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Field Report:

Establishing a Colony of Endemic, Critically Endangered Red-bellied Guenons (*Cercopithecus erythrogaster erythrogaster*) in a Newly Reconstituted Forest in Benin: A Personal Perspective

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Abstract: The red-bellied guenon (*Cercopithecus erythrogaster erythrogaster*) is an endemic, critically endangered monkey in West Africa. Here, I share my 30-year experience with this species. A group of 14 red-bellied guenons, which had been individually captured between 1994 and 2008 in the Ouémé floodplain in southern Benin, was cared for and observed. This group developed within 30 years into a viable population of about 40 monkeys living in two groups in a reconstituted rainforest, the *Sanctuaire des Singes*, in southern Benin. A total of 66 infants were born into the group. The intense group life of free-ranging, habituated monkeys is described in detail as well as their interactions with other forest species, local people, and tourists. Of particular interest is the observation of the replacement of a dominant male after 13 years, with ensuing infanticide of three neonates. The red-bellied guenon has become the flagship species for Benin nature protection, giving rise to modest ecotourism. The sustainability of this site depends on the acceptance by the local population and its use as a research and demonstration site by the International Institute of Tropical Agriculture (IITA), NGOs and the local university.

Key words: Conservation, red-bellied guenon, Dahomey Gap, Benin, introduction and establishment

Résumé: *Le singe à ventre rouge (*Cercopithecus erythrogaster erythrogaster*) est une espèce endémique, en état critique d'extinction en Afrique de l'Ouest. Ici, je partage mes expériences de 30 ans de contacte intime avec ces singes. Un groupe de 14 singes capturés entre 1994 et 2008 dans la pleine inondée de l'Ouémé au Sud-Bénin a été élevé et observé. Au bout de 30 ans, une population viable d'environ 40 singes, séparés en deux groupes, s'est développée, vivant dans une forêt pluviale ré-constituée, nommée 'Sanctuaire de singes'. Un total de 66 enfants est né. La vie familiale intense de singes sauvages, mais habitués, est décrite en détail, ainsi que les interactions avec d'autres espèces forestières, les villageois et touristes. L'observation du remplacement du mâle dominant après 13 ans par un jeune mâle, suivi d'infanticides de trois nouveau-nés est d'intérêt spécial. Ainsi le singe à ventre rouge est devenu l'espèce phare pour la protection de la nature au Bénin, source d'un écotourisme modeste. La durabilité de ce site dépend de l 'acceptance par la population locale et son usage comme site de recherche et de démonstration par l'IITA, les ONGs et l'université.*

Mots clés: Conservation, singe à ventre rouge, Sillon Dahoméen, Bénin, introduction et établissement

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INTRODUCTION

The red-bellied guenon, *Cercopithecus erythrogaster erythrogaster* (Gray 1866) (Cercopithecidae, Primates), is an endemic monkey of the Dahomey Gap with a small area of distribution in southern Benin and adjacent forests in Togo and Nigeria. The species has been studied only through surveys (Oates 1996; Hanon 2001; Assogbadjo & Sinsin 2002; Sinsin *et al*. 2002; Campbell 2005; Nobimè *et al.* 2008, 2009, 2011; Nobimè 2012; Agbessi *et al.* 2017; Ségniagbeto *et al.* 2018), particularly in forests in the Mono River valley in Togo and Benin (Houngbédji *et al.* 2012) as well as in forests in Nigeria on the border with Benin (Matsuda Goodwin *et al.* 2017). It inhabits small rain forest patches (mostly sacred forests of <5 ha), swamp forests, and seasonally inundated dense thickets (Assogbadjo & Sinsin 2002; Reitz 2016; Ganmou 2020), and has its largest population in Benin's Lama Forest (Nobimè & Sinsin 2003). The Nigerian subspecies, *C. erythrogaster pococki,* the white-throated monkey (with a grey belly) has a larger distribution in the forests of southern Nigeria, possibly with no range overlap with the red-bellied subspecies (Oates 1985, 2011). While at the species level *C. erythrogaster* is listed as Endangered (EN) by the International Union for the Conservation of Nature (IUCN) (Matsuda Goodwin *et al.* 2020a), the subspecies *C. e. erythrogaster* is classified as Critically Endangered (CR) due to the small size of its range, the continuous deforestation and habitat degradation even among sacred forests, and the killing for crop protection and bushmeat (Nobimè *et al.* 2011; Houngbédji *et al.* 2012; Zoffoun *et al.* 2019; Matsuda Goodwin *et al.* 2020b).

At the beginning of the experience described here, the range and conservation status for red-bellied guenons was much less clear. Haltenorth & Diller (1980) stated that 'W. Africa, probably S.W. Nigeria' could be the origin of individuals involved in trade. Kingdon (1997) described specimens in S.W. Nigeria and ranging toward the west had russet colored bellies.

My story with red-bellied guenons started in 1994 when my daughter acquired a young female from the Dantokpa Market in Cotonou. Together with my family, we had already maintained and raised mona (*Cercopithecus mona*) and tantalus (*Chlorocebus tantalus*) monkeys. In 1995, the primatologist John Oates, who had observed these monkeys in the Lama Forest the year before, and his student Reiko Matsuda Goodwin (see references) visited us. While the other monkeys either died or were released when we moved from the large town of Abomey-Calavi to the tiny village of Drabo Gbo, the red-bellied guenon came with us. In Drabo, I eventually bought 14 ha of land and converted these fallow fields to forests (Neuenschwander *et al.* 2015; Neuenschwander & Adomou 2017). All the while, I was employed by IITA as a specialist in biological control. In 2014, IITA received all title deeds and is now the owner of the property, now known as *Sanctuaire des Singes*.

I present here an informal account of the establishment of the *Sanctuaire des Singes* and a general description of the behavior and life events of its red-bellied guenon residents.

THE *SANCTUAIRE DES SINGES*

Location

The *Sanctuaire des Singes* in Drabo Gbo (6°30'N, 2°18'E) was founded in 1995 when I bought 2.5 ha of teak forest and agricultural land from the elders of Drabo Gbo, 30 km north of Cotonou, 12 km from the centre of the spreading town of Calavi, the second largest city of Benin. Up to 2005, more land was bought and today the sanctuary covers an area of 14 ha. It has become a well-developed, species-rich secondary forest, including about 10 ha in Drabo Gbo, the Orojamè (sacred forest of the Oro cult) in Drabo Fanto, a triangle of land of 2.5 ha further north, and the <1 ha sacred forest of Dodja (Figure 1; Neuenschwander *et al.* 2015; Neuenschwander & Adomou 2017).

Maintenance of monkeys

Initially, the monkeys were maintained in three partly interconnected, 2.0 m high cages of 55.8 m^3, 33.5 m^3, and 18.4 m^3, covered with chicken wire with a mesh size of 5.5 cm. Depending on need, a total of 107.7 m^3 could thus be partitioned into five cages. The monkeys were fed daily fruits, vegetables, green branches with fresh leaves of various trees and shrubs, and provided a basin with water. Once released into the forest, they could find earthen bowls with water in Cooun and *Grande Forêt*, while the bowls in the Orojamè were not replaced after having been stolen or broken. The monkey group around the house continues to receive fruits and vegetables twice daily; those in the *Grande Forêt* are not fed and live entirely off the forest.

In the first years, the caged monkeys received the deworming medications albendazole or praziquantel (on five occasions up to 1999, calculated for the weight of the animals, according to veterinary practice, and carefully disguised in a split banana;

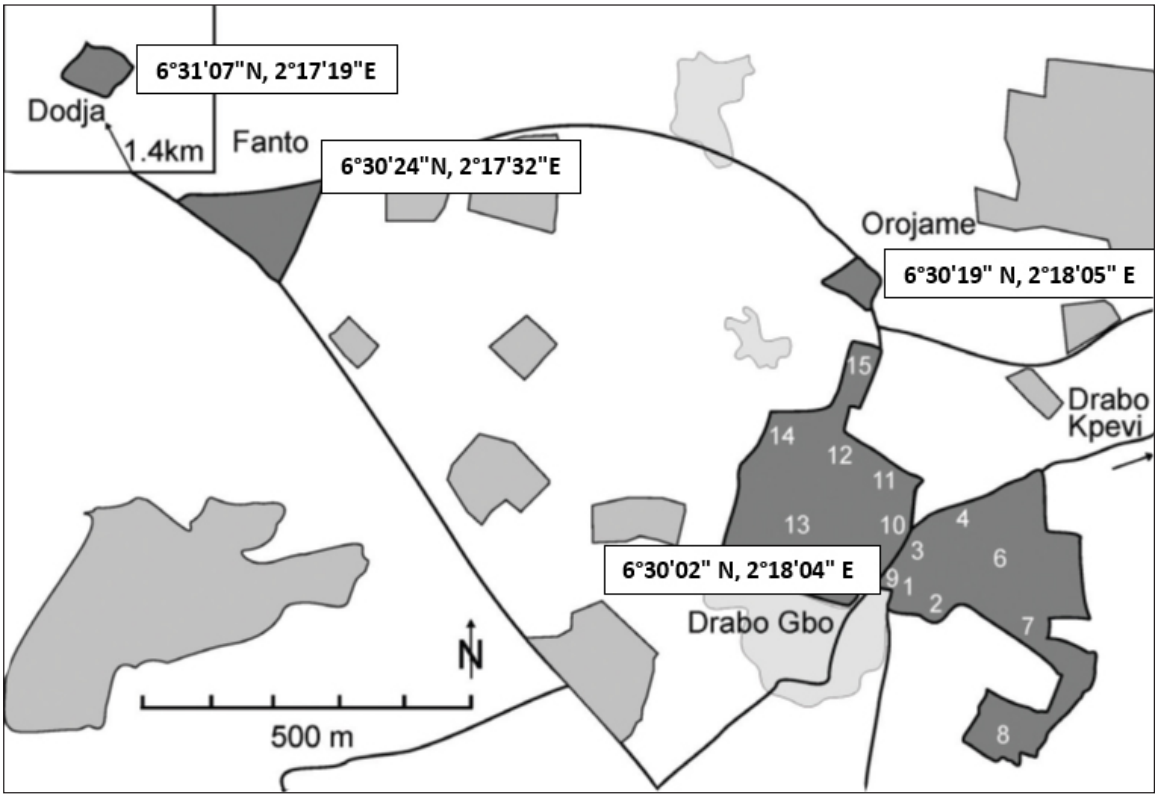

Figure 1. Map of the *Sanctuaire des Singes* at Drabo Gbo, with GPS data for entrance doors, year of purchase and start of forest management and major clearings: 1. nursery-garden 1997 (house constructed 1997-1998); 2. papa-garage 1999, 2000; 3. Lissanou 1999–2003; 4. mill 2000; 6. Cooun 2001, part of Cooun cleared in 2010; 7. corridor-Dansou 2004, 2010; 8. Emile 2001–2007 partly cleared 2012; 9. *Maison de Jeunesse* (MdJ house constructed 2005) 1998, cleared in 2013; 10. Tofinou 1998-2000; 11. Pierre 1999–2001; 12. Kakpo 2004; 13. *Grande Forêt* 1996, local fire in 2012; 14. AgoXwè 2000–2003; 15. Corridor north 1998, 2002–2003; Orojamè 1998; Fanto 1998–2000, partly cleared 2014; Dodja 2011, partly cleared 2016. The map features natural forests in grey with border line, wood lots light grey with border line, compact villages light grey, and unsurfaced roads as lines (see also Neuenschwander & Adomou 2017).

once supplemented with vitamins) and papaya seeds and leaves, traditional medicine with the same pharmaceutical properties. On the few occasions when animals were injured, no disinfection or other medical measures were attempted because the necessary holding of the animals was judged to be too stressful for them.

Ecotourism

The protected forests are clearly visible on Google Maps as *Sanctuaire des Singes* (including GPS data). Visitors are led through the forest by me or guards and shown the monkeys. For a 2-hour visit, foreigners pay a modest entry fee of about $6, Benin citizens $3, half for children, in order to support maintenance. For inhabitants of Drabo, visits are encouraged and free. Information is available on Facebook managed by IITA staff and assistant teachers (www.facebook.com/Sanctuaire-des-singes-de-Drabo-Gbo-de-lIITA-Bénin-10252330911910/).

OBSERVATIONS

History of introductions

The first red-bellied guenon, a young female ('Belly'), was acquired in 1994 from the Cotonou market with unknown origin ('Ouémé floodplain'). At that time, monkeys, pangolins, tortoises, chameleons, etc., were openly sold in the Dantokpa Market and at the road crossing near the Cathedral Notre Dame. Belly was moved to a large cage in the sanctuary in 1998. Several individuals in Adjohoun later captured young guenons near villages of the Ouémé floodplain (Togbota Aguè, Bonou, etc.), mostly by chasing the animals into fishing nets installed across pathways in dense bush or by luring them into cage traps. In those days, throughout the flood plain such captures were routinely made by the local populations to supply animals for the pet market in town.

A total of six females and eight males were

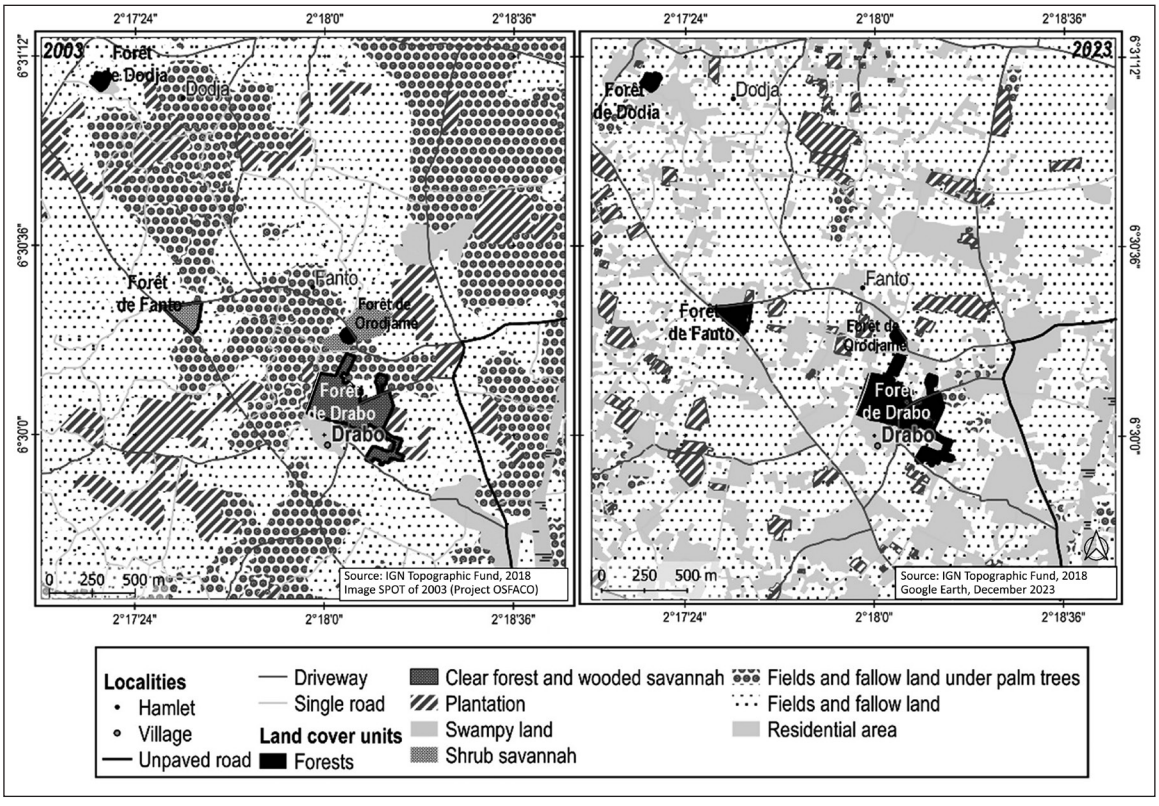

Figure 2. Land cover dynamics from 2003 to 2023 in the research area. Map prepared by Clément Adjire, Université Abomey-Calavi.

introduced, all from the Ouémé floodplain, with one exception, a male from Atiémé in the Mono province (Table, Supplementary Online Material*). Since the Government started to better control the forbidden sale and transport of live monkeys, no further captures and introductions were attempted or allowed.

In time, the paired monkeys reproduced and, a few weeks after birth, the infants began moving independently. They either moved to other cages or left the cages altogether, but returned to their mothers within hours. There, they grew and had infants of their own, but they always came back to the cages. From the age of two years onward, the monkeys could no longer pass through the cage wire but would sit on branches that crossed into the cage nearest their mothers (but not their fathers).

By 2019, most monkeys lived outside the cages. So, all doors were opened and the remaining monkeys were freed. They did not behave as expected. It sometimes took hours for a monkey to leave the cage, even if we lured it outside with bananas – often retrieved and taken back to the cage to eat. Evidently, they feared the unknown environment even though they had experienced it all their lives.

Past and Present Distribution

In 1995-1998, the only monkeys known to the villagers of Drabo Gbo were mona and tantalus monkeys, which occasionally foraged on the villagers' fruit tree crops. However, an elder from Ouéga, a village a few km south of Drabo, recounted how as a young man he had hunted red-bellied guenons in what we now call Cooun. The man explained further, that he had to stop this practice after his wife had given birth to twins, which according to vodun culture prevented him from killing monkeys.

Old villagers from Drabo Kpevi described how, as children, they had been afraid to enter the then dense forest of Drabo Gbo, i.e., the Cooun site that I had bought when it was a meadow. This lends some credit to the observation of forest-inhabiting red-bellied guenons in Drabo Gbo. Land cover maps of the region in 2003 (Figure 2) demonstrate that by that time the forest that would allow the presence of monkeys had shrunk to the sacred forests Orojamè at Fanto, and of Dodja, and perhaps the big *Cola gigantea* tree near the Legba square. Today, the entire sanctuary has dense forest, a good habitat for these monkeys, as a result of about 30 years of reforestation and intensive care to saplings.

At present, the main forests inhabited by red-

**http://primates.squarespace.com/storage/african-primates-journal/volume-181/NeuenschwanderSupplementaryMaterial.pdf*

bellied guenons are the ones known as *Grande Forêt* and Cooun, Papa, Garage, i.e, about 10 ha around the house (Figure 1). There are occasional sightings, by both guards, in the Orojamè, which is separated from the main forest by a 100 m gap. One red-bellied guenon, Louis, was seen briefly in Ouéga, a few km south of Drabo Gbo, before he returned again to the sanctuary after 9 days of absence. From Fanto and Dodja I have no secure observations. Some observations were reported by villagers, but these could also concern the much more wide-spread tantalus monkeys that often visit the sanctuary for a few days before disappearing again.

Behavioural observations

All caged animals were individually identifiable by staff and given names. Observations of their behavior were noted *ad libitum* in a daily journal, by me during my presence of 6-10 months each year or by two permanent staff (see Supplementary Online Material at http://www.primate-sg.org/african_primates/). Once released, the animals were more difficult to identify and most observations were no longer targeted on named individuals.

When the groups became large, counting the animals was difficult. The best results were obtained when a quietly advancing group of guenons moved to reach the dormitory tree around 6:30 to 7:00pm and by chance crossed a road over barbed wires or a narrow passage between trees. Observed against the sky, they could thus be counted.

Additional information was recorded, but not dated, and documented in the spreadsheet available in the Supplementary Online Material. Some of this information resulted from daily contacts with neighbors.

Births and deaths

Between 1999 and May 2024, a total of 66 births were recorded (Table 1; also see Supplementary Online Material). Only once did I succeed in observing a birth. In April 2005, the female, Asibè, was sitting on a horizontal branch 1 m above the ground near the house. Seemingly casual and fast, she bent forward and retrieved the infant, which appeared head first with its face towards the ventrum of the mother. The wet infant immediately clung to the mother as she licked it clean. While some newly born infants had red wounds or swelling on their faces, this one was clean and immediately active. The mother remained sitting, the umbilical cord still hanging from her vagina. One hour later, she withdrew the placenta, approximately the size of an avocado pit, and nibbled on it. It took her more than one hour to finally devour the placenta. As for the umbilical cord, it had meanwhile dried and dropped.

Generally, new mothers will hide for a few days, so most recorded dates of birth indicated in our records are estimates only. After delivery, the mother appears with the infant and can easily be observed by human visitors. All the members of the monkey group crowd around, touching the newborn.

The first birth, by Belly, occurred in 1999, but the infant died within days. Her next infant, Bellibè, was born in 2000. From 2002 onward, births in the group were recorded every year. In 2004, Asibè, who was 5 years old, gave birth in April to an infant who died that same month. Two months later, she snatched Bella's neonate from outside through the chicken wire, nursed it, and disappeared into the forest. In July, she returned with the dead infant. By October, Asibè had a second infant, a third in November 2005, and her fourth in March 2007. All were healthy. Her sister Lisa, had a single infant in 2007. Bella, who lost her infant in 2004, had infants in 2002, 2005, and her fourth in 2007. Adja, the newcomer, an old female, had two infants, one in April and another in September 2008. By 2017, the first infants were recorded in the *Grande Forêt* group. Henceforth, infants could no longer be assigned to named females. In conclusion, females typically delivered infants every two years, but at shorter intervals if an infant died. A maximum of four infants were registered per female.

Infant sex was sometimes difficult to assess. In fact, two purported females from Adjohoun were later determined to be males. Among the 66 recorded infants, only nine could be sexed with certainty: three females and six males.

There was a marked seasonality of births (Table 1); 54 (81.8%) of the 66 infants born in the last 30 years were born in the first half of the year. This is the rainy season. By contrast, across all years, no seasonality of deaths was apparent.

Longevity could be determined only for caged animals. Belly, born around 1990, died in 2011 at the age of 21 years. Bellibè, born in 2000, died in 2014 at the age of 14. Le Vieux, a male, born probably in 1995, died in 2011 at the estimated age of 16 years (see further details on mortality in the Supplementary Online Material).

In the cages, these monkeys occasionally were sick, exhibiting bare patches in their hair and apathic behavior. In the forest, by contrast, they invariably have clean, full, and healthy coats. More frequent than diseases were accidents, which we could monitor only for the caged monkeys. In 2005, we monitored an instance of wound-healing: le Vieux

Table 1. Number of infants born and monkeys died by month from 1994 to mid-2024. Temperature and rainfall data represent monthly mean temperature (C°) and monthly mean total rainfall (mm) from 2015 to 2022.

Month	Births	Deaths	Rainfall	Temperature
January	11	2	22.9	27.6
February	4	1	31.5	28.9
March	16	6	56.7	29.0
April	12	4	119.6	28.3
May	7	1	156.4	27.7
June	4	0	283.1	26.4
Rainy season total	54	14		
July	4	1	68.2	26.1
August	2	0	50.6	25.8
September	1	1	161.6	26.4
October	1	0	176.3	27.0
November	0	3	63.1	27.8
December	4	5	22.9	27.9
Dry season total	12	5		

inside a cage and Louis on the outside were fighting. Grabbing each other's hand and dragging the arms repeatedly across the chicken wire, both received serious wounds. On both males, the white bone showed through on a stretch of 5-10 cm on their arm, while the fingers remained mobile. The males finally withdrew, licking their wounds. They continued this for a week, sitting quietly, exposing their arm to the sun. Gradually, the dark hair of the arms returned and increasingly covered the red, uninfected wound. After two weeks, no damage could be seen and the two males returned to fighting much as before.

Family life, food, foraging

Play-mounting by youngsters could often be observed; but mating by adult males was seen only a few times. Similarly, giving birth was observed only once, as described above. With all infants, it is observed that the new mother is always accompanied by at least one other female, either a younger sister or an older daughter (Figure 3). These females tried to touch the infant; sometimes they were even allowed to carry it under the close supervision of the mother. However, at the smallest disturbance, the mother grabbed the infant, pulled it to her ventrum, and fled. Males had few contacts with their offspring. In the cages, if an infant clinged to the tail of its father, he would freeze until the infant left. If the father moved too much, the mother behaved aggressively toward him.

In the forest, red-bellied guenons frequently nibbled on leaves, particularly soft ones such as *Albizia* spp. and the fresh shoots of *Rhodognaphalon brevicuspe*, from which they licked sap, only to drop the shoot without consuming the leaves. They ate *Senna siamea* flowers and nibbled only briefly on the tough leaves of *Ficus exasperata* and 'sapotier' (*Chrysophyllum albidum*). Since the 'sapotier' trees in the forest did not yet produce fruit, the monkeys raided the free-standing trees in the village. Feeding was occasionally frantic, i.e., the monkeys used both hands to take food, sometimes displacing each other when they fed on fruits of *Flacourtia indica* (also eaten by humans), leaves of *Dialium guineense*, and - most markedly - branches of neem (*Azadirachta indica*). The latter is a well-known medicinal plant for humans; the monkeys stripped of its bark to eat. Of note, they did not feed on the abundant sweet fruits of *Carpolobia lutea* until these were offered to them. Nor did they eat the bittersweet fruits of *Ximenia americana*. They licked the sweet honeydew from the underside of leaves attacked by Homopterans, mostly whiteflies (Aleyrodidae). Hopping insects were chased, grabbed, and eaten – even the reportedly bad-tasting *Zonocerus variegatus* grasshoppers, which are abundant at the end of the

Figure 3. Red-bellied guenons from the *Sanctuaire des Singes*. a. An infant of less than 1 year. b. Mother and offspring. c. Mother with her infant and its two sisters. Photograph by Marc Bernard, Cotonou.

long dry season. Birds that accidentally entered a cage were played with and eventually killed, but not eaten. The same was observed for small geckos and other lizards. Water was obtained from several ponds, but also from clay jars placed far inside the forest. Increasingly, the house group drank the clean water from aquaria, where some males took an occasional swim. More recently, they even drank from the showerhead in my presence.

Young male and female guenons were often observed to play, roll on the ground, chase each other through the foliage, and repeatedly jump down from a high branch only to save themselves in the last moment by clinging to a branch or falling down on top of the cages. When a film crew of the national television services arrived for an event in the Maison de Jeunesse (MdJ), a group of youngsters exhibited especially impressive acrobatics around a low branch near the film crew for an hour without interruption - rather than play in the many hectares of forest nearby. Young males behaved similarly in front of tourist groups.

In the forest, individuals were often up to 100 m apart, maintaining contact through species-typical vocalizations, but generally they were quiet and unobtrusive. This is demonstrated by the fact that we have not seen them in all parts of Cooun's 4 ha forest, which has accessible paths. However, damage on maize, banana, 'sapotier', orange, and guava in fields all around the forest within about 50–100 m of its edge indicated that the monkeys had been foraging throughout and crossing the forest. They also followed tourist groups about half-way into the forest, then wait for their return.

In the 5 ha *Grande Forêt*, the unhabituated larger group with 25 individuals was often not seen, even when we worked for a full morning in the forest. Yet damage in surrounding gardens was noted and had to be compensated for, indicating that the red-bellied guenons traversed the entire forest.

Group size and group partitioning

The red-bellied guenon groups have an alpha male (Figure 4). The duration of the reign of these males could only be guessed at for the group around the house. While monkeys were kept in cages, no hierarchy could be established. Louis was a young male in 1999, but became active outside the cages in 2001. He was the dominant male up to 2008. Then le Vieux took over and was the alpha from 2009 to 2011. Since then, a male, born in the house group but not named, was the alpha for approximately 13 years. His dominance was displayed only when the monkeys were fed and he came first for feeding, chasing other members of the group including the younger males and females. In the forest, however, no aggressive behavior was observed. Bellibè, born in 2000, was alpha male in the forest group in 2011 until his death in 2014.

Tentative explorations by individuals, before returning back to the cages, were documented (see Supplementary Online Material). In 2007, the first three individuals were observed to penetrate the *Grande Forêt*, but returned soon after. Finally, two groups centered around dominant males developed and split. In 2007, the first infant was born in the forest group. At that time, there were 20 red-bellied guenons. The limits of the two territories ran along the road between my house and the MdJ. Fighting between groups was, however, infrequent. In those cases, the dominant male usually remained high up, while young and females, even those with infants, fought with open mouths and loudly vocalizing. However, actual physical contact was rare. On other days, incursions into the others' territory were made with no aggression observed. Head shaking, enhanced by the white throat, a sign of unease, was also exhibited toward too inquisitive visitors. Generally, looking directly into the eyes of these monkeys was responded to by head-shaking and they avoided eye contact with visitors.

In March 2024, the replacement of the alpha male could be observed in some detail in the house group. On 16 March 2024, the fourth infant of the year was born to the group of females that always stayed together. The same day, the alpha male mentioned above, was chased by a young male of unknown origin. The old male fled 500 m to the village, then was chased away and two days later was last seen on a mango tree on Emile inside the sanctuary. Assuming that this male had reached alpha status at age five, he was 18 years old at the time of his disappearance.

The new alpha male bit several females and an infant, but their wounds were not life threatening and remained red and dry. For several days, he chased the females with their infants nearby vocalizing and threatening. At the same time, youngsters played within his view without being disturbed. The females first kept together. On day four after the attack, a wounded infant was found abandoned behind a bank on the terrace of the MdJ. When retrieved, it shrieked so much that its mother returned and recovered it. On day six, this infant was, however, found dead, and on day seven another of the mothers appeared with full breasts but without an infant. One female with an infant hid for a few days, but on day twelve four females shared only one infant. One of the abandoned infants was

Figure 4. a. The dominant male in a rare moment of aggression. Photograph by Thomas Leaud. b. Young male red-bellied guenon. All other photographs by Peter Neuenschwander.

picked up by a genet two weeks later. Whether it was caught while still alive could not be ascertained. Occasionally, the male still chased the females. The mother with the last infant was seen sitting near the dominant male on the roof, leaning towards him, while in fact she had the opportunity to hide in the forest. Three weeks after the arrival of the new alpha male, the group was calmer and a new birth by a female of the *Grande Forêt* group, which was observed on a visit to the cages, did not elicit much reaction.

In the described manner, red-bellied guenons were counted on several occasions in 2023. The group in the *Grand Forêt* had 25 members, the house group 17. With 14 introduced monkeys, 19 documented dead animals (16 up to the end of 2023), and 66 births (only 61 up to 2023), we would expect 59 animals at the time of counting (end 2023), yet only 42 were seen. Over 30 years, a total of 17 out of 59, or 28.8%, were thus unaccounted for.

Interactions with other species

Red-bellied guenons had close contact with a pair of mona monkeys, which were maintained in adjacent cages in the initial years of this project. In 1998, a pair, Zio and Maman, along with young male Vincent, were received from Adjohoun. The next year, another male, Marcellin, was born. In 2000, 2001, 2002, and 2006, infants were born to Maman but by 2002 one of the young, Marcellin, plus the old Zio died. In 2006, Mamanbè died at age 6 years. In 2010, Maman, at the age of 16-17 years, escaped and disappeared without being seen again.

Mona monkeys and red-bellied guenons lived together in the sanctuary without apparent conflict. In one instance, in 2006, a mona monkey infant was carried around by a red-bellied guenon. In 2007, Zinvi, a young mona, was followed by red-bellied guenons when it raided trees and swam in an aquarium. In 2010, Maman, a mona female, was seen returning a red-bellied guenon infant to its mother.

Wild mona monkeys rarely visited the sanctuary, having arrived from the sacred forest of Akassato. In 2002, for instance, Louis, the largest red-bellied guenon male at the time, was chased from the 'sapotier' trees near the wall by roaming mona monkeys.

Tantalus monkeys were observed each year in the sanctuary, mostly a couple with one or two offspring. Large tantalus males frightened red-bellied guenons, who exploded in loud ka-ka calls. (In fact, Zin kaka is their Fon name in Togbota, Ouémé Valley). At times, the tantalus monkeys advanced close to the cages, but usually returned to the forest the same day. In 2023, however, a young tantalus monkey stayed for several days at the MdJ, visible by all, and gently played with red-bellied guenons.

Bushbabies (*Galagoides thomasi*) are common in the sanctuary. When red-bellied guenons congregated for sleeping, bushbabies were just waking and were seen in the same trees, though no direct interaction was observed between the two species, nor with the night-active Benin Potto (*Perodicticus potto juju*).

Gambian mongoose (*Mungos gambianus*) is common in the sanctuary, hunting in groups on the ground. Red-bellied guenons were seen following and observing them, though without any direct contact. This mongoose species is of no danger to the monkeys.

Three other small carnivores that were documented in the sanctuary, large-spotted genet (*Genetta maculata*), slender mongoose (*Herpestes sanguinea*), and African civet (*Civettictis civetta*) are, however, potential predators. In April 2024, a genet was observed with a young, perhaps dead, monkey. This was possibly an abandoned infant after the new dominant male had taken over as described above. No other interactions with predators were seen.

Two python species, *Python regius* and the much rarer *P. sebae*, are known from the sanctuary and are a potential danger to red-bellied guenons. When I showed a live, rolled-up royal python, picked up after rains on the road, to the monkeys, they produced loud, explosive and continuous ka-ka calls. The same calls were heard the next day, when I showed them only my brown patterned purse. Evidently, red-bellied guenons perceived pythons as a danger.

Three species of birds of prey, to which red-bellied guenons answered by hiding or calling, breed in the sanctuary: Black kite (*Milvus migrans*), African goshawk (*Accipiter tachiro*), and black sparrowhawk (*Accipiter melanoleucus*). The latter and female goshawks can capture infant monkeys. *Accipiter* spp. are particularly dangerous, because they sit still in the forest waiting for their prey to approach. Their attacks on pigeons were observed, but no attacks on red-bellied guenons were seen.

When in rut, Walter's duikers (*Philantomba walteri*), which are relatively common in the sanctuary, rush through the bush without paying attention to the monkeys. In 2013, red-bellied guenons observing duikers became afraid and did not return to the cages for a whole day.

Interactions with humans and ecotourism

Outside the sanctuary, mona and tantalus

monkeys are hunted by humans, but within the sanctuary we have never observed any attempt at shooting an animal.

In our daily interactions, we were bitten only in extreme situations, e.g., when we had to remove a dead or injured animal. Outside the cages, no monkeys (except Affli, see below, and a monkey freed from a trap) were ever touched by humans.

In 2012, an unnamed female died probably in a road accident, but her small infant, Affli, was saved and reared by humans. For the first time, children and adults had an opportunity to observe a monkey closely. As a result, Affli was popular and helped improve the acceptance of these monkeys. Unfortunately, it became ever more enterprising, played rough with small children, penetrated houses, and had to be caged again. Even though Affli in the cage had constant contact and played with other monkeys, it returned immediately to the village when released again. Affli was eventually given to the Botanic Garden of the university, where it played with students, but was caged again when it began steeling from women who brought the daily meals.

Increasingly, monkeys of the house group became less shy of humans. The animals, not content with the abundant water sources in ponds and jars, moved to aquaria and even the showerhead to drink clean water. They also increasingly took the whole terrace of the house into their possession. They openly "raided" maize fields and no longer cared when blind rifle shots were directed at them by a caregiver, engaged to protect the fields.

At present, approximately 3-5 groups of human visitors are received in the sanctuary each week. They typically find the sanctuary using Google Maps, and come to see the monkeys and the rainforest vegetation. Almost all visitors succeed in observing red-bellied guenons in the forest, often from close up. On one occasion, however, loud visitors could not spot a single monkey on the usual accompanied forest walk. As soon as these noisy visitors had left, red-bellied guenons congregated in the garage. This illustrates how well this species can hide in the forest when they do not want to be seen.

We have visitors from all over the world. In particular, the École Montaigne from Cotonou sends its pupils regularly to visit the sanctuary. Unfortunately, few young people come from local schools, though entry for them is free (Figure 5). The inhabitants of Drabo and surrounding villages, and the vodun elders I meet regularly, do not see a need to visit and are mostly not interested. Some newcomers, who bought land and installed themselves on the edge of the forest arrived in Drabo Gbo because of relatively low land prices, not for the love of the near forest. They expect urban conditions and complain about leaf fall on their roofs. Béninois, who do visit, however, are highly appreciative of their encounters with monkeys. The resulting income from ecotourism is modest, paying for about four months of official minimum salary (SMIG) for one guard.

Fortunately, the *Sanctuaire des Singes* belongs to IITA and is part of its research agenda. As long as I live in the village, support local organizations, and help in emergencies, the forest and its inhabitants thrive. It is hoped that IITA will eventually take over responsibility. Moreover, the sanctuary is integrated in the research activities of the Botanical Garden of UAC, the most important plant collection in the country, and I collaborate with NGOs, particularly the *Organisation pour le développement durable et la biodiversité* (ODDB) in the Ouémé flood plain. In 2023, six NGOs that are active in nature protection in Benin, honoured me in a celebration. Separately, the university of Abomey-Calavi, the biggest in Benin, declared the *Sanctuaire des Singes* a model for rehabilitating the dwindling sacred forests of the Ouémé flood plain. In addition to protecting the forest, we have offered schooling, including instructive visits to the sanctuary, to the children in Drabo for the last four years.

DISCUSSION

Scientific studies of the red-bellied guenon, first described in 1866, started only in the 1990s. Of course, the local people always knew this monkey and have a name for it. The distribution of the species is clearly linked to the presence of forests in the Dahomey Gap and with this the Pleistocene refugia. The main refuges of tertiary forest in the Quaternary are located in the Taï forest in Côte d'Ivoire and the Korup national park in Cameroon (Colyn *et al.* 1991; Maley 2001), where red-bellied guenons do not exist. Additional riverine refuges, where rainforest species like *C. erythrogaster* could survive, have been postulated and discussed (Booth 1958; Sinsin *et al.* 2002; Nobimè *et al.* 2008; Oates *et al.* 2022; Lambert *et al.* 2023). In fact, in the Ouémé flood plain, these guenons are equally at home in swamp forests and seasonally inundated dense thickets (Assogbadjo & Sinsin 2002; Reitz 2016; Ganmou 2020).

Today, rainforests in Bénin are located in an agricultural landscape embedded in human-induced so-called derived savannah (Mama *et al.* 2014) in a highly populated region with 250 people per km^2 (INSAE 2013). These sacred forests are islands of

Figure 5. Primates observing primates. A class of children visiting from Drabo. Photograph by Eustache Kinnenon, Drabo.

high biodiversity. They cover only 2% of the national territory, but harbor 20% of all plant species and 64% of threatened plants, according to IUCN criteria (Adomou *et al.* 2011). They lay mostly outside established nature reserves, making their protection the highest priority for nature conservation in Bénin (Adomou 2005; Neuenschwander & Sinsin 2011). The red-bellied guenon, which is limited to these forests and its surrounding thickets in swamps, has become the flagship species for Benin nature protection.

In general, reintroductions had mixed success (Guy & Curnoe 2013; Speiran *et al.* 2023). Of primate reintroduction projects, only 43% met benchmarks of success, such as post release survival for at least a year, transitioning to independence from human provisioning, and integration with wild populations, and only 14% were able to reach the more stringent conservation aim of becoming a fully self-sustaining wild population (Beck 2018). It is, however, noted that not all projects collected or published data on post-release outcomes. The IUCN therefore published guidelines for best practices in planning primate reintroductions (Baker 2002). Regenerating forests for primate conservation was particularly advocated (Millington *et al.* 2004).

From our experience, hand-raised monkeys like Affli can become good ambassadors for nature protection within the local community, but cannot overcome this human imprint and integrate into the wild population despite constant contact. Affli was rescued from certain death, but this does not in any way mean support for the pet trade.

What might have contributed to the success of the present 30-year effort? First, infants grew up in a group, tended by their mother and other females. The cages were spacious and situated in a forest. The infants escaped, but could return to their mothers, and thus could adjust to the forest environment, where food and medicinal plants were abundant. Gradually, they expanded their home range. The few animals that left the forest in search of new habitats could find their way back in an environment with gardens and fields. By comparison to other *Cercopithecus* spp. (Oates, 2011), group size in this study remained small.

Detailed knowledge about the life of West African guenons was gained mostly from few species (Jaffe & Isbell 2011; Oates 2011; Cords 2012; Lambert *et al.* 2023). The present observations on *C. erythrogaster*, which had not been studied in much detail before, mostly confirm previous observations on other *Cercopithecus* species. Unlike other guenons, however, the red-bellied guenons were never seen consuming vertebrate prey, even if they had such animals in their hands and played with them. Nobimè & Sinsin (2003) stress the importance of fruits of *Ceiba pentandra*, *Mimusops andongensis* and *Diospyros mespiliformis* trees, which do not yet fruit abundantly in the sanctuary. The same authors

found most infants are born in June-July, just outside the peak observed here. Janson & Chapman (2004) stress, how the availability of leaves, flowers, fruits, and seeds in tropical forests varies in time and affects behavior, demography, and dispersal of monkeys. Particularly, the availability of water changes the behavior (Pruetz *et al*. 2023), as seen so well in the dry season, when the red-bellied guenons came to the house for drinking. The possible searching for medicinal plants, as seen here when they debarked neem branches, is not discussed in the literature.

The observed grooming by other adult females (allomothering) was described for several other *Cercopithecus* spp. (Rudran 1978; Struhsaker & Leland 1979). That males reach maturity at six-plus years and females at five to six years, as well as interbirth intervals (Cords 2012) were confirmed here for *C. erythrogaster*. The description by Lambert *et al.* (2023) of the life style of guenons fits *C. erythrogaster.*

For mona monkeys in the Lama, population densities, as estimated from forest walks, reached up to 50 individuals per km^2 (Goodwin 2007). With the same census technique, a few individuals of *C. erythrogaster* per km^2 were recorded in other investigated forests in Bénin, Togo or Nigeria (Assogbadjo & Sinsin 2002; Houngbédji *et al.* 2012; Matsuda Goodwin *et al*. 2017). Yet, the 42 red-bellied guenons counted on about 10 ha in the sanctuary correspond to a ten times higher density, though based on total counts. While the closeness to human habitation and some provisioining certainly allows for higher population densities, some of the difference might also be caused by an undercounting of these shy animals in other localities, as confirmed by the observation with rambunctious visitors or our experiences in the *Grande Forêt*.

The home range of red-bellied guenons in the sanctuary of only about 10 ha is clearly much smaller than that of *Chlorocebus* spp., estimated at 64 ha on average (Pruetz *et al.* 2023). But populations of other species also survive in forests of less than 1 km^2 (Oates 2011), provided the surrounding human population accepts them. The question therefore arises about the carrying capacity of the forests of the sanctuary, considering that only the house group receives additional food. It would seem important that some members of the species from the dense population in the sanctuary succeed in reaching other forests in the area. Of particular interest here is the *Forêt Statale* near Dodja (close to the NW-corner of Figure 2), an extensive commercial plantation with teak (*Tectona grandis*) and *Gmelina arborea* stands of various ages interspersed with natural vegetation. Up to now, observations there and in the sacred forest of Dodja have not identified the presence of *C. erythrogaster*; but given the fact that the first camera traps placed in the *Sanctuaire des Singes* also did not record red-bellied guenons (M. Houngbédji, pers. comm.), the camera trap studies may need to be pursued more vigorously. Among the quarter of guenons unaccounted for, many probably died unobserved; but some might have reached new habitats and dispersed to other forests beyond the Orojamè.

Regarding ecotourism, its dangers and benefits are clearly outlined in Hansen *et al*. (2023) and Alexander *et al.* (2023). The local human population in Drabo Gbo has mostly accepted the presence of monkeys, provided crop damages are compensated for, which is a relatively small burden. It is therefore hoped that the security and protection of the forest will continue in the future through IITA protection under the heading of biodiversity conservation for the benefit of agriculture (McNeely & Scherr 2001; Neuenschwander *et al.* 2023). The *Sanctuaire des Singes* may be considered alongside the over 150 field stations worldwide that serve as Earth observatories with richer biodiversity than in their surroundings (Eppley *et al.* 2024).

For this establishment to be sustainable, the following challenges have to be overcome:

1. Many more exchanges, discussions, and guided visits to the forest, with the inhabitants of Drabo Gbo, who have up to now refused to visit the sanctuary, and education of their children in ecology are needed.
2. As the red-bellied guenons have become ever more fearless, it must be avoided that they become as aggravating to the villagers as Affli became. As a first step, feeding has been reduced. Some feeding remains, however, crucial to assure that visitors encounter monkeys. Long term, the population needs to disperse to other forests.
3. Sustainable protection of this sanctuary – as of any nature reserve – remains a challenge in view of the enormous human population pressure. The land itself belongs now to IITA and is assured by legal title deeds. IITA, the local university, and NGOs collaborate and use this forest as a research site. Despite all legal and customary protection, the survival of this biodiversity hot spot still depends on support by the local population, acceptance by the government, donors, and local champions to defend and popularize the site.

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