the area, it can be described as opportunistic, as most of the people observed or reported to be hunting are fully engaged in either logging or fishing.

Conservation

The Niger Delta landscape is high in biological endemism and has other, also threatened, primate populations such as the endemic Sclater's guenon (*Cercopithecus sclateri*), the Nigerian white-throated guenon (*Cercopithecus erythrogaster pococki*), the red-capped mangabey (*Cercocebus torquatus*) and the endangered Nigeria–Cameroon chimpanzee (*Pan troglodytes ellioti*). There are no effectively protected areas. Without effective conservation and management of its unique species and habitat, the Niger Delta may have already witnessed the extinction of one of its endemic mammals—Heslop's pygmy hippopotamus (*Hexaprotodon liberiensis heslopi*)—and now only time and proactive measures will determine if the Niger Delta red colobus will avoid extinction.

The numbers of red colobus are now dangerously low as their habitat continues to shrink. Urgent steps need to be taken to manage the remnant population(s) and ensure recovery from their present unsustainable levels. Since the forests of *P. epieni* are productive for timber, crude oil reserves, and other economically important resources, it is important that specific areas be delimited, created and managed as IUCN category IV protected areas—sites where active management interventions are undertaken so as to ensure maintenance of habitats and/or to meet the requirements of a particular species, and also where certain activities are prohibited (IUCN 1994). For *P. epieni*, we propose that certain areas of the Otolo-Kolotoro-Ongoloba axis (140 km²) be demarcated as a national park, while the Ukubie-Apoi-Gbanraun-Kokologbene axis (21.5 km²) be protected as a conservation sanctuary (Fig., 5). These two sites are extremely important for the continued survival of this species.

The creation, management and effectiveness of these protected areas will depend of course on the full involvement of the local communities in and surrounding them, taking into consideration their well-being and livelihoods.

Acknowledgments

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