

## Research Article

# Tanoé forest, south-eastern Côte-d'Ivoire identified as a high priority site for the conservation of critically endangered Primates in West Africa

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### Abstract

Human-induced extinction rate of fauna has increased over the last century. The danger is particularly acute in the tropics where conservation resources are scarcest, where habitat conversion is more rapid, and where the threat to biodiversity especially to primate species and populations is greatest. This is the case for the whole primate community occurring at the eastern part of the Upper Guinea forests. The situation is particularly critical for Côte d'Ivoire. To update the distribution and conservation status of primates in south-eastern and south-central Côte d'Ivoire, we conducted surveys consisting of interviews and walks in selected forests reserves, National Parks, private forests, and unprotected forests in Côte d'Ivoire in 2004-2006. Among the forests surveyed, the Tanoé forest is the only forest where several endangered primate taxa have survived. The diana rolway (*Cercopithecus diana rolway*) was found and the Miss Waldron's red colobus (*Piliocolobus badius waldronae*) was suspected in this forest. These monkeys are listed among the 25 most threatened primates in the world and the probable extinction of the latter was reported in the literature. The Tanoé forest also supports two Endangered monkey species (*Cercocebus atys lunulatus* and *Colobus vellerosus*) and one Near Threatened monkey species (*Procolobus verus*). This forest represents the most "threatened hotspot" for primate diversity and a priority for primate conservation in West Africa. Throughout Tanoé forest, Primate Conservation Societies have a unique opportunity to prevent the extinction of West African primates that are under severe threats.

**Key words:** Conservation, Critically endangered species, Tanoé forest, Primates, West Africa

### Résumé

Le taux d'extinction des espèces lié aux activités humaines a augmenté au cours de ces dernières décennies. Les menaces sont particulièrement importantes sous les tropiques où les moyens dégagés pour la conservation sont rares. Aussi, la conversion des habitats y est plus rapide et les menaces sur la biodiversité et particulièrement sur les espèces et populations de primates est importante. Cela est le cas de toutes les communautés de primates dont l'aire de distribution s'étend dans la partie Est de la forêt guinéenne. La situation est particulièrement critique en Côte d'Ivoire. Dans le but d'actualiser la distribution et le statut de conservation des primates rencontrés au sud-est et au centre-sud de la Côte d'Ivoire, nous avons effectué des investigations à travers des enquêtes et des prospections pédestres dans des aires protégées et des forêts villageoises de 2004 en 2006. Parmi les forêts prospectées, la Forêt des Marais Tanoé représente la seule forêt où plusieurs espèces de primates menacées de disparition ont survécu. Le cercopithèque diane rolway (*Cercopithecus diana rolway*) a été trouvé dans cette forêt et le colobe bai de Miss Waldron (*Piliocolobus badius waldronae*) y est suspecté. Ces deux singes font partie des 25 espèces de primate les plus menacées au monde. Deux autres espèces rencontrées dans cette forêt sont en danger d'extinction (*Cercocebus atys lunulatus* et *Colobus vellerosus*) et une autre presque menacée (*Procolobus verus*). La Forêt des Marais Tanoé représente actuellement le « point chaud » pour la biodiversité le plus menacé et une priorité pour la conservation des primates en Afrique de l'Ouest. A travers la Forêt des Marais Tanoé, la communauté pour la conservation des primates à l'occasion unique d'éviter la disparition des primates les plus menacés de l'Afrique de l'Ouest.

**Mot clefs :** Afrique de l'Ouest, Conservation, Forêt des Marais Tanoé, Espèces en danger critique, Primates.

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## Introduction

As a consequence of the radical restructuring of humankind's economic activities, political relations, and social demographic profile in the last century [1], human activities increasingly destroy animal and plant biodiversity leading to the decimation of populations, extinction of species and adversely changing habitats [2]. Human-induced extinction rates over the last century have ranged from 100 to 10,000 species per year [3] and has been described as "an extinction crisis" [4] or an "extinction spasm" [5]. The danger is particularly acute in the tropics where conservation resources are scarcest, where habitat conversion is more rapid [6], and where the threat to biodiversity especially to primate species and populations [7] is greatest. Extinction risk is considered highest in the case of taxa that have received little attention and live in parts of the world that are not a major focus of biologists and conservationists [8]. This is the case for the entire primate community occurring in the eastern part of the Upper Guinea forests. This subregion supports several endemic primate subspecies: Miss Waldron's red colobus (*Piliocolobus badius waldronae*), white-napped mangabey (*Cercocebus atys lunulatus*), the diana rolway monkey (*Cercopithecus diana rolway*), lesser-spot nosed guenon (*Cercopithecus petaurista petaurista*), the Lowe's guenon (*Cercopithecus campbelli lowei*), and Dollman's colobus (*Colobus polykomos dollmani*). Geoffroy's colobus (*Colobus vellerosus*) only occur in this subregion and some forests in southern Nigeria [9, 10]. Olive colobus (*Procolobus verus*) also is found in the region occurring in West Africa between Upper Guinea West and East and also in southern Nigeria [9, 10].

*Piliocolobus badius waldronae*, *Cercocebus atys lunulatus*, and *Cercopithecus diana rolway* are considered as critically endangered [11, 12] and have been listed at least once among the 25 most endangered monkeys in the world (2002: all three species, 2004: *Cercocebus atys lunulatus* and *Cercopithecus diana rolway*, 2005: *Piliocolobus badius waldronae* and *Cercopithecus diana rolway*). The probable extinction of Miss Waldron red colobus was reported by Oates *et al.* [8] after a minimum of one decade of unsuccessful surveys in its historical home range. The probability of rediscovering this red colobus remains low although there is evidence that a hunter killed at least one individual of that species recently in the Tanoé forest, a non-protected forest also called Ehy forest (in the literature) at the south-eastern corner of Côte-d'Ivoire [13]. *Colobus vellerosus*, *C. polykomos dollmani*, and *Procolobus verus* are considered species of great conservation concern [14].

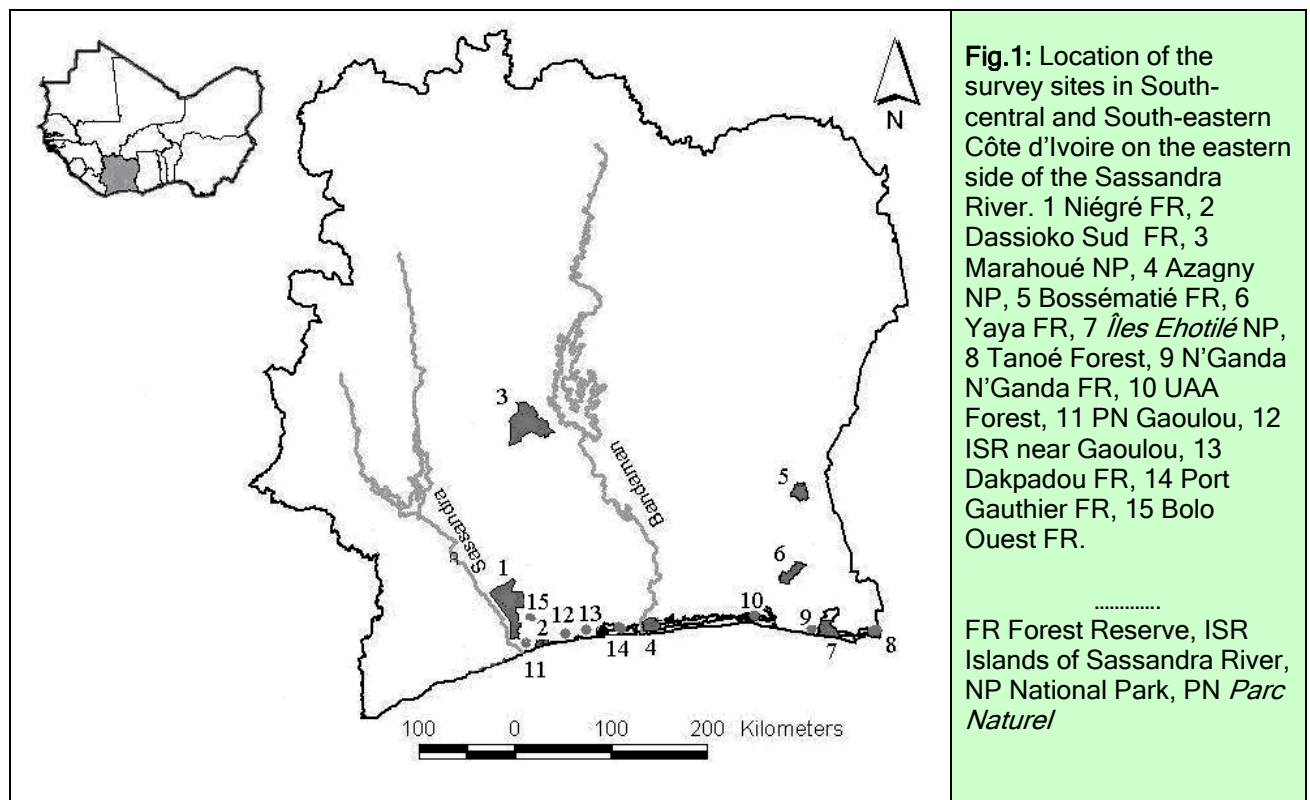
In spite of its biological richness and the endemism of its fauna and flora, Upper Guinea East has received relatively little attention from biologists and conservationists. In 1986, this led the IUCN/SSC Primate Specialist Group to recommend surveys in south-eastern and south-central Côte-d'Ivoire to update the distribution and conservation status of primates and identify sites for primate conservation [14]. Ten years later, very little has been done in this respect except a survey of chimpanzee populations across the whole southern Côte-d'Ivoire [15]. Therefore, in a revised edition of its conservation action plan for African primates the IUCN/SSC Primate

Specialist Group insisted on the urgency of surveys in south-eastern and south-central Côte-d'Ivoire, with the primary goal of searching for viable populations of *Ptilocolobus badius waldroneae*, *Cercocebus atys lunulatus*, and *Cercopithecus diana roloway*. Following that second recommendation, surveys conducted throughout this and neighbouring regions highlighted extensive habitat loss and dwindling primate populations within this faunal zone [16-20, 8]. In this paper, we present data from more recent surveys conducted in 2004-2006 in selected forests in South-eastern and South-central Côte-d'Ivoire on the eastern side of the Sassandra River. We discuss the results in light of current knowledge of the distribution and conservation status of primates in Upper-Guinea East and advocate for the conservation of a forest block in South-eastern Côte-d'Ivoire.

## Methods

### Survey sites

The survey sites were situated in South-eastern and South-central Côte-d'Ivoire on the eastern side of the Sassandra River (Fig. 1) and include three National Parks (Azagny, Iles Ehotilé and Marahoué), eight forest reserves or "forêts classées" (Bossématié, Dassioko Sud, Dakpadou, Niégré, Bolo Ouest, Port-Gauthier, Mabi, Yaya and N'Ganda N'Ganda), two private forests (the forest relic of the University of Abobo-Adjamé in Abidjan or UAA forest, and the *Parc Naturel de Gaoulou*), and five forests lacking any protected status (a complex of three islands of the Sassandra River near Gaoulou, Fresco forest and Tanoé Forest). In total, we surveyed ten sites between the Sassandra River and the Bandama River, and eight sites between the Bandama River and the Ghanaian border to the East.



### *Data collection*

We conducted surveys in selected protected and non protected forests in 2004-2006. Forest selection was based on the probability of finding primate species, especially those of conservation concern. In deciding which forest to survey, we relied extensively upon reports and published accounts indicating past distributions and also upon information about the forests and their wildlife provided by native people from different regions of Côte-d'Ivoire, and forest managers, (i.e the Directorates of National Parks) and representatives of the *Société de Développement des Forêts* (SODEFOR) in the case of national parks and forest reserves respectively. Before visiting a given forest, we questioned people in the nearby villages about their knowledge of past and current occurrence of primates in that forest and neighboring forests that were not on our list. We interviewed, in particular, old local residents (>40 years) as the majority of younger people living in these villages appear to have a poor knowledge of primate species. The primary exception to this was young villagers who either were hunters or employed as biomonitors of animal populations.

Based on information gathered through interviews we conducted forest surveys on foot. Given the relatively large number of sites selected for survey, and the fact that we had to examine multiple locations at most sites, we could not afford investing time and effort in cutting new paths through the forests. Instead, we generally used existing paths created either by hunters or for biomonitoring purposes, boundary lines, or old logging roads. We walked along these slowly and quietly, looking and listening for primates. In some forests we walked through the vegetation in a fixed direction using a compass when we felt that we could examine more ecozones by doing so. In all cases, we did not walk for more than 10 minutes without stopping to listen for primates for a period of 5-10 minutes. To survey a forest, we generally formed three teams each composed of a researcher and a local guide recruited among hunters, former hunters, or biomonitoring agents. The three teams examined different zones simultaneously so that a relatively large area was covered everyday. Most surveys lasted for 5-10 hours and were made between 06:00 and 18:00 with a break between 12:00 and 14:00 when primates are generally resting. We used Grubb *et al.* [21] for the taxonomy of the species and subspecies. As we noted primarily the presence-absence of diurnal primates, our survey method did not allow for estimates of population densities.

### **Results**

Table 1 provides the distribution results for the diurnal primate species encountered in the forests surveyed. These data are based on personal observations or reports from people that had a good knowledge of the primate fauna of their region

### **Species account**

*Miss Waldron's red colobus* (*Piliocolobus badius waldronae* Hayman, 1936)

*Piliocolobus badius waldronae* ranges between the Bandama River in Côte d'Ivoire and the Volta River in Ghana. The presence of *P. b. waldronae* was reported by hunters in two localities out of eight surveyed within that range in Côte d'Ivoire. We strongly suspected the presence of this monkey in the Tanoé forest a swamp forest near Ehy Lagoon and Tanoé River, in the south-eastern corner of Côte d'Ivoire at the boarder of Ghana. Many young hunters could provide an accurate description of the monkey and were very confident about the presence of at least a small population within the Tanoé forest. One individual reported that he observed a group of Miss Waldron's red colobus two weeks before we visited the forest in February 2006.

We heard three distinct calls of a red colobus monkey in the largest island of the *Îles Ehotilé* National Park in south-eastern Côte-d'Ivoire in July 2004. We neither heard again nor did we see any red colobus during further surveys of the same island and neighbouring islands in 2005 and 2006 or anywhere else in 2004-2006. Most people we questioned about the current status of the monkey in their forest believed there were no remaining populations except, perhaps, in the Tanoé forest.

**Table 1:** Anthropoid primate species observed (seen and/or heard) or reported in South-Central and South-eastern Côte d'Ivoire on the eastern side of the Sassandra River

Locality	Surface (ha)	Survey effort (day)	Species											
			<i>C. c. low.</i>	<i>C. p. pet.</i>	<i>P. ver.</i>	<i>Cb. a. lun.</i>	<i>Pn. t. ver.</i>	<i>Pa. anu.</i>	<i>C. d. rol.</i>	<i>C. p. dol.</i>	<i>C. vel.</i>	<i>C. sab.</i>	<i>P. b. wal.</i>	
<b>National Parks (NP)</b>														
Azagny NP	19,400	6	HSR	HSR	R		HSR							
Marahoué NP	101,000	3	R	HSR	R		R	HSR					R	
Iles Ehotilé NP	550	6	HSR	HSR	HSR							R	HSR	HR
<b>Forest Reserves (Forêts classées)</b>														
Dassioko Sud FR	7,980	5	HSR	HSR	HSR	HSR	R			R				
Dakpadou FR	294	2	HSR	HSR	HSR		R							
Port Gauthier FR	25,716	1			R		R						R	
N'Ganda-N'Ganda FR	4,849	3	HSR	R	R		R							
Bossématié FR	22,200	3	HSR	HSR	HSR		R							
Yaya FR	22,120	3	HSR	HSR	HSR		H					R		
Bolo Ouest FR	16,779	6			R		R					SR		
Niégré FR	92,741	4			R		R					R		
<b>Unprotected forests</b>														
ISR near Gaoulou	102	2	HSR	HSR	HSR									
Tanoé forest	12,000	4	HSR	HSR	HSR	HSR	R		HSR			HSR		R
Fresco forest	12,500	2	HSR	HSR	R									
<b>Private forests</b>														
UAA forest	11	2	HSR											
PN de Gaoulou	16,000	1	HSR	HSR	R									

Species: H= heard, S= seen, R= reported; *C. c. low.*: *Cercopithecus campbelli lowei*; *C. p. pet.*: *Cercopithecus pataurista pataurista*; *P. ver.*: *Procolobus verus*; *Cb. A. lun.*: *Cercocebus atys lunulatus*; *Pn. t. ver.*: *Pan troglodytes verus*; *Pa. an.*: *Papio anibus*; *C. d. rol.*: *Cercopithecus diana roloway*; *C. p. dol.*: *Colobus polykomos dollmani*; *C. vel.*: *Colobus vellerosus*; *C. sab.*: *Chlorocebus sabaeus*; *Pi. b. wal.*: *Piliocolobus badius waldroneae*

#### *Diana roloway* (*Cercopithecus diana roloway* von Schreber, 1774)

*Cercopithecus diana roloway* ranges from the Sassandra River to Western Ghana. The species was reported in two localities out of 18 surveyed in the Ivorian part of that range. The reports could be confirmed for only one of these localities (the Tanoé forest). This is the only forest where we saw and heard *C. d. roloway*. During the survey in the Tanoé forest in February 2006, we sighted two troops of this primate.

#### *White-napped mangabey* (*Cercocebus atys lunulatus* Temmink, 1853)

*Cercocebus atys lunulatus* is restricted to the region between the Sassandra River and the Volta River in Ghana [10]. We observed the species in two forests (Dassioko Sud Forest Reserve and Tanoé forest) out of 18 visited within their range. We heard and saw two troops of *C. a. lunulatus* in the Tanoé forest. In Dassioko Sud Forest Reserve, we saw two troops of mangabeys, one of which was relatively large with an estimated minimum of 50 individuals.

#### *The West African chimpanzee* (*Pan troglodytes verus* Schwarz, 1934)

West African chimpanzees (*Pan troglodytes verus*) are distributed throughout Côte d'Ivoire. The species was reported by local people and hunters in several surveyed localities. These localities include all of the national parks and forest reserves surveyed, with the exception of *Îles Ehotilé* National Park. Among the surveyed unprotected forests, the presence of chimpanzees has been reported only in the Tanoé forest. However, these reports could only be confirmed for two localities (Azagny and Yaya Forest Reserves).



*Dollman's colobus (Colobus polykomos dollmani* Schwarz, 1927)

*Colobus polykomos dollmani* is endemic to Côte d'Ivoire, and ranges in the interfluvial region between the Sassandra and Bandama Rivers. *C. p. dollmani* was reported by the local people and hunters only in the Bolo Ouest Forest Reserve and the Niégré Forest Reserve within this area (2/10). We were able to confirm the presence of the taxa only for Bolo Ouest Forest Reserve among the localities surveyed (1/10).

*Geoffroy's (White-thighed) Colobus (Colobus vellerosus* Geoffroy Saint-Hilaire, 1834)

*Colobus vellerosus* extends from the Bandama River to Western Nigeria. Within this range in Côte d'Ivoire, the species was reported in three localities (Yaya Forest Reserve, Ehy forest, *Îles Ehotilé* National Park). These reports were confirmed in only one locality (Tanoé forest) (1/8). During six survey days in the Tanoé forest, we observed two troops of *C. vellerosus*.

*Olive colobus (Procolobus verus* Beneden 1838)

We did not encounter more than two individuals of *Procolobus verus* in any forest except in the non-protected islands of the Sassandra River near the Gaoulou village. One individual was sighted in the Dassioko Sud Forest Reserve and another in the Tanoé forest. Although we did not observe *P. verus* in any of the forest surveyed, there is evidence of the presence of the species in these forests from interviewees.

*Lowe's guenon (Cercopithecus campbelli lowei* Thomas, 1923)

*Cercopithecus campbelli lowei* was frequently found in all the forests visited except the Marahoué National Park (17/18), and also was reported in adjacent forests by local people. This species is widespread throughout Côte d'Ivoire, residing in different habitats. They can be found in all of the forest habitats in the country and can even be seen in forest patches and secondary forest on sites formerly used for agriculture.

*Lesser spot-nosed guenon (Cercopithecus petaurista petaurista* von Schreber, 1774)

*Cercopithecus petaurista petaurista* ranges from the Sassandra River in Côte d'Ivoire to Ghana [10]. The species habitat preferences include lowland primary and secondary forests, riverine and gallery forests and secondary regeneration and coastal forests. We found *C. p. petaurista* in almost all of the forests surveyed (14/18).

*Green monkey (Chlorocebus sabaesus* Linnaeus, 1786)

The known distribution range of *Chlorocebus sabaesus* in Côte d'Ivoire generally restricted to the savannah woodland of the North. The species was reported in Marahoué National Park by interviewees. Within the southern forest zone, we found the species in the mangroves of *Îles Ehotilé* National Park in the coastal region. The presence of *C. sabaesus* also was reported by interviewees in Port Gauthier Forest Reserve in the coastal region too.

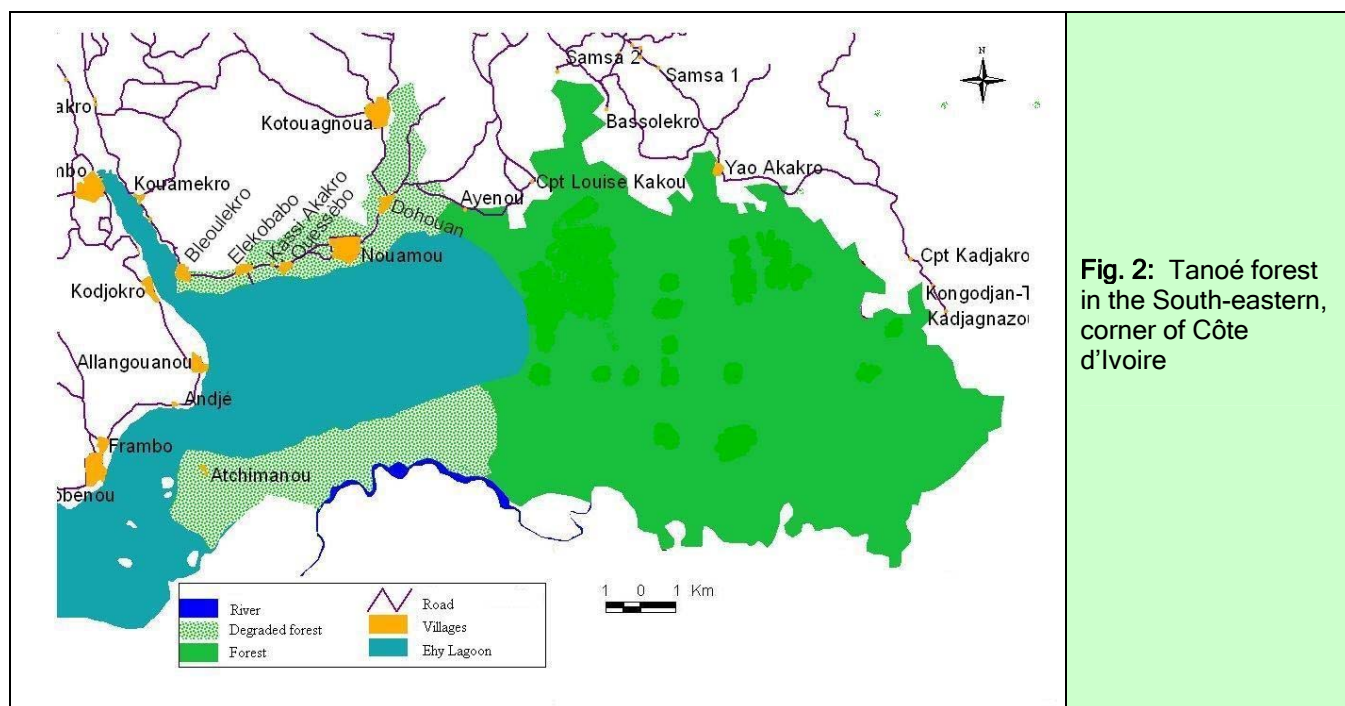
*Olive Baboon (Papio anubis* Lesson, 1827)

*Papio anubis* is distributed in the savannah woodland of the northern part of the country. We observed the species only in Marahoué National Park, which is characterized by Guinean savannah woodlands to the East and North-east, and dense deciduous forest and some gallery forests to the South and South-east.

**Status of the forests surveyed***Protected forests*

Overall, eight primates species were found in the 13 protected areas surveyed (three national parks, eight forest reserves, two private forests). The number of primate species sighted or heard per protected area ranged between one and four. One of the primate species observed in the protected areas (*Cercocebus atys lunulatus*) was actually observed only in the Dassioko Sud Forest Reserve. We did not have any direct contact (visual or auditory) with *Colobus vellerosus*, *Ptilocolobus badius waldroneae* and *Cercopithecus diana roloway* in any of these protected forests.

All protected forests surveyed were subject to both hunting and habitat destruction. Extensive networks of trails created by poachers were visible in all forests especially in Niégré, Monogaga, Dassioko Sud, Bossématié Forest Reserves and Azagny National Park. We frequently encountered poachers in these forests or observed their continuously used camps, which indicates that they are able to hunt freely in these forests without fear of arrest. During the surveys in Niégré Forest Reserve, Azagny National Park, and Monogaga Forest Reserve we frequently observed newly created cocoa tree plantations and encountered farmers clearing areas of forest. An extreme case is that of the Marahoué National Park where thousands of people have settled and created large cocoa and coffee tree plantations.



**Fig. 2:** Tanoé forest in the South-eastern, corner of Côte d'Ivoire

### Unprotected areas

Within the seven unprotected forests surveyed, we observed six primates' species *Colobus vellerosus*, *Cercocebus atys lunulatus*, *Procolobus verus*, *Cercopithecus diana rolaway*, *C. campbelli lowei*, and *C. pataurista pataurista*. Primate records in the unprotected forests ranged from two to six species or subspecies. Among the unprotected forests surveyed, Tanoé forest (Fig. 2), was the only one in which we observed *Cercopithecus diana rolaway*, *Cercocebus atys lunulatus* (Fig. 3), *Colobus vellerosus* and *Procolobus verus* (Fig. 3). In addition to the six primate species or subspecies found in the Tanoé forest, the presence of *Pan troglodytes verus* and *Ptilocolobus badius waldroneae* appears to be very likely. Unprotected forests also were under threat from hunting, logging and all other forms of forest resource exploitation including agricultural clearings and overexploitation of non-timber forest products. Only the most inaccessible forests areas were still relatively intact, but there appear to be continuous pressure to develop or alter even these most remote areas. A good illustration of this is logging that we observed in the swampy Tanoé forest in February 2006 and the planned creation of a large palm oil plantation within this logged area (Fig. 4).

### Discussion

Results from this survey indicate that the primate fauna of south-central and south-eastern Côte d'Ivoire consists of up to 11 species and subspecies. We recorded 1-6 taxa per site. This primate list is similar to previous lists assembled [9, 10, 22]. In the following sections, we will discuss the status of each taxon separately, compare our findings to previous accounts of the

distribution of primate species in the localities surveyed, and discuss the implications for primate conservation in Côte d'Ivoire.

#### *Miss Waldron's red Colobus*

We could not confirm the presence of Miss Waldron's red colobus in any of the surveyed localities except for calls heard from a single individual in the *Îles Ehotilé* National Park. , Nevertheless, we believe that this primate is now extinct in this forest. Previous surveys in Eastern Côte d'Ivoire and Western Ghana [19, 8, 23] could not confirm the presence of this monkey in these regions. However, strong evidences of the presence of Miss Waldron's red colobus in the Tanoé forest have been reported [13, 23]. The fact that the monkey is well known by young poachers suggests that it is worth intensifying the search for it to confirm these hunters' reports.

#### *The Diana roloway*

We confirmed the presence of *Cercopithecus diana roloway* in Tanoé forest only. As the presence of the monkey was previously reported in several forests [8, 19, 23], it is likely that it has been driven to extinction since the period of our surveys in 2004-2006. Indeed although previous studies had highlighted the heavy threat posed by unsustainable poaching on *C. diana roloway* in its historical range and advocated for urgent conservation measures, nothing has been done in the field.

#### *White-napped mangabey*

We found *Cercocebus atys lunulatus* only in Dassioko Sud Forest Reserve and Tanoé forest. The presence of this monkey was previously confirmed in these two forests. [23-25]. This suggests that the population size of this mangabey has declined dramatically and ongoing severe poaching may affect its survival chances in the near future [26]. In 2002, *C. a. lunulatus* was listed as critically endangered, but is now listed as Endangered, probably because it was reported recently in several forests, particularly in Côte d'Ivoire [8, 23, 24, 27-30] and Burkina Faso [31]. However, the distribution of *C. a. lunulatus* is still fragmented and the forests where it may be found are under sustained threats posed by overhunting, logging, and agriculture.

#### *West African chimpanzee*

*Pan troglodytes verus* is reported to be distributed throughout Côte d'Ivoire [10]. Their total number in this country was estimated to be 11,676 +/- 1.168 [32], very similar to estimated number of 11,867 [15]. The estimated population size of this great ape species seems to have declined in recent years and its range is now generally limited to areas that receive some form of protection [33]. Our surveys support this, as we did not observe *P. t. verus* in any unprotected forest and we found this ape only in Azagny National Park and Yaya Forest Reserve.

#### *Dollman's colobus*

We found *Colobus polykomos dollmani* only in the Bolo Forest Reserve. This primate should be listed as critically endangered [24]. Indeed this poorly known monkey is endemic to a narrow zone of Central Côte d'Ivoire between the Sassandra and Bandama Rivers and probably constitutes a hybrid between *C. polykomos* and *C. vellerosus* [10, 34, 35]. It has the most restricted distribution zone of any Côte d'Ivoire primate, and likely of all West African primates, which increases its threat level.

#### *Geoffroy's (White-thighed) Colobus*

We were able to confirm the presence of *C. vellerosus* only in the unprotected Tanoé forest. Previous survey data by Gonedélé Bi *et al.* [36] also reported the presence of the species in Dinaoudi forest grove in north-eastern Côte d'Ivoire. For Bossématié forest, the species has not been observed since 1997 suggesting that it might have been driven to extinction locally. The protected forests surveyed within the historical range of *C. vellerosus* have been relatively well preserved, although some encroachments have been observed in *Îles Ehotilé* National Park. Poaching remains the major threat posed to wildlife in these protected forests. Without



protection status, the situation of the Tanoé forest is more serious and potentially catastrophic, as logging is likely to continue in the absence of protection.

The overall situation of *C. vellerosus* seems to be similar in its other range countries (Ghana, Togo, Benin and Nigeria), where the monkey is now only found in small and isolated populations in small fragmented habitat patches [37-43].

#### *Olive colobus*

We confirmed the presence of *Procolobus verus* in almost all of the surveyed forests. This monkey is listed as Near Threatened, and habitat loss appears to be the main threat posed to it. Indeed, this small-bodied monkey is rarely the target of hunters who prefer large-bodied animals [44, 45]. As the population of *P. verus* is declining throughout its historical range, special attention must be paid to the islands of the Sassandra River where we found the largest numbers of individuals during our surveys.

#### *Lowe's guenon*

We observed *Cercopithecus campbelli lowei* in almost all of the forests surveyed, except for Marahoué National Park where its presence was reported by the interviewees. However, during the survey they conducted in this forest, Gonedélé Bi *et al.* [24] directly sighted *C. c. lowei* in the park. The species appear to be very common in Côte d'Ivoire and was found in swamp forests, semi-deciduous forests, fragmented semi-deciduous forests, and grasslands near forest fragments. Their utilization of various habitat types is consistent with previous published observations [9, 10].

#### *Lesser spot-nosed guenon*

The presence of *Cercopithecus petaurista petaurista* was confirmed in almost all of the forests investigated. Similar to Campbell monkey, the species also was found to be common in Côte d'Ivoire. Gonedélé Bi *et al.* [24] reported the wide distribution of this monkey in Côte d'Ivoire forests extending beyond the zone covered by the present survey. The species appears to have a relatively large geographic distribution and not restricted to any particular habitat type. This is consistent with previous published observations [9, 10].

#### *Green monkey*

We could not find any evidence of *Chlorocebus sabaenus* present in the forest zone, except for swamp mangroves in the coastal region. The general pattern of vervet monkey distribution in mangrove forest has been reported in other range countries in West Africa [10, 38, 46].

#### *Olive Baboon*

During our survey, we confirmed the presence of *Papio anubis* in Marahoué National Park. Previous studies [22, 47] also reported the presence of olive baboons in this park. The presence of the taxa in this forest is concordant to its previous distribution [10].

## Implications for conservation

### *Tanoé forest: a priority site for endangered primates' species conservation*

Among the primate taxa occurring in the Tanoé forest, *Cercopithecus diana roloway*, is listed among the 25 most threatened primate species in the world [48]. *Piliocolobus badius waldroneae* also is listed as Critically Endangered. Both of these taxa represent the most threatened primate taxa in West Africa together with the white-napped mangabey (*Cercocebus atys lunulatus*) that is also found in the Tanoé forest. In 2000, *P.c. waldroneae*, was suspected to be extinct [8]. However, recent evidence of its presence in the Tanoé forest [13, 23], suggests that a viable population of this primate may continue to exist in the Tanoé forest. Moreover, this forest is probably the only forest where *C. d. roloway* also has survived in Côte d'Ivoire. In Ghana, this monkey has been steadily extirpated from both unprotected and protected areas (for example, Bia National Park) and the monkey is either nearing extinction or extinct in that

country. Recent surveys failed to confirm the presence of the diana rolway monkey in several forests known to have harbored this primate only a few years ago [49, 8].

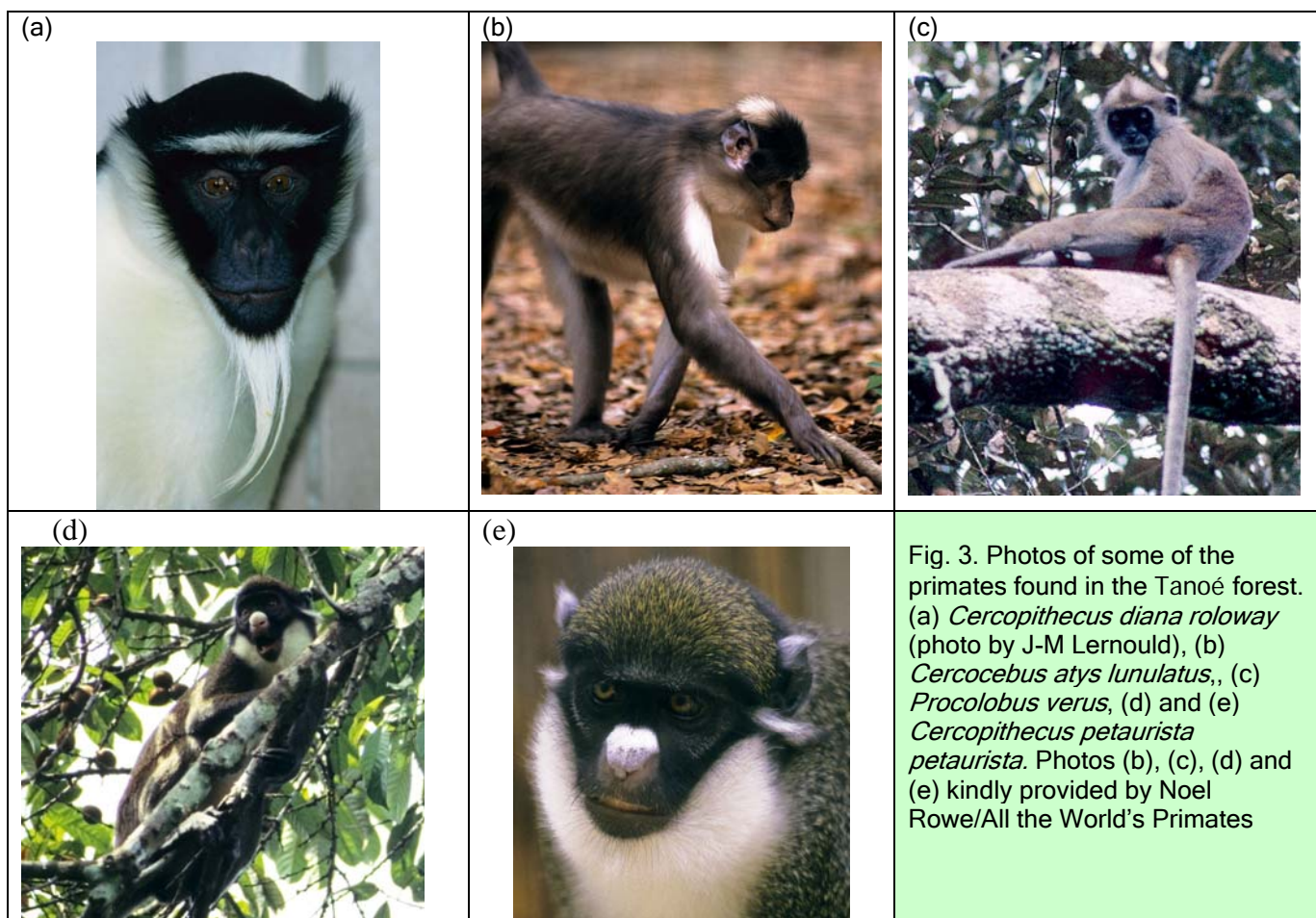


Fig. 3. Photos of some of the primates found in the Tanoé forest. (a) *Cercopithecus diana rolway* (photo by J-M Lernoald), (b) *Cercocebus atys lunulatus*, (c) *Procolobus verus*, (d) and (e) *Cercopithecus petaurista petaurista*. Photos (b), (c), (d) and (e) kindly provided by Noel Rowe/All the World's Primates

One other endangered species occurring in Tanoé forest is *Cercocebus atys lunulatus*. Although the species was reported in several forests, it has been directly sighted only in Dassioko Sud Forest Reserve and Tanoé forest [25]. These two forests probably remain the only sites where the species has survived in Côte d'Ivoire. The status of the species in Ghana is not better. Its presence could not be confirmed in a number of forests where it had been reported in 1995/6 [17, 18].

The Tanoé forest also represents a priority site for the conservation of *Colobus vellerosus*. This forest and the Dinaoudi sacred grove represent the only two sites where this species has probably survived in Côte d'Ivoire [36]. The status of *C. vellerosus* in other countries in its range is not more promising than in Côte d'Ivoire. Very few populations of *C. vellerosus* remain in most of these countries and are confined to extremely small forest patches. The conservation status of this primate needs to be revised as 'Endangered' at a global level and 'Critically Endangered' in Côte d'Ivoire, since its population size and areas of occupancy have dramatically declined in recent years [36].

This survey has demonstrated that Tanoé forest is the only forest in eastern Côte d'Ivoire and probably in West Africa that still houses more than two primate species that are of extreme conservation concern, in addition to several non-threatened species. Primates that have been driven to extinction elsewhere still occur or are strongly suspected to occur in this forest. Hence, the Tanoé forest must be considered as one of the most important "hotspots" for primate diversity and conservation in West Africa.

It is obvious that the only reason why the Tanoé forest is still relatively intact and harbors a high diversity of primates is its inaccessibility. Indeed because of it is swampy during all seasons of the year, the Tanoé forest is very difficult to penetrate (Fig. 4a) and only very experienced poachers hunt there. In addition any form of large scale habitat conversion of the Tanoé forest would require excessive financial costs and technical expertise. However, poaching pressure in Tanoé forest appears to be very heavy and recently a logging company has managed to open a road within the forest and fell trees in its north-western part (Fig. 4d). More recently a palm oil company and a private investor have begun to replace a large portion of the Tanoé forest with palm oil trees (Fig. 4e, f). This indicates how vulnerable the Tanoé forest is and highlights that urgent and strong conservation actions are needed to protect it.

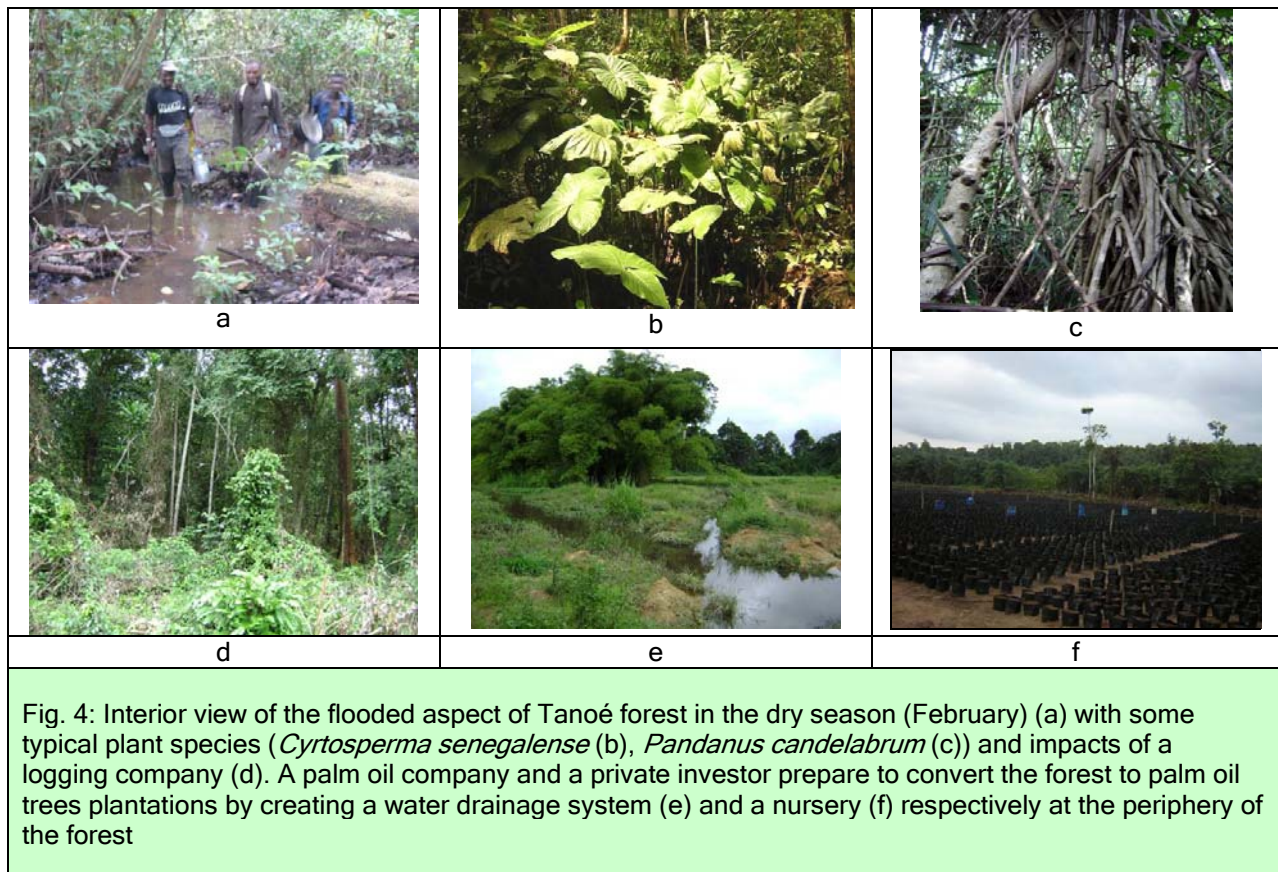


Fig. 4: Interior view of the flooded aspect of Tanoé forest in the dry season (February) (a) with some typical plant species (*Cyrtosperma senegalense* (b), *Pandanus candelabrum* (c)) and impacts of a logging company (d). A palm oil company and a private investor prepare to convert the forest to palm oil trees plantations by creating a water drainage system (e) and a nursery (f) respectively at the periphery of the forest

The conservation status of several primate species in Côte d'Ivoire has dramatically declined in recent years. Several of these primate species have been driven to extinction locally. The unprotected swampy Tanoé forest in the South-eastern corner of Côte d'Ivoire is the only known forest in Eastern Côte d'Ivoire and Western Ghana that harbors several endangered species. Four of these monkeys are the most threatened primates of West Africa (*Cercopithecus diana roloway*, *Ptilocolobus badius waldroneae*, *Cercocebus atys lunulatus*, *Colobus vellerosus*) The presence of these taxa in the Tanoé forest advocates for its listing among the top priority sites for primate conservation in West Africa.

For several decades, conservationists have expressed concern that humans are responsible for the extensive loss of wild animal and plant populations and are the only ones who can slow down or even stop this trend. Using the Tanoé forest as an example, the primatology community has the unique opportunity to stop the extinction of several West African primates. This applies for other forest blocks that also are considered important for primate conservation such as the Dassioko Sud Forest Reserve which houses an important population of *Cercocebus atys lunulatus* in Côte d'Ivoire. In late 2006, we initiated a pilot community-based



management program for the Tanoé forest but the successful continuation of this novel experience in Côte d'Ivoire remains a huge challenge.

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