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Authors: Gonedelé Bi, Sery, Bené, J. C. Koffi, Bitty, E. Anderson, Koné, Inza, and Zinner, Dietmar

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Distribution of the Green Monkey (*Chlorocebus sabaues*) in the Coastal Zone of Côte d'Ivoire

Sery Gonedelé Bi^{1,2}, J. C. Koffi Bené^{1,3}, E. Anderson Bitty^{1,4}, Inza Koné^{1,4} and Dietmar Zinner⁵

¹Laboratoire de Génétique, Université d'Abidjan-Cocody, Côte d'Ivoire

²Centre Suisse de Recherches Scientifiques en Côte d'Ivoire

³Laboratoire de Zoologie, URES Université de Daloa, Côte d'Ivoire

⁴Laboratoire de Zoologie, Université d'Abidjan-Cocody, Côte d'Ivoire

⁵German Primate Center, Göttingen, Germany

Abstract: The green monkey (*Chlorocebus sabaues*) of West Africa ranges from the north-west coast of Senegal to the White Volta in Ghana. In Côte d'Ivoire, *C. sabaues* was thought to be mainly distributed through the savannah and savannah-forest mosaic habitats north of the rain forest zone. During primate surveys in the forest zone of southern Côte d'Ivoire we were unable to confirm the presence of *C. sabaues* in any of the forest reserves; however, we did find the species in a littoral forest outside its expected range. *Chlorocebus sabaues* was also reported from two other forests in the coastal region of Côte d'Ivoire. The discovery of these three populations is surprising and shows that there is an urgent need for more surveys in the region. The absence of *C. sabaues* in areas where it was reported 30 years ago is another alarming indication concerning the conservation of primates in Côte d'Ivoire.

Key words: *Chlorocebus sabaues*, distribution, habitat, conservation status, Côte d'Ivoire

Résumé: L'aire de répartition du callitriche (*Chlorocebus sabaues*) de l'Afrique de l'Ouest s'étend de la côte nord-ouest du Sénégal à l'est jusqu'à l'Ouest du Volta blanc à l'ouest. En Côte d'Ivoire, son aire de distribution avait été confinée à la savane et aux mosaïques savane-forêts au Nord. Au cours de l'inventaire des primates dans la zone forestière au Sud de la Côte d'Ivoire, nous n'avons pu confirmer la présence de *Chlorocebus* spp. dans aucune des réserves forestières. Cependant, nous l'avons observé dans la forêt du littoral, en dehors de son aire de répartition connue. Aussi, la présence de *Chlorocebus* spp. a été rapportée dans deux autres forêts de la zone côtière de Côte d'Ivoire. La découverte de ces trois populations est surprenante et montre qu'il y a un besoin urgent de mener davantage d'inventaires dans la région. L'absence de *Chlorocebus* spp. dans des régions où il avait été rapporté plus de 30 ans auparavant est un autre signal alarmant concernant la conservation des primates de Côte d'Ivoire.

Mots clés: *Chlorocebus sabaues*; distribution; habitat; statut de conservation; Côte d'Ivoire

Introduction

Savannah monkeys (*Chlorocebus*) are among the most widespread of the African primates and inhabit large parts of sub-Saharan Africa (Hill 1966; Wolfheim 1983; Lernould 1988; Kingdon 1997). They are found across the continent from north-west Senegal to Eritrea, Djibouti and Somalia, as well as southward over much of southern Africa. *Chlorocebus* spp. live in a wide variety of habitats but show preference for savannahs and savannah forest mosaics and are not found in the moist forests of Central and West Africa, or in the deserts of south-west Africa (Hill 1966; Wolfheim 1983; Lernould 1988; Kingdon 1997). Numerous morphotypes have been

described (Hill 1966; Napier 1981; Kingdon 1997; Groves 2001). Their taxonomic status and phylogenetic relationships remain unclear and the taxonomy of the entire genus is in urgent need of a revision (Groves 2001). Even the generic name is under discussion. Groves (2001) resurrected *Chlorocebus* Gray, 1870, but Grubb *et al.* (2003) retained the genus name *Cercopithecus* Linnaeus, 1758, regarding the former to be a synonym. In the present paper we follow Groves (2001) and accept the generic name *Chlorocebus*. Among the various taxa of the genus we find the grivet (*Chlorocebus aethiops*), which occurs from south-eastern Sudan through Ethiopia into Eritrea, the Bale Mountains monkeys (*C. djamdjamensis*) from a restricted area in the highlands of Ethiopia, the vervet

(*C. pygerythrus*) from southern Ethiopia into the southern part of Africa, the malbrouck (*C. cynosuroides*) from southern D. R. Congo, central Zambia and Angola, the tantalus monkey (*C. tantalus*) in northern central Africa from the Volta River in Ghana east into Sudan, Uganda and north-western Kenya, and the green or callithrix monkey (*C. sabaesus*) in West Africa from Mauritania and Senegal to the western bank of the Volta River in Ghana and Burkina Faso (Kingdon 1997; Groves 2001).

The ecology and behaviour of savannah monkeys have been studied mainly in East and southern Africa (for example, Struhsaker 1967; Henzi and Lucas 1980; Seyfarth *et al.* 1980; Wrangham and Waterman 1981; Cheney and Seyfarth 1983, 1987; Isbell *et al.* 1991; Barrett *et al.* 2006), with considerably less information available for *C. sabaesus* and *C. tantalus* (for example, Dunbar 1974; Galat and Galat-Luong 1976, 1977; Kavanagh 1978; Galat 1983; Harrison 1983; Nakagawa 2000, 2003). A number of studies of *C. sabaesus* have been conducted on Caribbean Islands, where introduced animals have established populations (Poirier 1972; Fairbanks 1978; Horrocks 1986; Boulton *et al.* 1996).

For Côte d'Ivoire, several authors have reported the distribution of *C. sabaesus* as being limited to the Guinean savannah north of the forest zone (Booth 1956, 1958; Hill 1966; Galat and Galat-Luong 1980; Lernould 1988; Kingdon 1997). Its presence in the Comoé National Park, north-eastern Côte d'Ivoire, for example, is well documented (Gerling and Bokdam 1973; Balzamo *et al.* 1980; Fischer *et al.* 1999-2000, 2002). The distribution of *C. sabaesus* in southern Côte d'Ivoire, however, is not well known; only Tahiri-Zagrët (1976) had reported it to occur in parts of the southern forest zone. Here we report a population of *C. sabaesus* from the littoral forest of Iles Ehotilé National Park (NP), south Côte d'Ivoire; a site outside the previously described range of this species.

Methods

Between 2000 and 2006 we conducted surveys in 23 protected forests in southern Côte d'Ivoire (for a complete list see Gonedélé Bi *et al.* submitted). All 23 forests have habitat suitable for primates (Gonedélé Bi 2008). The surveys

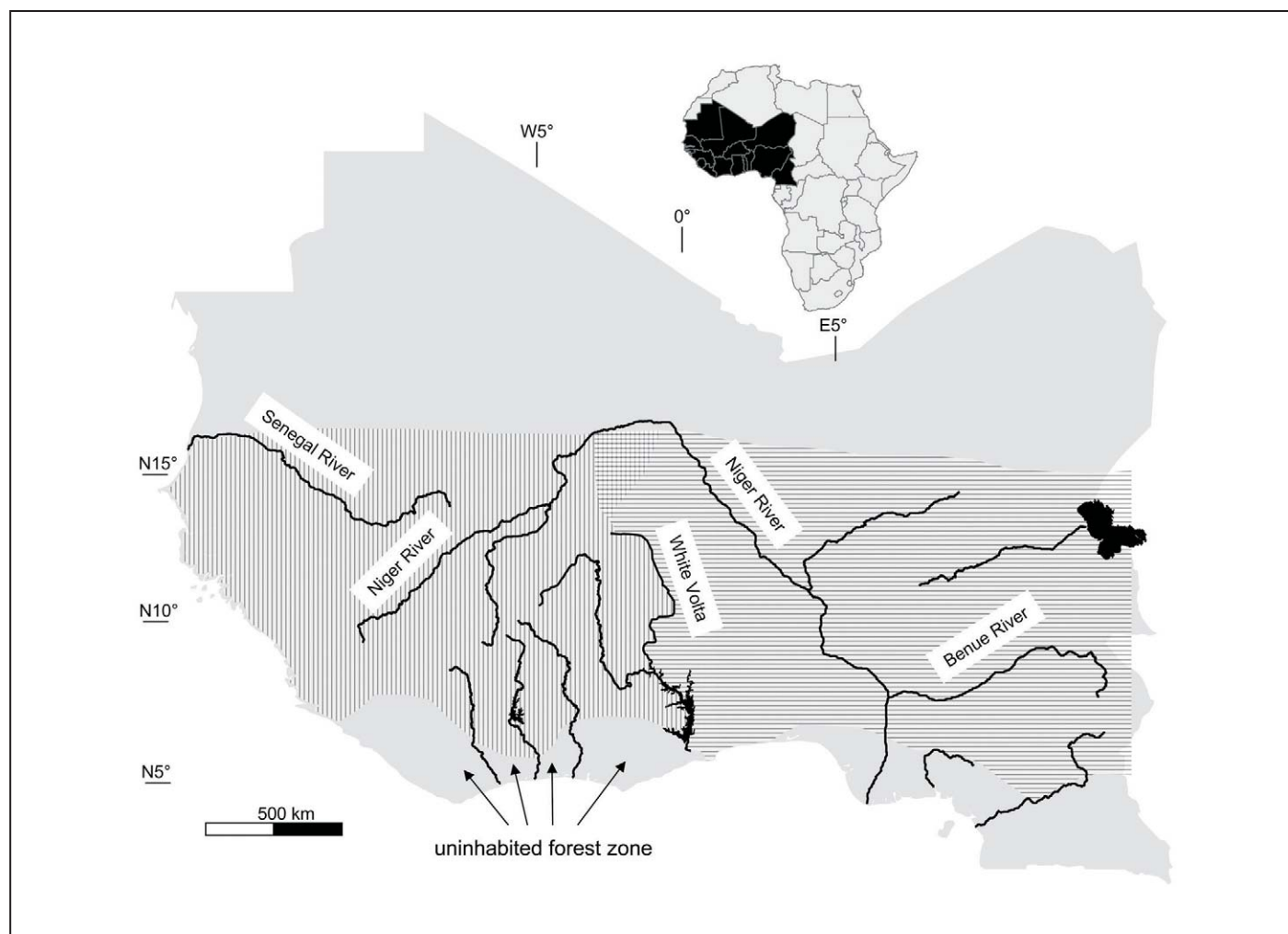


Figure 1. Distribution of savannah monkeys in West Africa, based on maps in Lernould (1988) and Kingdon (1997) (left, vertical hatching = *C. sabaesus*; right, horizontal hatching = *C. tantalus*; cross-hatching = possible overlap of both taxa). In Ghana, Côte d'Ivoire and Liberia, *C. sabaesus* is confined to the savannah habitats north of the rain forest region (but see Tahiri-Zagrët 1976).

included extensive walks in the forests, along with interviews with hunters, officials and other local people from villages surrounding the forests (for further details see Gonedélé Bi *et al.* 2006, 2008). We carried out foot surveys over 99 days in the 23 forests, with a mean of 4.13 survey days (range: 1 to 14 days) for each of the forests. In total, we covered 2,673 km.

For each survey we formed three teams, each composed of a researcher and a local guide recruited among hunters, former hunters, or staff of the local bio-monitoring programmes. The three teams surveyed different zones of the forests simultaneously so that a relatively large area was covered within a short period. Surveys normally lasted nine hours (between 06:30 and 17:30) with a break from 12:00 to 14:00. During surveys we walked slowly (1–1.25 km/hour) and quietly along old logging roads and paths. We noted all visible

or acoustic signs of primates, determined the species present and recorded geographic positions with a global positioning system. We were familiar with the appearance and behavior of *C. sabaues* from previous encounters with the species in Marahoué National Park (6°01'W, 7°07'N) and in Soko Forest Grove (2°44'W, 7°58'N) (Fig. 1). We had also seen and examined *C. sabaues* carcasses in local markets.

Results

During our survey in Iles Ehotilé National Park (550 ha) we sighted a group of five *C. sabaues* on Elouamin Island (3°18'W, 5°09'N, *c.* 95 ha), one of the five islands comprising this reserve. We also found dead specimens of *C. sabaues* among the bushmeat offered in a market in Assomlan, a

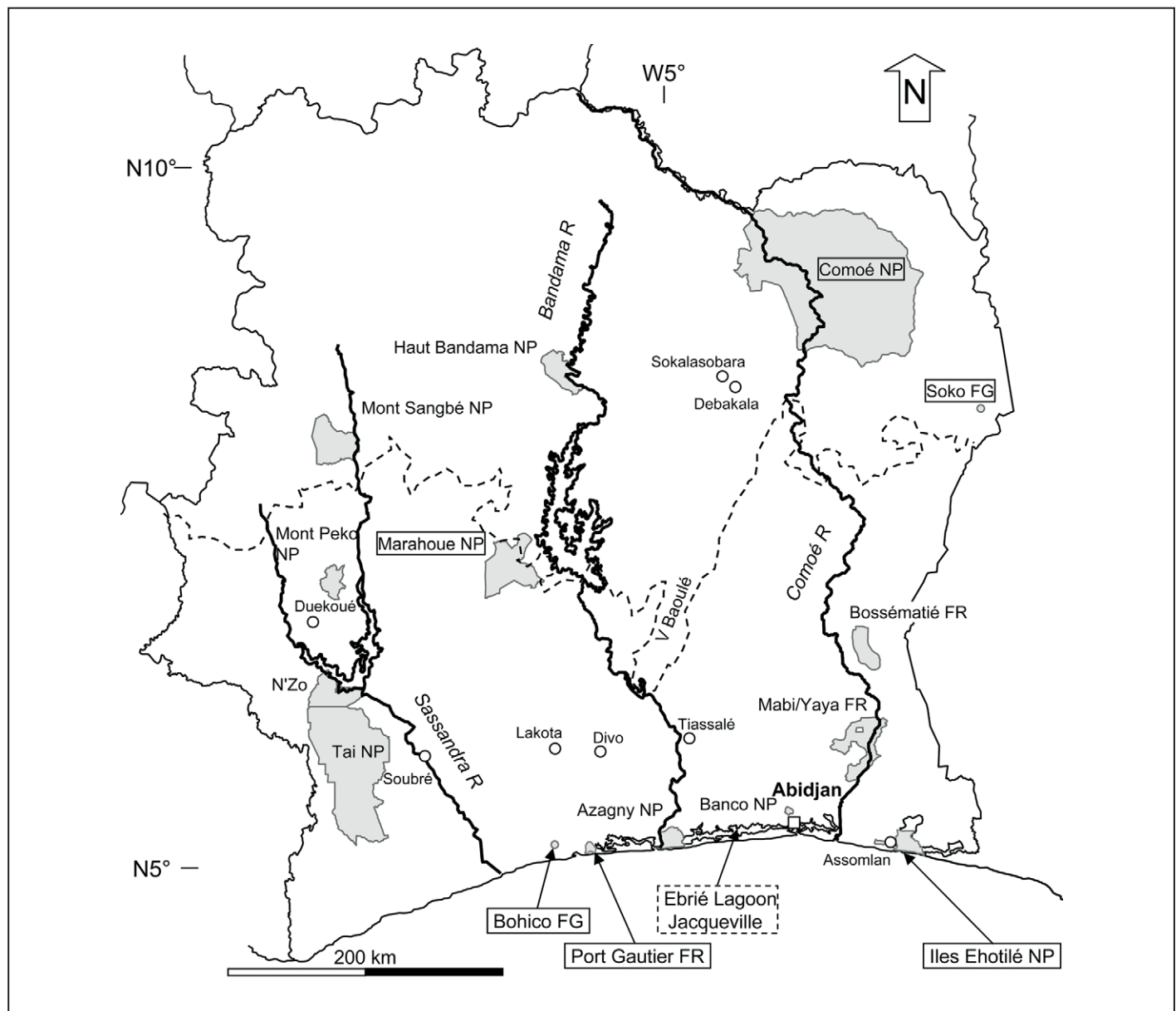


Figure 2. Geographical position of sites in Côte d'Ivoire where we encountered *C. sabaues* (Marahoué National Park, Soko Forest Grove) or where it was reported outside its expected range, (Iles Ehotilé National Park, Port Gautier Forest Reserve, and Bohico Forest Grove). Galat (1983) observed *C. sabaues* near Jacquenville. Dashed line = approximate northern limit of evergreen forest zone (Peltre 1976).

village adjacent to the National Park (c. 0.7 km from the border). The presence of *C. sabaesus* in two other areas, the Port Gauthier Forest Reserve (5°27'W, 5°08'N, c. 2,500 ha) and the Bohico Forest Grove (5°32'W, 5°08'N, c. 5 ha) was reported by several villagers. However, in the Port Gauthier Forest Reserve we failed to find *C. sabaesus* during one week of surveying. For the Bohico Forest Grove, we have only information from interviews. All three sites are in the forest zone of southern Côte d'Ivoire, outside the reported range of *C. sabaesus* (Fig. 2). We were unable to confirm the presence of *C. sabaesus* in any of the forest reserves in southern Côte d'Ivoire (see Gonedélé Bi *et al.* submitted) besides Soko Forest Grove and Marahoué National Park and the three reserves at the coast.

Discussion

The occurrence of *C. sabaesus* in the coastal forest zone of Côte d'Ivoire is surprising since, according to a number of authors, it is confined to the savannah and savannah forest mosaics of the drier northern parts of the country, such as Comoé, Marahoué National Park and Sokala-Sobara, near Dabakala (Booth 1956, 1958; Hill 1966; Galat and Galat-Luong 1980; Lernould 1988; Kingdon 1997). Galat and Galat-Luong (in press) draw the southernmost boundary of the geographical range of *C. sabaesus* at the south of the "V Baoulé" savannah (for example, near Lakota, Divo and Tiassalé) and exclude forest areas such as Tai, Duékoué, Soubré and the coastal forests. By contrast, Tahiri-Zagrët (1976) reported *C. sabaesus* from Tai, Duékoué and Soubré. Galat (1983), however, reported *C. sabaesus* from a site in the coastal area; a group on the edge of the Ebrié Lagoon, near Jacqueville (c. 40 km west of Abidjan), whereas Tahiri-Zagrët (1976) wrote that *C. sabaesus* does not occur in the coastal areas of southern Côte d'Ivoire. A possible reason for this contradictory information may be that local people call both Lowe's monkey *Cercopithecus lowei* and *C. sabaesus* "little black" or "little dark monkeys", and often mistake one for the other (Anh Galat-Luong and Gerard Galat, pers. comm.). Hence, it might be that the *C. sabaesus* reported from the forest area is indeed *Cercopithecus lowei*.

During our surveys (Gonedélé Bi *et al.* 2006; Gonedélé Bi 2008; Galat and Galat-Luong, in press; Gonedélé Bi *et al.* in press) we did not encounter *C. sabaesus* in any protected area in the forest zone where the species was reported by Tahiri-Zagrët (1976). This suggests that *C. sabaesus* has never occurred in these areas, has been locally extirpated, or that it is so rare that we did not find it. Our observations have confirmed the presence of *C. sabaesus* near the coast, namely in Ile Ehotilé National Park.

At this site (and also at the two other sites where *C. sabaesus* was reported by villagers) *C. sabaesus* seems to be restricted to swamp forests and mangroves. The use of mangroves by *C. sabaesus* has also been reported for populations in Senegal, Sierra Leone and Ghana (Galat and Galat-Luong 1976; Galat 1983; Grubb *et al.* 1998; Galat and Galat-Luong in

press). The current distribution of *C. sabaesus* in Côte d'Ivoire appears to be discontinuous: a northern savannah population and a coastal mangrove population with a distribution gap of about 300 km in the interjacent forest zone.

The disjunct distribution of *C. sabaesus* in Côte d'Ivoire is puzzling, and Galat and Galat-Luong (pers. comm.) suggest that those living in and near the mangrove swamps of the coast descended from introduced pets. The lagoon forests where *C. sabaesus* occurs are along the former north-south road to Abidjan and/or near important points of interest for tourists (exotic botanic garden and seaside resorts). These areas may have been used by foreigners to release pets before leaving the country. Due to the considerable adaptability and the ability of *C. sabaesus* to colonize mangrove swamps, the released monkeys would be expected to survive and reproduce in these areas (Galat and Galat-Luong 1976; Poirier 1972; McGuire 1974). Mangrove swamps in West Africa are becoming increasingly important refuges for large mammals as human populations increase (Galat-Luong and Galat 2007; Gonedélé Bi *et al.* 2008).

A second hypothesis sees the colonization of the coastal area by *C. sabaesus* as a consequence of relatively recent human-caused conversion of the rain forest into a forest agriculture mosaic. Savannah monkeys are known for invading cultivated forests (Kavanagh 1980) and since large parts of the forests in southern Côte d'Ivoire are already converted, there might now be a corridor for *C. sabaesus* to reach the coastal forests. If so, we would expect to also find *C. sabaesus* in areas between the northern savannah and the coastal region, wherever the forest has been converted to cultivation. There are, however, no reports of *C. sabaesus* from this region.

It might also be possible that the present populations of *C. sabaesus* in the littoral forests are relicts from a former continuous distribution of the species from the northern savannah belt to the coastal areas. There is some evidence that climatic fluctuations during the Pleistocene caused several retreats and expansions of rain forest in Côte d'Ivoire (Hewitt 2000). It is highly likely that savannah covered parts of southern Côte d'Ivoire during this period, thus connecting the northern savannah with the coast (Maley 1996; Ray and Adams 2001; Leal 2004). Under such conditions, it would have been possible for *C. sabaesus* to disperse from northern savannahs south to coastal areas, where they subsisted in mangrove habitats after the regrown rainforest isolated them from their northern conspecifics. A population genetic study, comparing northern and southern *C. sabaesus* is underway to test hypotheses about the origin of the southern population and about the time of their isolation.

Due to their wide distribution and large numbers, none of the five *Chlorocebus* spp. is regarded as threatened, with the exception of *C. djamdjamentis* (see IUCN 2008). In Côte d'Ivoire, however, even a generally common and adaptable species, such as *C. sabaesus*, has been apparently extirpated from large parts of its former range. This provides another example of the inadequate efforts to preserve primates in Côte d'Ivoire. The presence of *C. sabaesus* in the littoral forests of Côte d'Ivoire, on the other hand, demonstrates that more

survey work has to be done to document primate diversity and distribution in this region of the country. The information obtained from such surveys needs to be considered in the development of conservation measures for the region.

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Authors' addresses:

Sery Gonedelé Bi, Laboratoire de Génétique, Université de Cocody Abidjan, Côte d'Ivoire, 22 BP 582 Abidjan 22 and Centre Suisse de Recherches Scientifiques en Côte d'Ivoire, 01 BP 1303 Abidjan 01, Côte d'Ivoire. E-mail: <gonedelebi@yahoo.fr>.

J. C. Koffi Bené, Laboratoire de Zoologie, URES Université de Daloa, BP 150 Daloa, Côte d'Ivoire, and Centre Suisse de Recherches Scientifiques en Côte d'Ivoire, 01 BP 1303 Abidjan 01, Côte d'Ivoire. E-mail: <jc_bene@yahoo.fr>.

E. Anderson Bitty, Laboratoire de Zoologie, Université de Cocody Abidjan, Côte d'Ivoire, 22 BP 582 Abidjan 22, and Centre Suisse de Recherches Scientifiques en Côte d'Ivoire, 01 BP 1303 Abidjan 01, Côte d'Ivoire. E-mail: <anderson.bitty@csrs.ci>.

Inza Koné, Laboratoire de Zoologie, Université de Cocody Abidjan, Côte d'Ivoire, 22 BP 582 Abidjan 22 and Centre Suisse de Recherches Scientifiques en Côte d'Ivoire, 01 BP 1303 Abidjan 01, Côte d'Ivoire. E-mail: <inza.kone@csrs.ci>.

Dietmar Zinner, Deutsches Primatenzentrum, Kellnerweg 4, 37077 Göttingen, Germany. E-mail: <dzinner@gwdg.de>. (Corresponding author).

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