Volume 9 2014
ISSN 1093-8966

# AFRICAN PRIMATES

The Journal of the Africa Section of the IUCN SSC Primate Specialist Group

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# *African Primates*

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This issue of *African Primates* was produced with the assistance of a grant from The Margot Marsh Biodiversity Foundation, through Conservation International's Primate Action Fund, and the Interdisciplinary Perspectives on the Environment program of the University of Oklahoma.

**Layout, design, and copy-editing:** Janette Wallis
**IUCN SSC logo:** Stephen D. Nash, 2014
**Front Cover:** Adult female Eastern Chimpanzee (*Pan troglodytes schweinfurthii)* in Budongo Forest Reserve, Uganda. Photo by Janette Wallis
**Printed by:** University of Oklahoma Printing Services
***African Primates* online**: All volumes of *African Primates* are available online at www.primate-sg.org/african_primates

*African Primates* 9:1-14 (2014)

# Positional Behavior and Habitat Use of Peters' Angola Black and White Colobus Monkey (*Colobus angolensis palliatus*) in Structurally Distinct Areas of the Diani Forest, Kenya

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**Abstract**: We studied the positional behavior and habitat use of adult Peters' Angola black and white colobus monkeys (*Colobus angolensis palliatus*) in the Diani Forest of south coastal Kenya. Data were collected from June-August of 2012 on three groups inhabiting different forest patches characterized by varying levels of degradation. Habitat differences were quantified with regard to tree species composition, tree size, and diversity indices. Results indicate that overall stratum use differed significantly among all groups while support use of one group was significantly different from that of the others. Overall locomotor and postural behaviors were largely consistent among all habitats. Locomotion was comprised predominantly of quadrupedal walking and bounding with fewer instances of climbing and leaping. The most frequently adopted position was sitting, accounting for at least 85% of postural observations for all groups. The dramatic intergroup differences in strata and support use at the Diani site demonstrate that *Colobus* spp. do respond to localized structural conditions; however, that the positional repertoires were consistent across sites provide clear evidence that locomotion and posture are more constrained.

**Key words: primate locomotion, posture, support use, strata use, colobus monkeys**

## INTRODUCTION

Understanding how prosimians, monkeys, and apes move through their environments has been a central aim of primatology since the earliest field studies (Carpenter 1934; Ripley 1967; Walker 1969; Richard 1970; Rose 1974; Fleagle 1976). Primates have evolved an extraordinary array of positional adaptations and knowing when, where and why locomotor and postural behaviors are used in living animals helps illustrate the selective landscape in which postcranial anatomies evolved. Early studies of positional behavior emphasized a categorical approach: species were assigned to locomotor groups based on dominant movements and postures (e.g., quadrupeds, brachiators, and semi-brachiators) and these behaviors linked to different anatomical complexes (postcranial anatomy) (Erikson 1963; Ashton & Oxnard 1964; Prost 1965; Napier 1967; Ripley 1967; Stern & Oxnard 1973). Most of these categories are still in use (Hunt *et al.* 1996).

Subsequent field workers sought to identify factors that drove intra- and inter-specific variation and to establish behavioral traits associated with a given anatomical complex. Fleagle and Mittermeier (1980) were among the first to explicitly test the extent that positional behaviors varied as a function of body size, activity pattern, substrate use, and forest strata, and multiple studies have since explored how these relationships hold in other primates (Fleagle

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1980; Gebo 1987; Cant 1988; Hunt 1992, 1994; Doran 1993; Gebo & Chapman 1995a, 1995b; Remis 1995; McGraw 1998a, 1998b, 2000; Youlatos 1999; Bitty & McGraw 2007). In the course of these studies, a host of other factors that could drive positional differences between individuals, populations, and/or species were identified. These can be sorted into three categories: social (e.g., age, sex, status classes), physiological (e.g., body size, energetic constraints) and environmental (e.g., support availability at different strata, support inclination, canopy height, tree size, liana density, forest type) (Garber 1998, 2011). In addition to demonstrating that behaviors vary and grade into one another, these studies underscore the notion that positional behavior reflects both ultimate (i.e., evolutionary) and proximate (i.e., ecological) influences (Mayr 1961, 1993; Pounds 1991). Given the latter point, one question that has received a good deal of attention is how much behavior varies when proximate (e.g., habitat) conditions change.

The extent that a species' positional repertoire is consistent across structurally different forests is important because it impacts our ability to reconstruct fossil behavior based on living species. Inferences about extinct primates rely on the strength of analogies based on extant taxa (Plavcan *et al.* 2002), so determining the degree that behavior is context-specific is essential. If no modern analogy exists for a trait observed in fossil taxa, behavioral reconstruction is virtually impossible (Kay 1984). Similarly, if positional tendencies are not consistently associated with a particular morphology, or if a species moving in different habitats changes its behavior to degrees not anticipated, then inferences about past behavior may be equally futile. On the other hand, if behavior(s) is reliably associated with a particular anatomy and performance does not significantly change with habitat, then reconstructions of past lifeways from modern models are tenable (Dagosto & Gebo 1998; Garber 1998).

Additional inquiry into the ecological determinants of positional behavior variation is warranted because the diversity of studies to date has yielded contradictory results. In several taxa, positional behavior and support use were conserved across habitat types (Garber & Pruetz 1995; McGraw 1996; Manduell *et al.* 2012) while other taxa exhibited significantly different positional behavior frequencies in structurally distinct forests (Gebo & Chapman 1995b; Dagosto & Yamashita 1998; Schubert 2011). These mixed results are likely due to a combination of factors including challenges associated with quantifying habitat structures, differences in behavioral sampling methods (i.e., instantaneous vs. continuous sampling), idiosyncrasies in defining positional categories, inter-observer error, and differences in the behavioral flexibility of individual species (Dagosto & Gebo 1998). In this paper, we investigate several of these factors by examining the positional repertoire and habitat use of Peters' Angola black and white colobus monkeys (*Colobus angolensis palliatus*) inhabiting a habitat gradient within Kenya's Diani Forest. The striking structural differences within the forest at this site provide an excellent context for examining the extent that locomotion and posture vary with habitat.

We tested four null hypotheses:

H1: All groups will spend the majority of their time in the upper forest strata (i.e., main canopy and emergent layer) as has been documented in other black and white colobus monkey species (McGraw 1994, 1998a; Gebo & Chapman 1995a; Schubert 2011).

H2: Given constraints imposed by their relatively large body size (7.1-8.9 kg), individuals will utilize large supports most frequently for all activities (McGraw 1996; Schubert 2011).

H3: Locomotor frequencies will not differ significantly across habitat types and arboreal quadrupedalism (i.e., quadrupedal walking and bounding) will be the most common locomotor mode as described in other species of black and white colobus monkeys (Morbeck 1979; Gebo & Chapman 1995a; McGraw 1996; Schubert 2011).

H4: Postural frequencies will not differ significantly across habitat types and sitting will be the dominant behavior, as documented in prior studies of other black and white colobus monkeys (Mittermeier & Fleagle 1976; Morbeck 1977, 1979; Rose 1979; Gebo & Chapman 1995a; McGraw 1998b; Schubert 2011).

## METHODS

### Study Site

Kenya's Diani Forest is part of the Zanzibar-Inhambane Floristic Region stretching from Mozambique to Somalia and is recognized as a biodiversity hotspot with numerous endemic flora and fauna (Metcalfe *et al.* 2009). The forest is located in the Kwale District of south coastal Kenya (4°15'30", 4°35'30"S and 39°35'00", 39°34'30"E), measures roughly 10 km long by 0.5 km wide (area = 455 ha) and is one of the few remaining patches of coral rag forest (Anderson *et al.* 2007b; Metcalfe *et al.* 2009) (Figure 1). The climate is characterized by two rainy seasons with lighter, infrequent rains in October-December, and heavier, more frequent rains occurring March-June (Mwamachi *et al.* 1995). The remaining months (January-February and July-September) are markedly drier. Annual rainfall averages 744 millimeters (Mwamachi *et al.* 1995), and temperature ranges from 35°C in dry seasons to 28°C in the rainy seasons (Okanga *et al.* 2006). The humidity ranges from 80-100% year round (Okanga *et al.* 2006).

**Figure 2.** *Colobus angolensis palliatus* feeding on *Premna hildebrandtii.* Photograph by N. Dunham.

The forest is home to six primate taxa including small-eared galago (*Otolemur garnettii*), Kenya coast galago (*Galagoides cocos*), vervet monkeys (*Chlorocebus aethiops*), Sykes' monkeys (*Cercopithecus albogularis*), yellow baboons (*Papio cynocephalus*), and Peters' Angola colobus. Angola colobus are found in a variety of forest habitats throughout much of Tanzania and the Kwale District of south coastal Kenya. The IUCN considers *C. a. palliatus* of "least concern;" however, in Kenya, the subspecies is considered nationally threatened with likely fewer than 3,000 individuals remaining (Anderson *et al.* 2007b). Recent mitochondrial DNA analyses suggest that *C. a. palliatus* from Kenya and northeastern Tanzania should be considered as a distinct subspecies from the more numerous central Tanzanian forms, highlighting the need for immediate conservation initiatives (McDonald & Hamilton 2010).

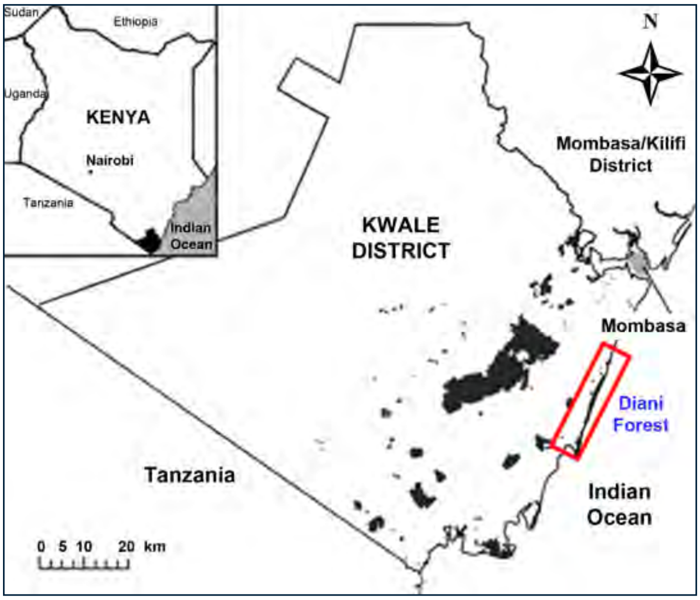

**Figure 1.** Map of south coastal Kenya forests with location of study site indicated.

Angola colobus are medium sized, sexually dimorphic monkeys: mean body weight for females = 7.1 kg, males = 8.9 kg (Bocian & Anderson 2013) (Figure 2). The few studies conducted on *C. a. palliatus* suggest that they are similar to most other colobines with a predominantly folivorous diet and energy conservation lifestyle (Lowe & Sturrock 1998; O'Dwyer 2011; Wijtten *et al.* 2012). Like other black and white colobus monkeys, the Angola colobus is highly arboreal and noted for its spectacular leaping ability (Rose 1973, 1979; Moreno-Black & Naples 1977). Groups at Diani average six individuals (range for this study = 5-12) and usually consist of one adult male and multiple adult females and their offspring (Donaldson, pers. comm.). Larger groups of ten or more individuals, including those with two or more adult males, are also present.

Three groups inhabiting ranges within the Diani Forest were examined and labeled Intact Group (IG), Semi-Degraded Group (SDG), and Highly Degraded Group (HDG). The non-overlapping home ranges of these groups occur in areas representing a gradient from mostly intact forest (IF) dominated by indigenous plant species (Figure 3), to semi-degraded forest (SDF) with residential buildings and exotic plants interspersed throughout (Figure 4), to highly degraded forest (HDF) immediately behind a beach resort (Figure 5). Study group names correspond to forest area names (e.g., the Intact Group (IG) inhabits the Intact Forest (IF) area). To assess differences in forest structure, all trees (n = 2,341) greater than 10 cm diameter at breast height (DBH) within each home range area were measured and plotted using a portable GPS device (as in Ganzhorn 2003). We recorded the height (estimated visually in 5 m increments) and DBH of each tree species, classifying each as indigenous or exotic. Overall comparisons of DBH categories and tree height categories using G-tests revealed significant differences among all sites (Table 1).

Positional behavior and support use data were collected from June 10 to August 12, 2012. Each group, fully habituated to human observers prior to this study, was followed on a weekly (4-6 days per week) rotational basis. Data were collected from dawn (6:00) until dusk (18:00). Data were collected on one adult male and two adult females per group. We used an instantaneous time point

**Figure 3.** Intact forest study area.

**Figure 4.** Semi-degraded forest study area.

**Figure 5.** Highly degraded forest study area. All photographs by N. Dunham.

**Table 1.** Summary of three forest sites in the study area.

| Habitat Variables | Forest Site | | |
|---|---|---|---|
| | **IF**[a] | **SDF**[b] | **HDF**[c] |
| Area[d] (ha) | 10.49 | 7.37 | 5.01 |
| Trees sampled | 1145 | 844 | 352 |
| Density | | | |
| Trees/ha | 155.36 | 114.52 | 70.26 |
| DBH/ha | 3328.18 | 2758.93 | 1985.09 |
| Diversity Indices | | | |
| Richness | 83 | 69 | 61 |
| Shannon-Weaver | 3.41 | 2.59 | 3.34 |
| Evenness | 0.77 | 0.61 | 0.81 |
| Indigenous Trees (% of sample) | 77.1 | 31.0 | 59.1 |
| DBH categories (% of sample) | | | |
| 10-29 cm | 59.7 | 76.2 | 64.5 |
| 30-49 cm | 28.5 | 20.0 | 29.8 |
| 50+ cm | 11.9 | 3.8 | 5.7 |
| Tree height categories (% of sample) | | | |
| 5 m | 32.0 | 27.5 | 36.9 |
| 10 m | 38.6 | 56.5 | 50.9 |
| 15+ m | 29.4 | 16.0 | 12.2 |

[a]Intact Forest; [b]Semi-Degraded Forest; [c]Highly Degraded Forest; [d]Home range size of groups during study period.

sampling scheme at three minute time intervals and did not sample any individual within 15 minutes of itself in order to maintain data independence. The 15 minute time interval is sufficient to avoid temporal auto correlation even among black and white colobus monkeys that spend extended periods resting (C. Janson, personal communication in McGraw 1996). At each time point, we recorded (1) strata (ground, sapling, lower canopy, upper canopy, emergent layer), (2) support type (Table 2), (3) positional behavior (Table 2), and (4) tree species utilized by the focal animal. All categories were used in each habitat; however, because main canopy height differed among the three forest areas, strata categories were recorded independent of substrate height. Differences in the abundance of supports at different strata were readily apparent but were not quantified. A total of 4,134 time point samples were collected over a period of 340 observation hours.

G-tests of interdependence (Sokal & Rohlf 1981) were used to compare overall locomotor and postural profiles (Doran 1992, 1993; McGraw 1996, 1998a, 1998b). When these tests yielded significant differences, Z-tests were used to compare individual behaviors across positional repertoires (Gerstman 2008). Similarly, overall strata use and support use were compared using G-tests of interdependence and proportions of individual categories were compared using Z-tests. We pooled data on adult males and females within each group after it was determined that the sexes did not differ in any behavior. Statistical tests were performed using SAS 9.3 statistical software.

## RESULTS

### Strata Use

Overall strata use for each group is shown in Table 3. For all groups, time spent on the ground was less than 1% and time spent in the emergent stratum also constituted a small percentage (0.28-2.1%). The groups were considerably more variable

**Table 2.** Definitions of positional behaviors and support types.

**Locomotor Behaviors**[a]

1) Quadrupedal Walk: relatively slow, pronograde quadrupedal locomotion
2) Quadrupedal Run: faster version of quadrupedal walk, includes diagonal sequence gaits and galloping
3) Bound: quadrupedal pronograde locomotion in which the both hindlimbs contact simultaneously followed by both forelimbs contacting simultaneously (usually rapid movement )
4) Leap: locomotion with aerial phase between discontinuous supports characterized primarily by hindlimb extension with landing including hindlimbs and/or forelimbs
5) Climb: vertical or near vertical (support angle greater than 45°) ascent in which forelimbs reach above head and hind limbs push the animal up
6) Arm Swing: locomotion involving forelimb suspension (e.g., brachiation, bimanualism)

**Postural Behaviors**[a]

1) Sit: ischia bear a majority of body weight with torso relatively orthograde
2) Stand: all four limbs extended on a relatively horizontal support with torso pronograde
3) Supported Stand: standing posture in which at least two limbs are extended on a relatively horizontal support with one or more limbs flexed or reaching out; torso may be orthograde or pronograde
4) Prone Lie: lying posture with majority of body weight on the ventral surface; limbs may be dangling below support or tucked under body
5) Recline: lying posture with majority of body weight on dorsum or lateral aspect of torso
6) Forelimb Supension: below-support hanging posture using one or more appendages
7) Cling: flexed limb posture on relatively vertical support

**Support Types**[b]

1) Bough: large supports, greater than 10 cm in diameter and large enough that adult monkeys cannot fully grasp with hands or feet
2) Branch: medium-size supports, between 2 and 10 cm in diameter and small enough for adult monkeys to grasp with hand and feet
3) Twig: small supports, less than 2 cm in diameter and usually found on the terminal end of branches
4) Vertical trunk: vertical support of any diameter in which the monkey must cling
5) Artificial support: manmade supports of any size (e.g., rooftop, power line, wall)

[a] categories follow Hunt *et al.* 1996; [b] all categories except artificial support follow Mittermeier 1978.

**Table 3. Frequenceis of strata use, support use, and positional behaviors** for three groups of *C. a. palliatus*.

| Habitat Use and Positional Behavior Variables | Group | | |
|---|---|---|---|
| | IG[a] | SDG[b] | HDG[c] |
| Strata Use | n = 1413 | n = 1480 | n = 1544 |
| sapling layer | 30.2 | 15.8 | 17.8 |
| lower canopy | 30.5 | 37.7 | 48.0 |
| upper canopy | 38.2 | 45.0 | 31.5 |
| other | 1.2 | 1.5 | 2.8 |
| Support Use | n = 1394 | n = 1467 | n = 1530 |
| bough | 32.9 | 42.6 | 42.0 |
| branch | 57.1 | 48.7 | 49.5 |
| twig | 6.2 | 3.1 | 3.4 |
| artificial | 3.8 | 5.6 | 5.2 |
| Locomotor Behavior | n = 140 | n = 92 | n = 72 |
| quad. walk | 44.6 | 45.7 | 44.4 |
| bound | 18.7 | 30.4 | 23.6 |
| climb | 18.0 | 6.5 | 15.3 |
| leap | 16.6 | 16.3 | 16.7 |
| other | 2.1 | 1.1 | 0 |
| Postural Behavior | n = 1389 | n = 1267 | n = 1451 |
| sit | 90.7 | 91.2 | 85.3 |
| prone lie | 5.1 | 5.5 | 6.7 |
| recline | 3.2 | 2.8 | 6.5 |
| stand | 1.1 | 0.6 | 1.2 |
| other | 0 | 0 | 0.2 |

[a]Intact Group; [b]Semi-Degraded Group; [c]Highly Degraded Group

in time spent at the sapling level (15.8-30.2%), lower canopy (30.5-48.0%), and upper canopy (31.5-45.0%). Significant differences were present for every comparison of overall strata use ($p < 0.01$ for all pairwise comparisons; Table 4). Similarly, all but one pairwise comparison of individual strata categories yielded significant differences (Table 5). In general, SDG spent more time in the upper canopy, the HDG in the lower canopy, and the IG was nearly even across sapling, lower canopy, and upper canopy strata.

## Support Use

Frequencies of support use for each group are reported in Table 3. Comparisons of overall support use revealed no differences for SDG vs. HDG; however, significant differences were found for IG vs. SDG ($G = 47.6$, $p < 0.01$.) and for IG vs. HDG ($G = 39.7$, $p < 0.01$) (Table 4). The IG utilized boughs significantly less but used branches and twigs significantly more often than SDG and HDG (Table 5).

## Locomotor Behavior

Table 3 reports data on locomotor behaviors. Quadrupedal walking was the predominant locomotor mode for all groups (44.4-45.7%), leaping frequencies were nearly identical (16.3-16.7%), but percentages of bounding (18.7-30.4%) and climbing (6.5–18.0%) were more variable. For statistical tests, four locomotor categories were used: quadrupedal walking, bounding, climbing, and

**Table 4. Comparison of overall strata use, support use, and positional behavior profiles** for three groups of *C. a. palliatus*.

| **Positional Behavior and Habitat Use Variables** | **Overall Comparison Using G-Test** | | |
|---|---|---|---|
| | **IG[a] vs. SDG[b]** | **IG[a] vs. HDG[c]** | **SDG[b] vs. HDG[c]** |
| Strata Use | G = 85.1, $p < 0.01$ | G = 115.2, $p < 0.01$ | G = 56.5, $p < 0.01$ |
| Support Use | G = 47.5, $p < 0.01$ | G = 39.6, $p < 0.01$ | n.s. |
| Locomotor Behavior | G = 9.2, p = 0.03 | n.s. | n.s. |
| Postural Behavior | n.s. | G = 17.5, $p < 0.01$ | G = 24.4, $p < 0.01$ |

[a]Intact Group; [b]Semi-Degraded Group; [c]Highly Degraded Group

leaping. Comparisons of overall locomotor profiles revealed no significant differences for IG vs. HDG and SDG vs. HDG, but significant difference for IG vs. SDG (G = 9.2, p = 0.03; Table 4). Comparisons of individual locomotor behaviors show that the SDG bounded significantly more and climbed significantly less than IG (Table 5).

### Postural Behavior

Table 3 reports postural behaviors for each group. Sitting was the most common (85.2-91.2%) posture used by members of each group. Prone lying (5.1-6.7%) and reclining (2.7-6.5%) constituted smaller percentages while quadrupedal standing (0.43-1.2%) and supported standing (0.14-0.24%) were rarely used. For statistical tests, we recognized three categories: sit, prone lie, and recline. Overall postural comparisons yielded non-significant results for IG vs. SDG but significant differences for SDG vs. HDG (G = 24.4, $p < 0.01$) and for IG vs. HDG (G = 17.5, $p < 0.01$; Table 4). The HDG sat significantly less often and reclined significantly more often than the IG and SDG (Table 5).

## DISCUSSION

Due to the extensive variation in structural and ecological characteristics (i.e., tree density, diameter, height, and species composition) across the three forest areas (Table 1), it is no surprise that groups exhibit some significant differences in habitat use. As is common in other black and white colobus species (Davies & Oates 1994) the three groups at Diani spent the majority of time (range = 60.7-82.7%) in the main (upper and lower) canopy. It is possible that members of each group sought high canopy levels as a means of increasing safety: although there are few natural predators, many monkeys at Diani are killed by domestic dogs and automobiles (Kahumbu 1997). IG, however, spent nearly twice as much time in the sapling layer (30.2%) than either of the other groups (15.8-17.8%), demonstrating that *C. a. palliatus* need not be restricted to a main canopy niche. In the case of IG, we suspect factors such as food availability and support differences at different strata account for this group being found at lower levels. During the study period 50.1% of feeding observations for IG occurred in the sapling layer compared to 35.6% and 33.0% for the SDG and HDG respectively (Dunham, unpublished data).

Overall support use was virtually identical for SDG and HDG, but both differed significantly from IG with the latter utilizing fewer boughs and more branches and twigs. This is almost certainly explicable due to IG's affinity for feeding on *Premna hildebrandtii*, an indigenous plant that grows in tangled clusters on thin supports predominantly in the sapling layer. This plant, which is rare within the SDG and HDG home ranges, constituted the largest portion (28.9%) of the IG's diet compared to less than 1% in the other groups (Dunham, unpublished data). Despite statistically significant differences in support use, all groups spent at least 90% of observations on large (boughs) or medium sized supports (branches) as predicted by constraints associated with large body size.

Inter-group differences in canopy and support use appear to be a function of local habitat features including food availability. Despite these differences, locomotor behaviors are generally consistent across habitats and the few minor differences in individual behaviors are a function of group-specific support preferences (Prost 1965; McGraw 1996, 1998a). Arboreal quadrupedalism (i.e., quadrupedal walking and bounding) comprises between 64 and 76% of each group's locomotor profile followed by similar frequencies of climbing and leaping. No

**Table 5. Pairwise comparisons of individual strata use, support use, and positional behavior categories for three** groups of *C. a. palliatus*.

| Positional Behavior and Habitat Use Variables | Individual Comparison using Z-Test | | |
|---|---|---|---|
| | IG[a] vs. SDG[b] | IG[a] vs. HDG[c] | SDG[b] vs. HDG[c] |
| Strata Use | | | |
| sapling layer | Z = 9.2, p < 0.01 | Z = 7.9, p < 0.01 | n.s. |
| lower canopy | Z = 4.1, p < 0.01 | Z = 9.7, p < 0.01 | Z = 5.7, p < 0.01 |
| upper canopy | Z = 3.7, p < 0.01 | Z = 3.8, p < 0.01 | Z - 7.7, p < 0.01 |
| Support Use | | | |
| bough | Z = 5.4, p < 0.01 | Z = 5.1, p < 0.01 | n.s. |
| branch | Z = 4.5, p < 0.01 | Z = 4.2, p < 0.01 | n.a. |
| twig | Z = 3.9, p < 0.01 | Z = 3.6, p < 0.01 | n.s |
| artificial | Z = 2.3, p = 0.02 | n.s | n.s |
| Locomotor Behavior | | | |
| quad. walk | n.s. | n.s. | n.s. |
| bound | Z = 2.1, p = 0.04 | n.s. | n.s. |
| climb | Z = 2.5, p = 0.01 | n.s. | n.s. |
| leap | n.s. | n.s. | n.s. |
| Postural Behavior | | | |
| sit | n.s. | Z = 4.2, p < 0.01 | Z = 4.9, p < 0.01 |
| prone lie | n.s. | n.s. | n.s. |
| recline | n.s. | Z = 3.9, p < 0.01 | Z = 4.7, p < 0.01 |

[a]Intact Group; [b]Semi-Degraded Group; [c]Highly Degraded Group

instances of arm swinging or "semi-brachiation" were observed, corroborating results from previous studies (Mittermeier & Fleagle 1976; Morbeck 1977, 1979; McGraw 1996; Schubert 2011). McGraw (1996) argued that one way locomotor modes are conserved across architecturally different habitats is by primates consistently choosing the same support types despite differences in their availability. Support types, in turn, limit the kinds of locomotor behaviors that can be performed. This appears to be the case in the Diani black and white colobus. For example, IG spent more time moving and foraging on small, densely packed clusters of supports that required nimble climbing and quadrupedal walking to navigate. Conversely, SDG engaged in more bounding behavior which is likely facilitated by their greater use of the largest arboreal support type: boughs.

Despite a few statistically significant differences among groups, postural profiles were generally consistent across the three habitats, as predicted. Previous studies have documented the primacy of sitting behavior (Mittermeier & Fleagle 1976; Morbeck 1977, 1979; Rose 1979; Gebo & Chapman 1995a; McGraw 1998b) and the same was found at Diani with this behavior comprising between 85-91% of all postures for the three groups (Figure 6). After sitting, the three groups followed the same trend in which time spent prone lying > reclining > quadrupedal standing > supported standing.

As noted above, primatologists have long been interested in sources of behavioral variation as well as the extent a primate is able to adjust its behavior to accommodate changes in local ecological conditions. It is clear that there is tremendous variation in the degree to which even closely related species are able to adjust to changing conditions (Struhsaker 2010). Unlike many other cercopithecids including the closely related red colobus monkeys (*Procolobus* spp.), black and white colobus monkeys (*Colobus* spp.) readily adapt to altered forest environments (Fashing 2011). In addition to ranging throughout primary forest, black and white colobus are known to thrive within secondary and degraded forest

**Figure 6.** A group of *Colobus angolensis palliatus* sitting on a bough in Diani Forest. Photograph by N. Dunham.

fragments where they may be found at densities higher than those reported from primary forests (Onderdonk & Chapman 2000; Anderson *et al.* 2007a, 2007b; Mammides *et al.* 2008). The ability of *Colobus* spp. to not only withstand but thrive in disturbed environments is likely due to their behavioral and dietary flexibility (Marsh 2003). Black and white colobus monkeys are able to use very small home ranges (Fashing 2011) and adapt to food scarcity with an energy conservation strategy of increasing rest while reducing daily travel (Dasilva 1992). The pronounced variation in strata use among the three troops at a single site illustrates the extent that black and white colobus can adjust elements of behavior to suit local conditions.

Still, the remarkable similarity in locomotor and postural behaviors among the *C. a. palliatus* troops inhabiting three structurally distinct forest areas suggests positional behavior is less plastic than other aspects of behavior, most likely due to constraints imposed by musculoskeletal anatomy. That positional behavior is conserved across architecturally different forests has been documented in several species of New and Old World primates (Garber & Pruetz 1995; McGraw 1996; Manduell *et al.* 2012) while other studies have reported significant differences in behavior between distinct forest types (Gebo & Chapman 1995b; Dagosto & Yamashita 1998; Schubert 2011). What factors might account for the apparent inconsistency in results?

First, some investigators argue that minimal differences in locomotor or postural behavior are an artifact of studies that compare forests that are not structurally dissimilar enough to warrant positional behavior differences (McGraw 1996). Although we did not quantify availability of different sized supports as others have done (McGraw 1996; Dagosto & Yamashita 1998; Manduell *et al.* 2012), the striking differences in tree species composition, tree density, DBH and height categories, combined with the significant differences in strata use across the three forest patches, strongly suggest that these habitats differ profoundly in their architecture and that ecological dissimilarity is not an issue.

It is also the case that some taxa are simply more able to adjust their behaviors to different external conditions than are others. In general, red colobus monkeys (*Piliocolobus* spp.) are described as ecologically sensitive monkeys who are less able to adjust their behavior to changing ecology (Struhsaker 2010). Their ecological sensitivity is reflected in the fact that many populations, incapable of adapting to secondary or regenerating forest, are confined to shrinking blocks of undisturbed primary forest. This behavioral inflexibility has been disastrous for the genus: there are no red colobus monkeys in zoos, captive breeding programs have not proven successful, most red colobus species are classified as endangered or critically endangered, and one taxon may have become the first primate in over 400 years to go extinct (McGraw 2005; Oates *et al.* 2001; Struhsaker 2010). In contrast, closely related black and white colobus monkeys are much more able to adjust to habitat perturbation, they are found in a variety of forest types across Africa, and they are quite common in zoological parks (Mittermeier *et al.* 2013; Rowe & Myers 2013). Understanding the basis for this dichotomy has profound conservation implications and we look forward to future studies that examine the physiological, social, and ecological drivers of behavioral variation and, in particular, those studies that can explain why some primates are better able to adjust their behaviors- including positional behavior- than others (Garber 2011).

## SUMMARY AND CONCLUSION

We suggest that differences in forest structure and ecological variables among three areas of the Diani Forest account for variation in overall strata use and support use. Locomotor and postural behaviors are largely consistent across habitat types. It is possible that our results are a victim of scale (Chapman *et al.* 2002) and that long term study could yield significantly different positional behavior repertoires (Garber 2011); however, we argue that positional behavior is largely constrained by morphology - regardless of the scale and predict that additional examination of the Diani populations would generate results similar to ours. These findings emphasize the link between morphology and behavior and strengthen our confidence in using morphology to reconstruct the behavior of fossil primates.

## ACKNOWLEDGEMENTS

This material is based upon work supported by the National Science Foundation Graduate Research Fellowship under Grant No. 2012136655, The Ohio State University, and the Earth and Space Foundation. We recognize the Kenyan government for permission to conduct this research. Special thanks to Andrea Donaldson, Keith Thompson, and Pam Cunneyworth of Colobus Conservation for providing logistical support and advice for this study. We would especially like to thank John Ndege and Bakari Mnyenze for their expertise in plant identification and assistance in data collection. We thank Dr. Barbara Piperata, Erin Kane, and three anonymous reviewers for their comments on earlier versions of this manuscript.

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*Received:* 3 April 2014
*Accepted:* 24 May 2014

*African Primates* 9:15-22 (2014)

# The Tonkolili Chimpanzee Project in Sierra Leone: Implications for Chimpanzee Conservation Strategies in Anthropogenic Landscapes

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**Abstract**: In 2012, we observed a small group of chimpanzees (*Pan troglodytes verus*) living in close proximity to two villages in Central Sierra Leone. At the time of our visit, the population of chimpanzees had been heavily hunted. As we studied the group, we ascertained from the villages that the main reason for the active hunting was resource competition. The chimpanzees were raiding oil palm crops, which were the sole source of economy for the village at that time. The palms had replaced bee keeping and livestock management, neither of which presented a source of competition with the chimpanzees, and both of which had been destroyed during the Sierra Leone Civil War. In order to protect this population of chimpanzees, we established a partnership between the two villages, a local NGO, and ourselves in order to enact a moratorium on chimpanzee killing in the area. In return, we would provide the funds to restore pre-war economic practices. This partnership has led to further initiatives and the establishment of the Tonkolili Chimpanzee Project. The project has implications for the conservation strategies for chimpanzees, a species universally facing threats from anthropogenic effects.

**Key words: chimpanzee, anthropogenic landscapes, conservation, Sierra Leone, community-based conservation.**

## INTRODUCTION

Wild chimpanzees (*Pan trolodytes verus*) in Sierra Leone face unique conservation challenges, as a greater proportion of the population lives outside of protected areas than inside (Brncic *et al.* 2010). As a result, the majority of chimpanzees in the region live alongside human populations. Understanding the ecology and conflicts of chimpanzees at the human-primate interface is therefore critical to chimpanzee conservation in Sierra Leone. We have developed the Tonkolili Chimpanzee Project to study such a situation involving a small population of chimpanzees (estimated through a standing crop nest count at 14 individuals) living within two human villages (Figure 1). It is the goal of this project and the aim of this paper to explore this particular microcosm of an ecological predicament facing chimpanzees, as well as to offer possible solutions through current initiatives.

As interactions with humans increase throughout chimpanzee habitats, understanding the ecology of the human-primate interface becomes crucial to the survival of chimpanzees. Chimpanzees in Sierra Leone and elsewhere in West Africa face an ever-increasing reality where forest fragmentation is expanding, along with the frequency and severity of human-chimpanzee interactions. Often, these

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**Figure 1.** A chimpanzee at the Tonkolili Site. Photograph courtesy Tonkolili Chimpanzee Project (camera trap).

interactions lead to a situation where chimpanzees are killed in anthropogenic landscapes, stemming predominantly from either real or perceived resource competition in a heavily fragmented landscape.

In the years prior to the Sierra Leone civil war, surveys showed chimpanzees to be primarily concentrated in the protected and semi-protected areas of Sierra Leone: specifically Outamba-Kilimi National Park (Teleki 1989). Chimpanzees were also shown to be less densely scattered throughout the country in non-protected areas. Counts were estimated at 2,000 (Hanson-Alp *et al.* 2003).

Deforestation increased exponentially during and after the civil war (Lindsell *et al.*, 2011). Between the years 1990 and 2010, Sierra Leone lost an average of 0.63% of its forest annually, totaling 12.6% of its forests during the twenty year period. Currently, 38.1% of Sierra Leone is forested. However, only 4.1% of that is classified as primary forest (FAO 2010).

Despite massive deforestation, Sierra Leone still hosts a large population of chimpanzees. In 2010, chimpanzee numbers in Sierra Leone were estimated at 5500; double that of pre-war estimates (Brncic *et al.* 2010). The same survey, however, pointed to the fact that over half of the nation's chimpanzees were now living outside protected areas.

Because this relatively large population of chimpanzees must survive in dwindling and increasingly fragmented forest, the rates of interactions with humans have increased. Fluctuations in availability of preferred fruits lead primates to routinely crop raid local resources (Salafsky 1993, Hill 1997, Saj *et al.* 2001, Humle 2003, Reynolds 2005, Hockings *et al.* 2007). In 2011, a Population and Habitat Viability Assessment (PHVA) for chimpanzees in Sierra Leone concluded that the fragmentation of local forests has indeed led to increased resource competition between humans and chimpanzees. This competition has likely compelled chimpanzees to crop raid, due to lack of naturally occurring resources (Carlsen 2012).

In addition, often despite evidence to the contrary, chimpanzees may be blamed for all crop damage. A review by Hockings and McLennan (2012) examined crop raiding tendencies and the variation, similarity, and abundance of species to species consumption. This review qualitatively measured the pattern of crop selection, establishing high- and low-conflict crops, and suggested that some crop damage may be wrongly attributed to chimpanzees. Other studies have corroborated these findings. In the Nimba Mountains, Guinea, it was found that although the chimpanzees were widely perceived as destroying oil palm crops, they were, in fact, not consuming them at all (Humle & Matsuzawa 2004).

These human-chimpanzee interactions highlight the importance of an ethnoprimatological approach to understanding primates living at the human/primate interface. They also illustrate the importance of acknowledging and changing negative perceptions by local communities. In recent years, this integrative, ethnoprimatological approach has been used to understand the economic and sociological realities for human communities of primate conservation, and has helped shape land management policies in nonhuman primate habitats (Estrada 2013). These studies have also provided guidelines for the prevention of human-primate conflict (Hockings & Humle 2009). Perhaps most importantly, ethnoprimatology acknowledges the views of the local communities, who view chimpanzees as threats to their safety and livelihood (Fuentes 2012; McLennan & Hill 2012). In this way, conservationists can adopt a more realistic approach when attempting to incorporate local communities as partners in conservation.

As forest fragmentation continues to expand at an exponential rate, human encounters will continue to increase. Understanding human-primate conflicts, and developing an integrative approach to researching future conflicts, remains a realistic hope for the conservation of chimpanzees in the Anthropocene. It is from this framework that the Tonkolili Chimpanzee Project proceeds.

## The Tonkolili Chimpanzee Project

In 2012, we observed previously unreported chimpanzees in the southern Tonkolili District of Sierra Leone (Halloran *et al.* 2013). The habitat consisted of forest fragments and open savannah along the Pampana River. The chimpanzees shared this area with villagers and were frequently observed by the community. The two villages, Marocki and Manoni, reported repeated instances of crop raiding by the chimpanzees; in particular, they voiced concern about the destruction of their oil palm crops (*Elaeis guineensis*) due to chimpanzees feeding on the petiole and the heart of the palms. This perception of intense resource competition resulted in the chimpanzees being actively hunted.

During our initial two-week stay at the site, we gathered information from community members regarding their interaction with the chimpanzees; we found an almost universally negative perception toward them at the site. As in other published community surveys (Hockings *et al.* 2010; McLennan & Hill 2012), chimpanzees were feared, and stories were recounted of recent violent attacks on several members of the human community. Chimpanzees were also described as “thieves” who stole the villages’ crops, which included palms, mangoes, pineapples, cassava and bananas. It was from these initial community interviews that we learned that the primary crop being raided by chimpanzees was oil palm. It is important to note that the local people made distinctions between chimpanzees and the other primates in the forest, thereby ensuring proper identification of the species.

Since the Sierra Leone civil war (1991-2002), both Marocki and Manoni have relied on cultivating palm crops as their main source of economy. Prior to the war, the villages had engaged in honey production and livestock management as their chief source of income. Neither of these practices have been reported to present any competition with the chimpanzees at this site. It should be noted, however, that there have been reports of chimpanzees taking honey and livestock at sites in East Africa (McLennan & Hill 2012, Reynolds 2005). However, during the war, bee-keeping boxes were destroyed and all of the livestock was killed. Without the means to rebuild pre-war economic practices, the villagers report that they have had to obtain loans to purchase palm seeds from lenders in the nearby town of Mile 91.

At the conclusion of this initial visit, we worked with our partners at the Conservation Society of Sierra Leone to hold a meeting with representatives from Marocki, Manoni, and the two chiefdoms controlling the land that the chimpanzees habitually utilize. During this meeting, we expressed our intent to return to the site with funds to rebuild pre-war economic practices, provided a moratorium on chimpanzee hunting was observed. All parties agreed to the arrangement, and the Conservation Society of Sierra Leone arranged to monitor the site to ensure that human-brokered chimpanzee deaths had ceased.

## The Tonkolili Site

The chimpanzees at the Tonkolili Site live in a seven km$^2$ riverine forest fragment located on the

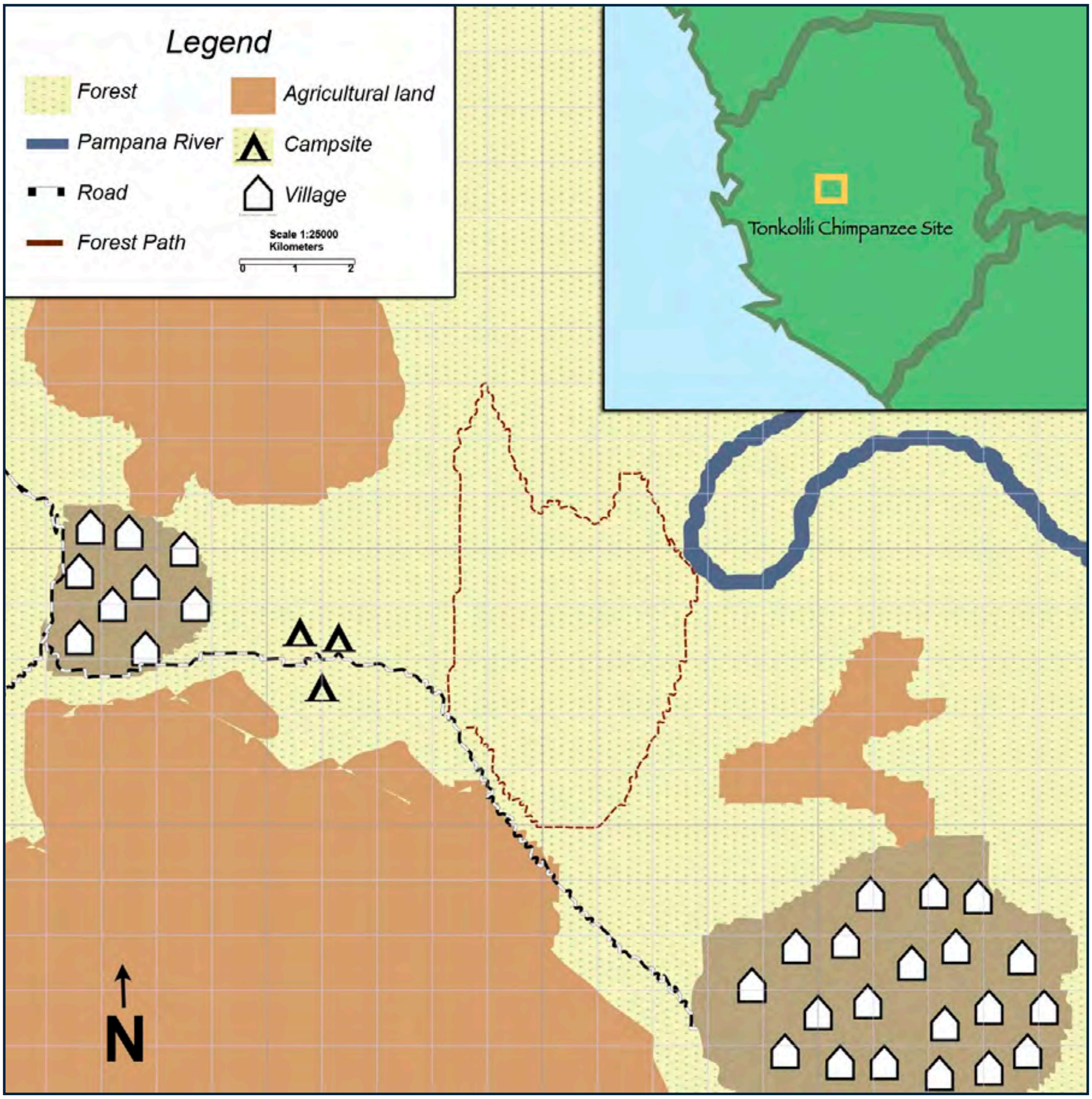

**Figure 2.** Map of the Tonkolili Site.

banks of the Pampana River (see Figure 2). Here, the Pampana is wide and impassible during the rainy season, though the villagers report that chimpanzees occasionally cross the river during the dry season. On the opposite end of the Pampana, the forest fragment is bordered by open savanna and cultivated land containing oil palms, cassava and ground nuts. Marocki and Manoni are located within the site and flank the southern edges of the forest. A research campsite, established in the summer of 2013, is located between the two villages. It also boarders the southern edge of the forest.

Within their core area, the chimpanzees have been observed consuming black velvet tamarind (*Dialium indium*), rubber tree fruit (*Funtumia* sp), and tamarind (*Tamarindus indica*). In the agricultural areas, the chimpanzees reportedly consume oil palm (both fruits and petiole), as well as the non-native mango (*Mangifera indica*) and pineapple (*Ananas comosus*).

The interior of the forest is used by Marocki and Manoni for game hunting during the dry season and — because the Pampana River floods much of the forest floor for several months a year — fish trapping during the rainy season. Despite these activities, humans rarely use the forest interior. However, there was an existing rudimentary trail system within the forest. This trail system, created prior to our arrival, was recently marked by researchers as part of the Tonkolili Chimpanzee Project.

## Human-Chimpanzee Interactions at the Site

After our initial visit, the Conservation Society of Sierra Leone conducted an informal community survey in order to further understand the history of human-chimpanzee interactions within the two villages. According to this survey, neither village actively hunted chimpanzees prior to the Sierra Leone civil war. At the time, the economy of both villages was dependent on the sale of honey and livestock. At the onset of the war most village residents fled, leaving the area occupied by soldiers. We learned from these informal surveys that the bee-keeping boxes had been destroyed and the livestock had been killed by soldiers, which left the village with no economic means.

In the years since the war, both Marocki and Manoni have relied heavily on the cultivation of oil palms. The villages report that, in order to obtain palm seeds, they receive loans from brokers in the nearby town of Mile 91. Once the trees are fully-grown, they are harvested for oil and kernels. These goods are then sold. The income initially goes to repaying to loans, which leaves the villages with what little remains afterward.

As the palms grow, the villagers report that chimpanzees often destroy the trees by consuming petiole and heart of palm. Thus, there is a perceived struggle to keep chimpanzees from destroying these resources. Community members indicate that they attempt to keep the primates from destroying the palms by guarding the crops, but are often unsuccessful; the chimpanzees reportedly raid palms that are out of sight of the guards. The result is that the village yields very little from the trees, which leaves the people unable to repay their loans. This, of course, means that they are left with virtually no economic means to survive. The situation propagates a deeply negative perception of chimpanzees, which leads to their being hunted.

During informal interviews with community members, we learned that neither Marocki nor Manoni typically consume chimpanzee meat. Instead, it is sold in the town of Mile 91, along with other game meat or crops. During these conversations, we also learned that juvenile chimpanzees had occasionally been captured. In some instances, members of the community had attempted to care for them, but were unsuccessful. In other cases, orphaned infants were also sold for profit.

## Initiatives

There are obvious concerns at this site with a history of human-chimpanzee conflicts and chimpanzee hunting. These factors force us to proceed with extreme caution in a situation where chimpanzee research could lead to habituation and put the chimpanzees at exponentially greater risk (Gruen *et al.* 2013). We are also mindful of the risk to human community members to habituated chimpanzees (McLennan & Hill 2010). Therefore, the paramount goals of the Tonkolili Chimpanzee Project are to eradicate chimpanzee hunting and minimize human-chimpanzee conflicts. In addition, the project will monitor the status of these goals and work alongside the community as partners.

The nucleus of the Tonkolili Chimpanzee Project was formed when we proposed a partnership between primate researchers (Halloran and Cloutier), the Conservation Society of Sierra Leone, and the Marocki and Manoni villages. In turn, we sought approval of this partnership from the two chiefdoms governing the respective villages.

The Tonkolili Chimpanzee Project partnership currently rests on an oral agreement between all parties that the killing of chimpanzees shall cease and that the forest is to be used for primate research. In return, we obtained funds to begin rebuilding pre-war economic practices. It is our intent that restoring these economic practices will reduce the reliance on palm crops and, likewise, will reduce resource competition with chimpanzees.

Upon our initial return from Sierra Leone, we also contacted a domestic nonprofit organization, The Maderas Rainforest Conservancy [MRC]. MRC routinely offers students the opportunity to attend primate field courses in Nicaragua and Costa Rica. We proposed to offer a field course for the conservancy at the Tonkolili site in Sierra Leone. The conservancy agreed to facilitate an initial six-student field course in chimpanzee ecology. The funds generated from the tuition enabled us to build livestock pens and holding areas, and purchase goats for both villages.

The pilot course was held during the summer of 2013, when advanced primatology students from the United States worked on several research objectives at the site. These included camera trapping, dietary surveys, fecal sample collection, and community interviews. Students performed no direct observational studies of the chimpanzees. We were also able to hire several of the community members to serve as guides, cooks, and watchmen.

In addition, the Environmental Studies program at Lynn University in the United States contributed to conservation initiatives at the Tonkolili Chimpanzee Project. Students spent the spring semester of 2013 manufacturing bee-keeping boxes (Figure 3). This

**Figure 3.** Newly constructed bee-keeping box at the Tonkolili Site. Photograph by P. Bai Sesay.

was done as part of a course in "Science Serving Humanity" and provided a hands-on educational opportunity for the students. Likewise, Lynn University donated all manufacturing supplies and the shipment costs to the project. Currently, hive boxes, starter wax, protective outfits, supplementary supplies and 10 bee-keeping boxes are in Marocki and Manoni. For each village, the boxes are expected to yield an average of 150 kg of honey per semiannual harvest.

Since our most recent departure in 2013, the Tonkolili Chimpanzee Project has included additional members of the Marocki and Manoni communities. We have hired a former hunter from Manoni to act as a forest patrol. We have enlisted the aid of the Marocki village chief to monitor camera traps set up within the trail system. When we are not present at the site, we are in regular telephone contact with the villages. In addition, The Conservation Society of Sierra Leone regularly visits the site to monitor progress.

### Future Initiatives

As the Tonkolili Chimpanzee Project progresses, we intend to continue to rebuild sustainable agricultural/economic practices within the two communities. Livestock herds will be restored to their pre-war level and crops that are unfavored by chimpanzees will be cultivated in existing fields; for example, cassava has been shown to be a 'low' conflict crop (Hockings & McLennan 2012) and is a sellable crop for the villages. We are currently assessing additional community needs, such as: wells for clean water, clothing, and housing supplies.

Also, we intend to fund opportunistic visits to the village by healthcare and education professionals. Halloran and Cloutier will conduct educational programs for the village regarding chimpanzee behavior, ecology, and conservation. We will also develop programs specifically for children. In this way, we ensure that the presence of primate researchers at the site carries a continued benefit to the local community.

## DISCUSSION

As our closest living relatives, chimpanzees occupy a unique region of the anthropocene. The human-chimpanzee interface occurs when humans and chimpanzees occupy the same land

and compete for the same resources (Hockings *et al.* 2009). The Tonkolili site offers an extreme example of this reality, where wild chimpanzees keenly feel the impact of human presence across multiple facets of their ecology. Successful conservation initiatives must take the human-primate interface into account (Hockings & Humle 2009; Fuentes 2012; McLennan & Hill 2012).

A recent Population and Habitat Viability Assessment sponsored by the IUCN in 2011 attempted to assess the issues affecting chimpanzees in Sierra Leone and establish viable and effective conservation strategies for the nation's chimpanzee population. A key tenant of the workshop pointed to small-scale partnerships with local communities as potential solutions to reduce resource competition (Carlsen 2012). It is with the goals of this workshop in mind that the Tonkolili Chimpanzee Project operates.

In order for any initiative to survive, it is crucial that the conservation projects keep the needs of the local human populations as the foundation from which the initiative proceeds. In this, conservation initiatives may benefit both chimpanzee and human populations, and ensure local participation and resolve for the initiative. Thus, conservation is not achieved at the expense of community needs, but rather enhances the well-being of the human population while preserving the targeted fauna.

Understanding the behavior and ecology of chimpanzees at the human-primate interface is critical to understanding the methods by which chimpanzees adapt to human presence (Hockings & McLennan 2012). This understanding will enable us to create workable conservation strategies in an era where the human impact on wild chimpanzees is exponentially increasing. We believe that small, targeted community-based initiatives, such as the Tonkolili Chimpanzee Project, are crucial additions to far-reaching chimpanzee conservation strategies. These projects can work in tandem with larger strategies, such as protected game reserves (Oates 2005), conservation education programs (Karimu 2006), and regular population surveys (Kühl *et al.* 2007).

## ACKNOWLEDGMENTS

Permission to conduct the research was granted by the Sierra Leone Forestry Division of the Ministry of Agriculture. We are indebted to the Maderas Rainforest Conservancy for this project's initial support, especially Renee Molina. We would like to acknowledge our continued partnership with the Conservation Society of Sierra Leone. Many of the initiatives have, and continue to be, supported by Lynn University. We thank Bala Amarasekaran and Frankie McKenna for their assistance and guidance. We are grateful to Drs. Tatyana Humle, Susan Love Brown, and Catherine Bolten for their comments. We specifically wish to acknowledge Frank Lucas and his design, implementation, and oversight of the bee-keeping box construction project. We are extremely indebted to Dr. John Oates for his guidance since the onset of this project. Finally, we wish to acknowledge the work done at the Tonkolili site by Veronica Butterfield, Breanna Cabaniss, Benni Litman, Jacqueline Meyncke, Kelsey Ragsdale, and Autumn Thorpe.

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*Received:* 2 December 2013
*Accepted:* 24 May 2014

*African Primates* 9:23-34 (2014)

# Distribution du Colobe Vert Olive, *Procolobus verus*, au Bénin et Menaces Pesant sur sa Conservation

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**Résumé:** Le colobe vert olive (*Procolobus verus*), le plus petit de tous les colobes, est peu documenté au Bénin. De 2008 à 2010, des investigations ont été menées dans le but de déterminer la distribution actuelle de ce singe au Bénin ainsi que les formes et la gravité des menaces pesant sur l'espèce. Pour y parvenir, des enquêtes ont été menées auprès des populations riveraines de 88 villages et de vendeurs de parties et produits d'animaux. Par ailleurs, des prospections ont été menées dans 16 forêts. Les résultats indiquent que le colobe vert olive n'est pas aussi rare qu'on le pensait: sa présence a été confirmée sur des sites où elle n'était pas confirmée auparavant. Son aire d'occurrence actuelle s'étend du sud au nord du Bénin entre 6°30 et 9°45 latitude nord et couvre une superficie de 25.403 km². Les formes de pression qui pèsent sur la survie du colobe vert olive au Bénin sont les perturbations diverses sur les habitats créées par les activités humaines notamment la chasse de subsistance et l'agriculture extensive. Au regard de ces menaces et du fait du manque de protection du colobe vert olive, une priorité doit être accordée à la conservation de l'espèce.

**Mots clés: *Procolobus verus*, distribution, menaces, conservation, Bénin.**

**Abstract:** Olive colobus (*Procolobus verus*), the smallest of all colobine monkeys, is not well documented in Benin. From 2008 to 2010, we conducted surveys through the range of the species in Benin to determine the current distribution and assess the threats to its survival. To achieve the objectives, we interviewed local people from 88 villages, visited local fetish markets where animal's parts are sold, and then, conducted surveys in 16 forests. Results indicated that olive colobus is not as rare as we thought: its presence is confirmed in several previously unknown sites. Its range extends from south to north Benin between 6° 30 and 9 °45 north latitude and covers an area of 25,403 km². Various forms of threats including hunting for bush meat and extensive agriculture, affect the survival of olive colobus in Benin. According to these threats in its current range and the lack of attention in olive colobus's protection, a priority has to be accorded to its conservation.

**Key words: *Procolobus verus*, distribution, threats, conservation, Benin.**

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## INTRODUCTION

La conservation des espèces animales et de leurs habitats a toujours été une préoccupation tant au Bénin, avec la création d'aires de conservations (parcs nationaux, forêts classées, réserves de gibier), que sur le plan mondial avec la détermination des organismes de conservation tels que l'IUCN et le CITES. En dépit du vif intérêt porté à la conservation de la faune, les données de base sur de nombreuses espèces restent encore insuffisantes et le statut de conservation de ces espèces reste à être clarifié. Au sein des Mammifères, et plus particulièrement dans l'ordre des primates, l'attention est souvent focalisée sur des espèces charismatiques comme les chimpanzés, les gorilles, les orangs-outangs et les bonobos (Cavalieri & Singer 1993) à cause de leur proximité avec l'homme. Pourtant, les espèces de plus petite taille comme les Cercopithecinae (*Cercopithecus diana roloway, Cercopithecus sclateri, Cercopithecus erythrogaster pocoki*) et les Colobinae (*Procolobus badius, Procolobus ruformitratus* et *Procolobus epieni*) sont plus menacés et pourraient disparaître en premier (Oates 1996; Mittermeier *et al.* 2009). Déjà, deux sous-espèces de colobes sont probablement éteintes (Oates *et al.* 2000): Procolobus pennantii bouvieri et Procolobus badius waldroni.

Le colobe vert olive est la plus petite espèce de la sous-famille des Colobinae. Son aire de répartition très discrète reste limitée à l'Afrique de l'ouest, le long de la côte atlantique (Galat & Galat-Luong 1985). Selon Oates (1996) et Kingdon (1997), la carte de répartition du colobe vert olive indique une distribution discontinue de la Sierra Leone et de la Guinée jusqu'au sud-est du Nigeria. Quelques études socio-écologiques concernant ce singe ont été réalisées dans le Parc National de Taï en Côte d'Ivoire (Korstjens & Schippers 2003; Korstjens & Noë 2004) tandis que son régime alimentaire a été étudié sur l'île de Tiwaï, en Sierra Leone (Oates 1988; Oates & Whitesides 1990; Davies *et al.* 1999).

Pendant longtemps, l'étude des primates n'était pas une préoccupation au Bénin. Depuis 1998 cependant, avec la découverte du singe à ventre rouge (*Cercopithecus erythrogaster erythrogaster*), espèce endémique du Bénin, une attention croissante leur a été accordée comme en témoigne les travaux de Sinsin & Assogbadjo (2002); Nobimè & Sinsin (2005); Nobimè *et al.* (2008, 2009); Matsuda (2007); Djègo-Djossou & Sinsin (2009); Houngbédji (2010); Houngbédji *et al.* (2012) ; Djègo-Djossou *et al.* (2012).

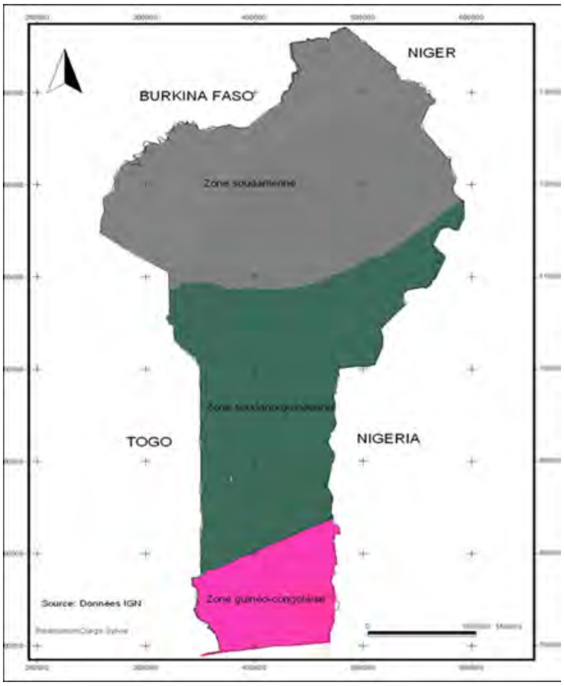

**Figure 1.** Carte des zones chorologiques du Bénin

Observé pour la première fois dans la Forêt Classée de la Lama au Bénin par John Oates en 1995 (Oates 1996) lors de ses prospections forestières, le colobe vert olive n'a spécifiquement bénéficié d'aucune étude. Les études réalisées de façon générale sur les primates au Bénin n'ont cependant apporté que très peu d'informations sur le colobe vert olive. Aussi, la vulnérabilité de l'espèce ne peut qu'être exacerbée par le manque de données. Nous nous proposons ainsi de faire un état des lieux sur le colobe vert olive en inventoriant les sites d'occurrence afin de définir la distribution géographique ainsi que les menaces pesant sur l'espèce au Bénin.

## MATÉRIEL ET MÉTHODE

### Zone d'étude

L'étude s'est déroulée au Bénin situé dans la zone intertropicale de l'Afrique entre 6°20' et 12°30' latitude nord puis 1°45' et 2°70' longitude est. Situé dans le Dahomey Gap, le Bénin couvre une superficie de 114.763 km$^2$. Le pays est actuellement divisé en 12 départements administratifs et en 77 communes administratives couvrant trois grandes zones climatiques (Figure 1) à savoir: la zone guinéenne ou guinéo-congolaise avec une pluviométrie variant entre 1.000 et 1.300 mm, la zone de transition soudano-guinéenne avec une pluviométrie allant de 1.100 à 1.200 mm et la zone soudanienne avec moins de 1.100 mm de pluie par an (Adomou *et al.* 2006).

**Tableau 1. Superficies des forêts investiguées.**

| Forêts | Superficies (ha) | Présence/ absence | Forêts | Superficies (ha) | Présence / absence |
|---|---|---|---|---|---|
| **Classées** | | | **Classées** | | |
| Abomey | 173 | NR | N'dali | 4.721 | NR |
| Agoua | 75,300 | NR | Natitingou | 400 | NR |
| Agrimey | 2,800 | NR | Ouémé Boukou | 20,500 | R |
| Alibori Supérieur | 255,500 | NR | Ouémé Supérieur | 107,542 | R |
| Atchérigbé | 3,150 | NR | Ouénou Bénou | 30,000 | NR |
| Bassila | 2,500 | NR | Parakou | 256 | NR |
| Bélèfougoun | 1,300 | NR | Pénéssoulou | 5,470 | R.E.V. |
| Bimi | 3,200 | NR | Sakété | 60 | R ? |
| Dan | 1,237 | NR | Savalou | 1,015 | NR |
| Dassa | 2,645 | R ? | Sérou | 500 | NR |
| Djigbé | 4,300 | NR | Sota | 43,000 | NR |
| Dogo Kétou | 42,850 | R | Taneka | 1400 | NR |
| Dounga | 250 | NR | Tchatchou | 2,400 | R ? |
| Ichédé | 191 | NR | Tchaourou | 1,100 | NR |
| Kandi | 250 | NR | Toui Kilibo | 27,030 | R ? |
| Klir | 50 | NR | Wari-Maro | 107,500 | R.E.V. |
| Kouandé | 3000 | NR | ***communautaires*** | | |
| Lama | 16,800 | R, V, E | Vallée de l'Ouémé | 192 | R.E.V |
| Logozohê | 1,200 | R ? | Vallée du Mono | - | R.E.V. |
| Mékrou | 9,350 | NR | Ilots forestiers de Domè | 1400 | R.E.V. |
| Monts Kouffé | 180,000 | R, V, E | Lokoli | 500 | R.E.V. |

Légende : R=rapporté par les enquêtés ; R ? = discutable ; NR= non rapporté par les enquêtés ; V= vu ; E= entendu

## Méthode d'étude

Trois approches méthodologiques ont permis d'identifier les sites d'occurrence (Gonedelé Bi *et al.* 2010) et les formes de menace pesant sur le colobe vert olive :

- **les enquêtes:** elles ont été effectuées dans 88 villages couvrant 40 communes administratives dont les chefs lieux sont matérialisés sur la Figure 2. Ces villages ont été choisis parmi l'ensemble des villages riverains à 41 forêts au total dont 37 Forêts Classées et 4 Forêts Communautaires (non classées). Les enquêtes sont basées sur des entretiens de groupes focalisés (focus group) et sur des entretiens personnalisés (interviews) à l'aide de guide d'entretien et de questionnaires d'enquête. Les données collectées sont relatives à la distribution géographique du colobe vert olive (présence/absence) dans les forêts environnantes et aux différentes formes de menaces pesant sur l'espèce. Le guide des Mammifères d'Afrique de Jonathan Kingdon (2006) accompagné d'une planche physionomique portant diverses images de primates rencontrés au Bénin ont été exploitées lors des enquêtes pour faciliter l'identification des espèces. Les superficies des forêts ciblées sont résumées dans le Tableau 1.
- **la phase de prospections forestières:** elle concerne dans la présente étude, les habitats probables du colobe vert olive dans 16 forêts

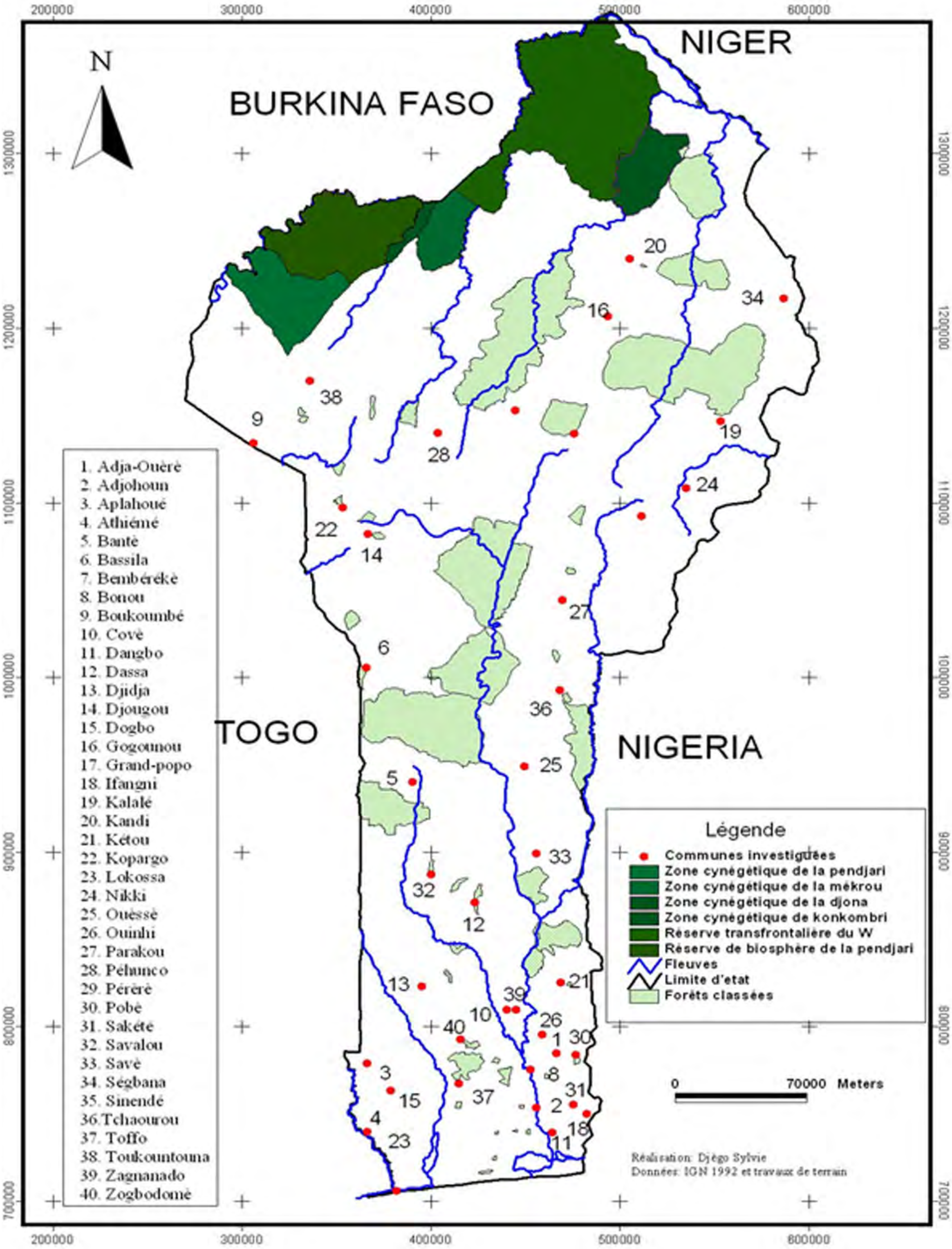

**Figure 2.** Carte du réseau forestier montrant les positions des chefs lieux de communes investiguées.

(Tableau 2) afin de rechercher non seulement des indices de présence de l'espèce à travers des observations directes (contacts visuels et auditifs) et indirectes (sites de nourrissage avec restes alimentaires, crottes); mais aussi pour apprécier l'état des habitats (type de végétation et les traces éventuelles dues aux activités humaines (transhumance, coupe de bois, agriculture, chasse, urbanisation). Dans chaque forêt prospectée, les anciens transects traversant les formations forestières ont été parcourus avec une vitesse moyenne ne dépassant pas 1.2 km/h. Des pauses régulières sont effectuées pour écouter et observer éventuellement les singes notamment le colobe vert olive. Des coordonnées géographiques des points de contacts du colobe vert olive ont été enregistrées dans un Global Positioning System (GPS).

- **la phase de visites de marchés de vente d'organes animaux:** craignant d'être arrêtés par la police forestière, les riverains vendent souvent leurs marchandises de viande de brousse de façon clandestine si bien qu'il n'existe pas de marchés officiels de vente de viande de brousse. Pour cela, 15 étalages de ventes de parties et produits d'animaux (produits utilisés en médecine traditionnelle et entrant dans plusieurs recettes) ont été visités dans 7 marchés (Manigri, Alédjo, Abomey, Covè, Alafiarou, Cotonou, Savè) pour avoir des informations sur les parties ou produits de primates vendus et plus particulièrement sur ceux du colobe vert olive ainsi que leurs provenances. Les marchés choisis sont ceux dans lesquels, il existe des étalages d'organes et de parties d'animaux tandis que les étalages choisis sont ceux où au moins un organe ou sous-produit de primates a été observé lors des visites.

### Echantillonnage

Au sein de la population des chasseurs, d'autorités locales, des membres de l'Administration forestière (forestiers, gardes forestiers et autres), des

**Tableau 2. Forêts prospectées et effort de prospection.**

| Forêts parcourues | Superficie (km²) | Effort de prospection | |
|---|---|---|---|
| | | Jours | distance (km) |
| **Forêts Classées** | | | |
| Lama | 16.5 | 27 | 182 |
| Pénéssoulou | 54.7 | 11 | 74 |
| Dogo- Kétou | 428.5 | 4 | 31 |
| Ouémé- Boukou | 205.0 | 5 | 67 |
| Wari-Maro | 1075.0 | 6 | 94 |
| Monts Kouffé | 2010.0 | 6 | 98 |
| Logozohê | 12.0 | 2 | 15 |
| Ouémé Supérieur | 1425.0 | 4 | 59 |
| Dassa | 26.5 | 4 | 32 |
| Sakété | 0.6 | 2 | 19 |
| Tchatchou | 20.0 | 1 | 11 |
| Toui-Kilibo | 270.3 | 4 | 31 |
| **Forêts Communautaires** | | | |
| Lokoli | 5 | 7 | 20 |
| Vallée de l'Ouémé | 1.92 | 7 | 22 |
| Vallée du Mono | - | 3 | 12 |
| Ilots forestiers de Domè | 14 | 15 | 117 |

guérisseurs et des agriculteurs; nous avons enquêté auprès de 595 personnes d'âge supérieur ou égal à 25 ans. Aussi, un échantillon de 16 forêts a été prospecté pour la collecte de données biogéographiques. Enfin, 15 vendeurs de parties animaux ont été en plus enquêtés dans les marchés.

### Traitement des données

### 1. Données biogéographiques

Un système binaire de présence/absence a été utilisé pour déterminer les sites d'occurrence du colobe vert olive. Le colobe vert olive est supposé présent:

- lorsqu'il est signalé par les enquêtés ou lorsque les enquêtés témoignent que les parties du colobe vert olive (queue, fourrure, tête, membres) qu'ils détiennent, proviennent des spécimens abattus dans leurs zones,
- lorsqu'on enregistre lors des prospections forestières au moins un contact direct visuel ou auditif de la présence du colobe vert olive.

Le colobe vert olive est supposé absent lorsqu'il n'était ni signalé par les enquêtés, ni rencontré lors des prospections forestières. Enfin, le colobe vert olive est supposé absent mais ayant existé dans le passé lorsqu'il était observé, entendu ou bien signalé il y a plus de trois ans par les enquêtés. Ces diverses informations ont permis d'inventorier les sites d'occurrence et les zones d'occurrence (ancienne et actuelle) du colobe vert olive ont été évaluées avec le logiciel Arc Gis 9.3. Les limites de la zone d'occurrence actuelle ont été évaluées grâce à des lignes continues les plus courtes possibles renfermant tous les sites d'occurrence (IUCN 2001). Pour évaluer l'aire d'occurrence dans les Forêts Classées, la méthode utilisée a consisté à faire la sommation des superficies des Forêts Classées ou bien des communes administratives où la présence de colobe vert olive était signalée. Pour la superficie de l'aire d'occurrence hors Forêts Classées, nous avons soustrait la superficie des Forêts Classées de l'aire d'occurrence actuelle.

### 2. Données sur les formes de menaces

Après dépouillement des fiches d'enquête, les données recueillies ont été sériées en 3 types de menaces dues aux activités humaines: chasse, agriculture et transhumance. Avec le logiciel Excel, les pourcentages des enquêtés ont été calculés pour chacune de ces menaces.

### 3. Données collectées auprès des vendeurs de parties de colobe vert olive

Ces données sont relatives à la diversité des parties de colobe vert olive disponibles sur les étalages, les provenances des marchandises et éventuellement les utilisations qui en sont faites.

## RÉSULTATS

### 1. Aires d'occurrence du colobe vert olive

A partir des données d'enquête, l'aire d'occurrence ancienne du colobe vert olive a été estimée à 45.756 km² et couvrait plusieurs Forêts Classées et Forêts Communautaires (Figure 3) à savoir :

- les Forêts Classées de la Lama, des Monts Kouffé, de Wari-Maro, de l'Ouémé Supérieur, de l'Ouémé Boukou, de Pénéssoulou, de Dogo Kétou;
- les Forêts Communautaires situées dans les communes administratives d'Adjohoun, de Bonou, de Dangbo, de Covè, de Zangnanado, d'Agbangnizoun, de Mono, de Savè, de Ouèssè, de Tchaourou, de Bassila, de Nikki, (Sakabansi), de Pérèrè (Tasso), de Ségbana et de Kalalé appartenant aux départements du plateau, du Zou, de l'Ouémé, des Collines, du Borgou, de la Donga, de l'Alibori.

Actuellement, la zone d'occurrence du colobe vert olive couvre une superficie totale estimée à 25.403 km² et est limitée à la zone guinéo-congolaise et à la zone soudano-guinéenne. Elle comprend aussi bien les Forêts Classées que les Forêts Communautaires. Sept Forêts Classées sont concernées et elles couvrent une superficie évaluée à 4.991 km². Il s'agit des Forêts Classées de la Lama, des Monts Kouffé, de Wari-Maro, de l'Ouémé Supérieur, de l'Ouémé Boukou, de Pénéssoulou, de Dogo Kétou.

Les Forêts Communautaires concernées sont: les forêts de la Vallée de l'Ouémé et de la Vallée du Mono, la forêt marécageuse de Lokoli, les îlots forestiers de Domè et d'autres îlots situées dans plusieurs communes (Adjohoun, Bonou, Covè, Zakpota, Zagnanado, Comè, Grand-Popo, Tchaourou, Zogbodomey et Bassila). L'ensemble de ces Forêts Communautaires couvrent une superficie de 20.412 km² (Figure 4). Le colobe vert olive est davantage présent dans les Forêts Communautaires (plus de 80% des indices de présence ont été trouvés dans ces forêts) que dans les Forêts Classées (moins de 20% des indices de présence).

Par ailleurs, dans les Forêts Classées de l'Ouémé supérieur, de Dogo-Kétou, de l'Ouémé Boukou, et les autres Forêts Communautaires, ce sont les témoignages des enquêtés qui permettent de notifier la présence du colobe vert olive.

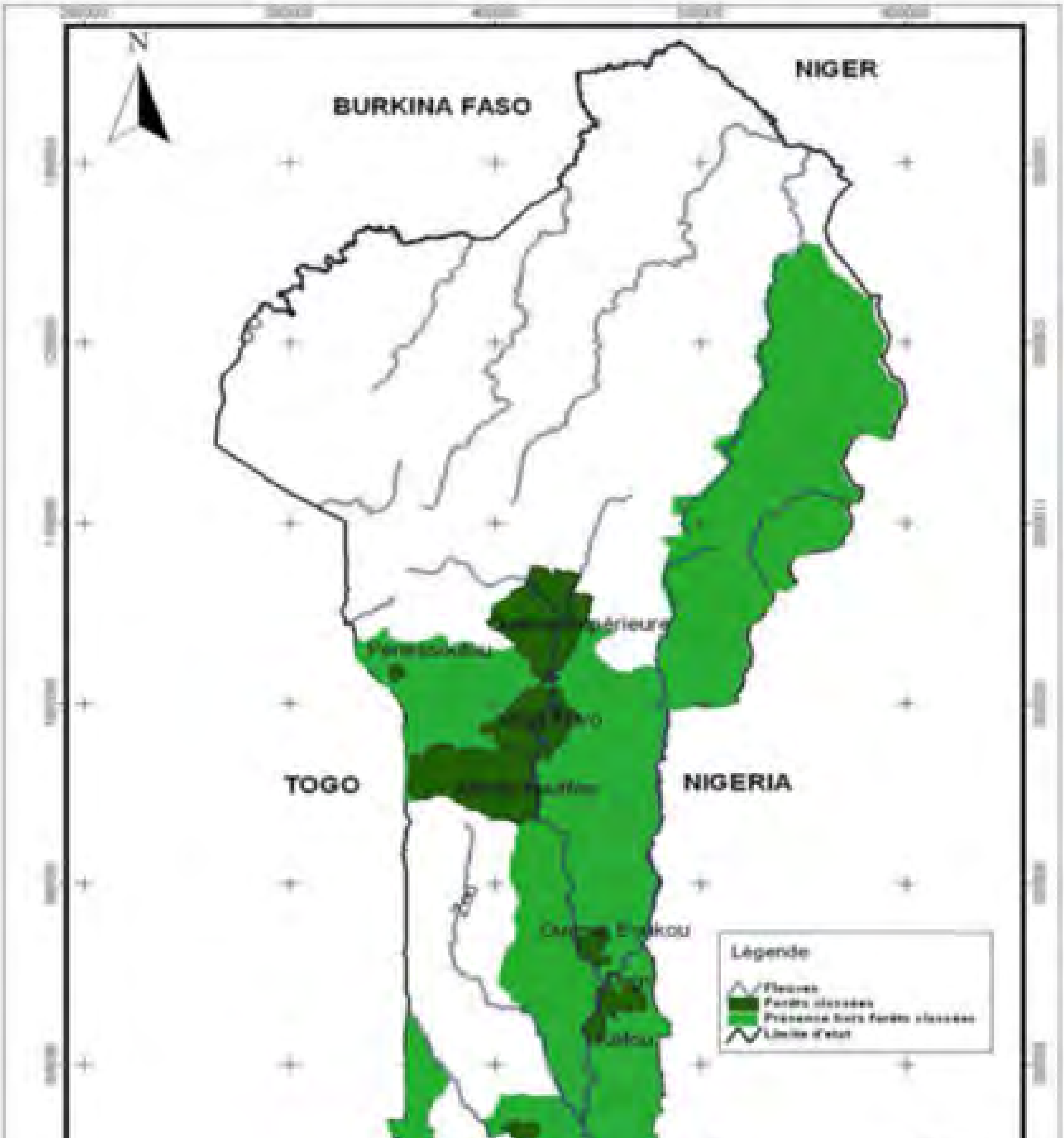

**Figure 3.** Aire d'occurrence ancienne du colobe vert olive au Bénin.

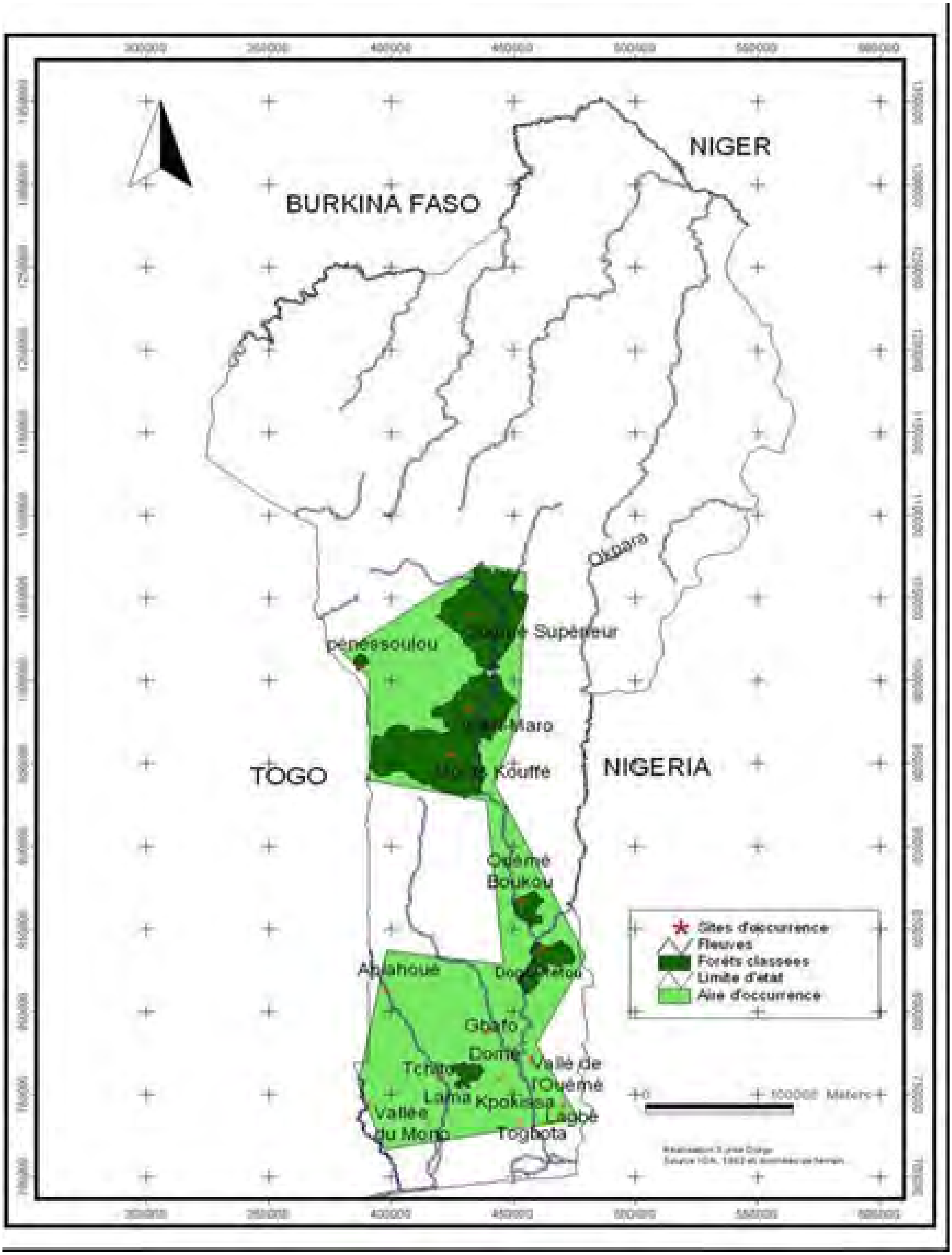

**Figure 4.** Aire d'occurrence actuelle du colobe vert olive.

Lors des prospections forestières, la présence du colobe vert olive est seulement confirmée grâce à des contacts visuels et auditifs dans les Forêts Classées de la Lama, des Monts Kouffé, de Wari-Maro, de Pénéssoulou, et dans les Forêts Communautaires de la Vallée du Mono et de la Vallée de l'Ouémé, la forêt marécageuse de Lokoli, les îlots forestiers de Domè.

La distribution du colobe vert olive est inégale. En effet, l'espèce est mieux distribuée dans la zone guinéo- congolaise où les sites d'occurrence sont plus nombreux que dans la zone de transition soudano-guinéenne, et elle est totalement absente de la zone soudanienne.

### 2. Parties et sous-produits du colobe vert olive

Aucune partie du colobe vert olive n'a été retrouvée sur les 15 étalages de vente de parties d'animaux enquêtés dans les 7 marchés. Cependant, 3 enquêtés (à Covè et Abomey) ont déclaré avoir souvent vendu les parties (fourrure, membres antérieurs et postérieurs, tête, queue) du colobe vert olive. Ils nous ont confiés que les différentes parties de ce singe sont utilisés pour soigner plusieurs maladies sans plus de précisions.

### 3. Causes de régression du colobe vert olive perçues par les populations riveraines

Selon les enquêtés, la chasse, l'agriculture et la transhumance sont les principales causes ayant concouru à la diminution drastique des populations de primates et plus particulièrement du colobe vert olive au Bénin.

Pour 88% des enquêtés, le gibier devient rare car la chasse a décimé les populations animales. Les enquêtés en étaient conscients et déclaraient que, les chasseurs revenaient fréquemment bredouilles de leur chasse. Dans le passé, certains sites étaient même nommés officiellement « lieu de massacre des singes » ; c'est le cas par exemple du mont « Akpa Ato » qui signifie en dialecte local Idatcha « endroit où on tue les singes ». Ce site est localisé à l'intérieur du village de Kèmon dans la commune d'Ouèssè à une dizaine de kilomètres des formations forestières abritant encore le colobe vert olive.

Plus d'un quart des enquêtés (27%) estiment que l'agriculture extensive est la cause de la perte des habitats du colobe vert olive.

Seuls 13% des enquêtés ont reconnu l'effet néfaste de la transhumance sur le colobe vert olive. Pour assurer la nourriture au bétail, les forêts sont prises d'assaut par des éleveurs transhumants dont le bétail, non seulement ravage tout sur leur passage, mais entre aussi en compétition avec la faune sauvage pour certaines ressources alimentaires. Les Forêts Classées de l'Ouémé Supérieur, de l'Alibori supérieur, d'Ouénou Bénou, de l'Ouémé Boukou, des Monts Kouffé, de Wari-Maro, d'Agoua, de Toui-Kilibo, de Dogo-Kétou étaient les plus concernées malgré les efforts des forestiers pour le respect de couloirs de transhumance définis.

Les différentes perceptions des populations riveraines indiquent que la chasse est le principal facteur de régression des populations du colobe vert olive (88%) ; elle est suivie de l'agriculture (27%) alors que la transhumance n'occupe que 13%.

## DISCUSSION

### 1. Limite de la méthode d'estimation des aires d'occurrence

Les aires d'occurrence (ancienne et actuelle) du colobe vert olive sont évaluées dans la présente étude à l'échelle des Forêts Classées et des communes administratives du Bénin, choisies comme unités d'échantillonnage. Ainsi, l'unité d'échantillonnage était d'emblée incluse dans l'aire d'occurrence dès lors que le colobe vert olive était rapporté ou rencontré en un endroit de la Forêt Classée ou commune administrative, même si cela n'impliquait pas que ce primate soit toujours présent à travers toute l'unité.

### 2. Aires d'occurrence du colobe vert olive

L'aire d'occurrence actuelle est en accord avec la répartition du colobe vert olive en Afrique qui était limitée à 8°50 latitude nord (Oates 1981). La distribution actuelle du colobe vert olive au Bénin, limitée aux zones guinéo-congolaise et soudano-guinéenne, est évidemment liée à la répartition des forêts. En effet, le colobe vert olive est une espèce des formations forestières (Galat-Luong & Galat 1985) et celles-ci sont mieux représentées dans la zone guinéo-congolaise où l'on trouve des formations marécageuses (à *Mytragina inermis* et *Raphia hoockeri* ou à *Xylopia rubescens* et *Mitragyna inermis*), des forêts denses humides semi-décidues (à *Triplochiton scleroxylon* et *Celtis zenkeri*, à *Khaya grandifolia* et *Aubrevilla kerstingii* ou à *Dialum guineense* et *Mimusops andogensis*) puis des forêts inondées ou périodiquement inondées.

Quant à la zone de transition soudano-guinéenne, sa pluviométrie explique la dominance de savanes. Cependant, au sein de cette zone, la région de Bassila présente une végétation de forêt dense humide semi-décidue, habitat du colobe vert olive. De plus, dans les autres régions de cette zone climatique, on rencontre quelques poches de forêts denses sèches associées à des forêts claires et des galeries forestières qui constituent des refuges pour le colobe vert olive.

Le colobe vert olive trouve aussi refuge dans les milieux humides (Kingdon 1997) si bien que sa répartition au Bénin est liée au réseau hydrographique, ce qui explique sa présence dans les forêts marécageuses, la vallée du Mono jusqu'à Nangbéto et la vallée de l'Ouémé, les forêts inondées de Zogbodomey arrosées par le fleuve Zou, les galeries forestières des Forêts Classées et les forêts riveraines le long des grands cours d'eau (Okpara, Zou).

Au-delà d'être des zones refuges, les milieux humides sont en fait des zones de préférence de la plupart des colobes car la présence de l'eau améliore la qualité nutritionnelle des feuilles qui constituent les principaux items consommés (Oates 1994).

Les fortes fréquences d'observation du colobe vert olive dans les Forêts Communautaires (Oderdonk & Chapman, 2000 Wong & Sicotte, 2006; Baker *et al* 2009) pourraient être liées non seulement à une abondance de ressources alimentaires mais aussi et surtout par les conditions environnementales notamment la présence permanente de l'eau dans les divers habitats.

## 3. Causes de régression des populations de colobe olive

### 3.1. Chasse

La plupart des enquêtés (88%) reconnaissent que la chasse constitue une menace directe à la conservation de la faune notamment à celle du colobe vert olive; elle constitue ici le premier facteur de régression des populations de colobe vert olive. Les singes sont prélevés à un taux qui dépasse largement leur rythme de reproduction et cette chasse non sélective désorganise les groupes sociaux. Mais l'existence au Bénin des tabous et des interdits alimentaires relatifs à la consommation de la viande de singes au sein de l'ethnie Fon et au sein de la religion musulmane, fait que la pression de chasse sur les primates non-humains n'est pas aussi forte que sur les autres mammifères qui sont prisés (Delvingt 2001). Toutefois, sur certains sites au Bénin, les singes ont été longtemps massacrés comme ce fut le cas dans les villages de Kèmon (commune d'Ouèssè) et de Savè (commune de Savè). La chasse non sélective et intense touche directement les populations de primates et constitue l'une des causes fondamentales du déclin actuel de leurs populations animales. Par exemple, en Afrique centrale, la chasse a été la cause de la disparition des colobes blanc et noir au nord-est du Gabon alors que les espèces du genre Cercopithecus ont survécu. En effet, les Colobes sont plus vulnérables à la chasse que les Cercopithèques (Lahm 1993; N'goran *et al.* 2012).

Par ailleurs, la chasse influence la taille de la population de singes, sa structure et même le comportement des individus dans les divers groupes qui adoptent des stratégies anti-prédation remarquables (Cowlishaw & Dunbar 2000).

### 3.2. Perturbations de l'habitat liées à l'agriculture et l'exploitation forestière

L'agriculture constitue la seconde cause de déclin des populations de colobe vert olive après la chasse selon les résultats d'enquête. Parmi les extinctions préhistoriques, la perturbation des habitats apparait comme le principal facteur conduisant à l'extinction (Ajibade *et al.* 2011) bien qu'elle soit exacerbée par la chasse. La fragmentation et la perte des habitats associés à la chasse provoquent l'isolement des populations, conduisant à leur vulnérabilité (Mace & Balmford 2000). La fragmentation conduit non seulement à l'isolement des groupes mais aussi à une insuffisance de ressources alimentaires. Associée aux diverses perturbations, la fragmentation peut contribuer à la diminution de la taille des groupes, de leur composition et de la densité de la population (Struhsaker *et al.* 2004). Ces diverses perturbations bouleversent le fonctionnement normal des forêts avec comme conséquence l'érosion de la biodiversité (Sinsin & Kampmann 2010).

## 4. Enquêtes de marchés réalisés auprès des vendeurs d'organes animaux

La rareté des parties du colobe vert olive dans les marchés pourrait s'expliquer par le peu d'attention que les chasseurs accordent à ce singe du fait de sa petite taille qui ne constitue pas un gibier de choix. Cependant, quelques enquêtés ont témoigné de l'utilisation des différentes parties du colobe vert olive dans le traitement des maladies. Mais, les maladies traitées ne sont pas précisées car pour ces enquêtés, donner ces informations serait trahir leurs secrets.

## CONCLUSION

La présente étude a permis de documenter la distribution géographique du colobe vert olive au Bénin. Jadis, réparti dans les trois zones climatiques, le colobe vert olive est une espèce de primate très discrète, dont la distribution est actuellement limitée à la zone guinéo-congolaise et à la zone soudano-guinéenne. L'identification de nouveaux sites d'occurrence pour le colobe vert olive dans les Forêts Communautaires est un signal fort pour les perspectives de recherche sur ce primate et surtout pour sa conservation quand on sait que ces Forêts non Classées ne bénéficient plus d'aucune forme de protection.

## REMERCIEMENTS

Nous tenons à remercier le Conseil pour le Développement de la Recherche en Sciences Sociales en Afrique (CODESRIA) et la Société Américaine de Primatologie (ASP) pour leurs appuis financiers dans la collecte des données. Nos remerciements vont aussi à l'endroit de l'Unité de Biologie du Comportement, Ethologie et Psychologie Animale de L'Université de Liège qui nous a assistés dans le traitement des données.

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*Received:* 9 October 2013
*Accepted:* 30 August 2014

*African Primates* 9:35-44 (2014)

# Ethology and Ecology of the Patas Monkey (*Erythrocebus patas*) at Mt. Assirik, Senegal

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**Abstract**: We report ecological and ethological data collected opportunistically and intermittently on unhabituated patas monkeys at Mt. Assirik, Senegal, over 44 months. Although unsystematic and preliminary, these data represent the most ever presented on far western populations of the West African subspecies (*Erythrocebus patas patas*). Patas monkeys at Assirik live in a largely natural mosaic ecosystem of grassland, open woodland and gallery (riverine) forest with a full range of mammalian predators and competitors but without domestic plants and animals. All sociecological variables measured fall within the range of patas monkeys studied elsewhere in East and Central Africa, but apparent nuanced variation could not be tested, given the lack of close-range, focal-sampled data. This awaits further study.

**Résumé:** Des données écologiques et comportementales ont été récoltées de façon opportuniste et discontinue durant 44 mois sur les patas sauvages à Mont Assirik, Sénégal. Malgré leur nature préliminaire et non-systématique, ces données sont actuellement les plus nombreuses sur la sous-espèce d'Afrique occidentale (*Erythrocebus patas patas*). Les patas de Mont Assirik vivent au sein d'un écosystème constitué d'une mosaïque de savanes herbeuses et boisées avec des forêts galeries, en présence de nombreuses espèces de mammifères prédateurs et compétiteurs, mais en l'absence de toute plante ou animal domestique. Nos résultats montrent que les patas de Mont Assirik ressemblent à ceux d'Afrique de l'est et d'Afrique centrale de façon générale, mais des analyses approfondies des variables socio-écologiques requièrent des données systématiques sur des individus habitués à la présence des observateurs.

**Key words: Patas monkey, *Erythrocebus patas*, behaviour, habitat, West African primates**

## INTRODUCTION

The main aims of the study were to: (a) compare the main features of the socioecology of patas monkeys (*Erythrocebus patas*) in Senegal to those noted elsewhere in Africa, and (b) investigate the general ecology of patas in a mosiac of mixed woodland and grassland in far western Africa.

Most recent studies have been done in East Africa on *E. p. pyrrhonotus* or in Central Africa on *E. p. patas*. Both of these long-term studies, at Laikipia in Kenya (Chism & Rowell 1986, 1988; Enstam & Isbell 2002, 2004; Isbell & Chism 2007; Pruetz 2009; Burnham & Riordan 2012) and Kala Maloue in Cameroon (Ohsawa *et al.* 1993; Nakagawa 1999, 2000, 2003; Ohsawa 2003), have lasted for decades and systematically have compared patas with sympatric guenons. We report data on the largely neglected, far West African sub-species of patas monkey (*E. p. patas*), found from Senegal to Chad (Isbell 2013).

The first systematic study of patas was done on grassland savannas in Uganda, toward the eastern end of the species' range (Hall 1965). Struhsaker

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and Gartlan (1970), Gartlan and Gartlan (1973) and Gartlan (1975) later studied a central African population of patas in the more arid Sahelian savannas of Cameroon. All of their observations seem to have been done at waterholes in the dry season. The species' range extends westward from Cameroon for another 3000 km, to the Atlantic Ocean. In pelage, western populations are subspecifically different, lacking the contrasting pattern of facial hair, but they are similar in morphology and dimensions to the eastern forms (Isbell 2013).

The only previous reports on the socioecology of far western patas are brief or lack detail. Galat-Luong *et al.* (1994, 1996) studied patas in coastal Senegal, in the Saloum Delta National Park, on the northwestern side of the country. Chism and Rowell (1988) studied patas for 4 weeks at Tenzugu in Ghana, a depauperate, highly human-modified site where the patas raided crops daily. Pruetz and Marshack (2009) reported chimpanzees (*Pan troglodytes verus*) preying on patas in southeastern Senegal, at Fongoli.

## STUDY AREA AND METHODS

From February 1976 to December 1979, the Stirling African Primate Project (SAPP) maintained a small field camp (12° 53' N, 12° 46' W) by one of the main watercourses draining from Mont Assirik (elevation: 311 m). Two to four observers at a time concentrated on studying the chimpanzee, and in 1977, fulltime studies began on both Guinea baboons, *Papio papio* (Sharman 1981) and green monkeys, *Chlorocebus sabaeus* (previously *Cercopithecus aethiops;* Harrison 1983a, 1983b).

### Vegetation

McGrew *et al*. (1981) presented quantitative data on climate and vegetation at Assirik. The slopes of the low, flat-topped hill are covered in deciduous woodland and bamboo (*Oxytenanthra* sp.) and merge into basins dominated by tall elephant grass (*Andropogen* sp.) with occasional, isolated trees. These basins are separated by a series of flat laterite plateaux ('bowes'), covered mainly by *Danthiopsis* sp. grass. Some areas of plateaux have scattered *Combretum* bushes, *Acacia* scrub, or coarser vegetation in poorly-drained places. Seasonal streams cut through the plateaux in rocky gorges and provide the only suitable sites for the small strips of gallery forest with evergreen trees. Other ridges and slopes support further deciduous open woodland. Thus, four distinct habitats – forest, woodland, plateau, and grassland – cover most of the study area. Within the study area, only one stream has permanently flowing water. By the end of the dry season (March-May), the only other surface water comprises small pools in streambeds at about eight sites in steep-sided valleys.

### Fauna

Five potential mammalian predators on patas occurred at Assirik: lion (*Panthera leo*), leopard (*Panthera pardus*), spotted hyena (*Crocuta crocuta*), African wild dog (*Lycaon pictus*), and side-striped jackal (*Canis adustus*). All were encountered occasionally year-round, although most were nocturnal (McGrew *et al.* 2014). Large predatory reptiles such as Nile monitor lizard (*Varanus niloticus*) and Nile crocodile (*Crocodylus niloticus*) also occurred in the study area (McGrew 2014).

Assirik had no domesticated animals or plants, thus no crop-raiding nor provisioning. There was little sign of anthropogenic modification of the habitat, apart from the annual burning mentioned above: no water tanks, fence lines, charcoal-making, or forest clearance. The fauna and flora in 1976-79 was typical of the Guinea-Soudanian woodland of the Sahel, including the presence of elephants (*Loxodonta africana*). Some small-scale illegal hunting occurred, but there was no evidence of human killing of patas.

### Climate and Seasonality

Four years (1976-79) of records of temperature, rainfall, relative humidity, and cloud cover show that Assirik undergoes a pronounced dry season with highest temperatures towards its end in April and May (McGrew *et al.* 1981). Annual rainfall varied from 824 -1224 mm (median = 885 mm), with much rain from June to October and almost no rain between November and May. By mid-November, grasses were dead and highly inflammable; bushfires swept through plateaux and basin grasslands. Only the gallery forest escaped severe fires and even there leaf litter often burned. The blackened, leafless and arid appearance of most of the Assirik region during the dry season belies the fact that many trees and shrubs then come into flower, such as *Pterocarpus erinaceus, Bombax costatum* and *Combretum* sp., whilst others (e.g., *Adansonia digitata*) produce ripe fruits at this season.

## Data Collection

All SAPP researchers occasionally encountered patas and took notes on group size, habitat, and general behaviour. As these observers concentrated on the other three species of diurnal primates, they spent most of their time in gallery forest or woodland and rarely saw patas in these biomes. Encounters usually happened as researchers crossed plateaux en route to other areas or when taking the hourly meteorological readings on the plateau at camp.

Most of the observations beyond brief glimpses were of monkeys as they drank, rested, moved, or foraged across extensive open spaces. The terrestrial observer usually was several hundred metres distant, so even thin vegetation cover was a visual hindrance. During the middle of the day, heat shimmer greatly reduced the effectiveness of binoculars. It was rarely possible to record continuous sequences of behaviour, to make regular time samples of activity, or to ascertain the exact composition of a group by age and sex. Here, we based analyses on putative breeding groups in which infants were seen, or on an adult male with females, or on groups larger than six, i.e., greater than the largest all-male group ever seen at Assirik.

We opportunistically collected patas faecal samples and examined them by sluicing and sieving (McGrew *et al.* 2009).

From late November 1977 to late January 1978, observations were made sitting quietly, monitoring a waterhole near camp that was visited by patas for drinking.

From 1978, we used notecards with standardised categories of data for patas. At each encounter, observers recorded initial and final distance to encountered monkeys, how monkeys reacted, and details of their departure. Observation distances varied with season, location, and with circumstances (see below). Thus, 126 encounters were classed by:

(a) type of response: i.e., fleeing; undisturbed activity (such as feeding, or continued relaxed presence, for more than 3 min.); or ambiguous response (much vigilance or unhurried movement away)
(b) season: July-November (wet, poor visibility) or December-June (dry, after burning, so improved visibility);
(c) locality: Home (plateau around camp constantly crossed by SAPP researchers) or Away (other places);
(d) Observer circumstances: on foot or from vehicle.

CH spent 5 November – 2 December, 1979, at Assirik. He employed a mixed strategy of extensive survey walks and long-range scanning with binoculars of plateaux. He made spot-checks from a vehicle at places where patas had been seen before and that were visible from the 2.8 km of motorable track. Besides intensive observations in the same areas close to camp, CH twice visited eight of the nine major outlying plateaux within the usual SAPP survey region.

## RESULTS

### Social Interaction

Patas showed remarkably little physical or vocal interaction that could be detected by observers from a distance of 50 m or more. Monkeys sat near or moved past others in a relaxed way, with no obvious display signals or signs of avoidance. Those resting in the same tree were often several metres apart. In 17 encounters totalling 481 min of relatively undisturbed observations, mainly around a waterhole, social grooming occurred only three times.

We saw 15 instances of chasing play. Nine times, juveniles or infants usually took part, but once an entire large group romped around together. Another time, two pairs of adult females chased and play-grappled for ca. 6 min before following the rest of the departing group.

We saw no adult sexual behaviour, but once a juvenile entered a group and briefly mounted another, clasping with the hands on the back. There was a marked birth season: two heavily pregnant females were recorded in February, whilst young infants, which are dark in colour and carried ventrally, were recorded between February and May, with a peak in March. After early June, all infants had the coat colour of fully-grown females and rarely were carried, except during disturbances.

### Group Dispersion

Patas groups often spread over a wide area, so that recording of group scatter was possible only in fairly open situations. The range of dispersion distances (n = 35) were from 15-300 m, with most records at 30-150 m. Larger groups (10 or more members) had a median dispersion of 125 m, almost twice that of smaller groups at 60 m.

## Progression Order

We made only nine fairly comprehensive identifications of individuals in progression orders; in 18 other cases, we had data only about the easily identified adult male. We analysed the data for individual position in the group for each age-sex class in terms of first in progression, last in progression, leading and trailing four individuals, and individuals in the middle between the first and last four. Juveniles and infants never were first in a moving group. Adult males were never in the middle but instead were either in the leading section or, often, at the rear. Adult females occurred anywhere in the progression order.

Several times an adult male moved through a static group from one side to the other, and males often showed vigilance at the edge of a group. But the adult male of a group was sometimes far from it: several times a group of females was watched for many minutes before a male appeared, or vice versa. Once, an adult male appeared out of woodland, 250 m away from a group of 10 females and young, whom he joined/rejoined.

## Relations with Other Species

Patas regularly were seen close to ungulates, taking little notice of oribi (*Ourebia ourebi*) or bushbuck (*Tragelaphus scriptus*). They avoided the larger roan (*Hippotragus equinus*) and hartebeest (*Alcelaphus buselaphus*) if these bovids approached too closely. Once a group of 14 patas, including three young infants, fled from the observer to a line of *Combretum* bushes where there were already two jackals. There was no sign of tension between the two species, although the monkeys were as close to the jackals as 5 m on the ground and 2 m in the vegetation, before the group moved off foraging. A group of patas called continuously, with a lion resting in tall grass 100 m away; they continued calling (but type of vocalisation was unspecified) for 30 min from the same place before moving back into woodland.

Patas behaved differently toward green monkeys versus baboons. Several times green monkeys were seen close to patas on the ground or feeding in a tree within 1 m, with no sign of interaction. In contrast, patas avoided baboons as soon as they were seen or heard, except for one occasion toward the end of the dry season. Then the patas came down to a waterhole only 40 m from a noisy baboon troop and approached as close as 5 m to one juvenile baboon. Patas treated observers the same way they treated baboons.

Full analysis of the data on encounters with observers was handicapped by observations being distributed unequally. For example, there were only 15 observations from vehicles, and, excluding these, other combinations of variables (see above) ranged from 4-19 cases.

Using only Away data and keeping seasons separate, the median response distances (from observer to nearest patas) were: for Fleeing, 80 m in dry season and 70 m in wet season; for Undisturbed, 300 and 170 m; for Ambiguous response, 200 and 175 m.

For vehicular observations, using the Away data for Undisturbed and Ambiguous responses combined gave a median distance of closest observation of 50 m, whilst on foot the median was 200 m. At the Camp waterhole, patas often showed undisturbed behaviour at about 70 m. Thus, a quiet, immobile observer on the ground seemed to be equivalent to one watching from a vehicle, but this may have been confounded by a context-specific habituation effect (see below).

Detection of genuine habituation of patas to observers close to camp was difficult. For outright Fleeing, median distances of encounters were identical (75 m) for Home versus Away. For Undisturbed and Ambiguous encounters, mode of observation was equated by eliminating from the Home records cases in which the observer was sitting quietly outside the hut that overlooked the waterhole. For the remaining data, the median observation distances for Home versus Away were 165 versus 200 m for Undisturbed responses and 80 versus 200 m for Ambiguous responses. Thus, Home observation distances tended to be shorter than Away. Some groups that often were active around camp seemed to become partly habituated to human activity. Once, when two groups of patas interacted, the observer moved to within 20 m of them without their showing any obvious response, although this may have been because they were preoccupied with each other.

The monkeys' main escape response to an observer was to move away on the ground. During four Fleeings and 45 Ambiguous responses, patas only once climbed trees and even that was transient. If they were encountered first in trees, then the monkeys climbed down immediately or moved across to the next tree before descending. However, patas that moved away from an observer often disappeared into scrub or woodland cover or paused and climbed up into *Combretum* bushes. Movement into cover occurred in 25 cases of fleeing versus seven cases of climbing into vegetation. This difference was not due to just environmental necessity, as movement into cover was noted only four times in both Ambiguous and Undisturbed conditions. Some climbing was noted in about half of feeding bouts and in four Ambiguous withdrawals. Thus, when cover from bushes or trees was nearby, patas actively used it in escape from some disturbances.

Although males were often the last of a group to leave, threats or distraction (branch-shaking, hindquarter bouncing, yawning toward observer) were unusual. Even when undisturbed, patas spent much time scanning their surroundings, often from bushes, rocks or termite mounds.

## Vocalisations

In most encounters with humans, patas made no audible calls, although only rarely were observers closer than 50 m. Thus, the monkeys may have used low-intensity calls that were undetected by observers. We noted four distinct types of call:

Repeated barking by adult males and 'chirrup' calls by breeding groups were as reported by Hall (1965) but we also heard two other vocalisations:

Squeal: "peeyow". The context of this call was unclear, but it was heard most often when a large group of patas hesitantly approached a waterhole in the gallery forest, with baboons close by. Once, a barely independent infant squealed when bitten by an adult female. Calls recorded as "cat-like miaouw", "mew", or "thin wailing" may have been variations of Squeal.

Growl: "(g)rrr" sound audible at about 40 m. Growls were heard from a large group as they crossed a wooded ravine, and from another group in the presence of what was probably a strange adult male. In the latter case, growling also was the second component of a double call with the bark and was probably given by the solitary adult male.

Thus, calls audible at 40 m or more distance were prompted by some disturbance from outside the group, either by observer, potential predator, or extra-group patas.

## Eating and Drinking

Feeding was recorded whenever a monkey put its hand to the substrate and then immediately up to its mouth. Sometimes items were seen to be picked up and eaten, but at long-range, and sometimes even at close range, small items such as insects or seeds were unidentifiable. Monkeys turned over stones in order to inspect exposed cavities and swept the hand through ground litter.

Pooling feeding incidents by hour of the day suggests that peaks of activity occurred in mid-morning and late afternoon. Changes in observer activity were accounted for by calculating the hourly rates of feeding per 10 encounters with patas. The monkeys showed high frequencies of feeding 08.00 – 12.00 hr and 15.00 - 1800 hr. For drinking, a single peak from 12.00 – 13.00 hr emerged, after the morning peak of feeding.

Patas foraged mainly on the ground (36 of 54 encounters), and their faeces contained many grasshoppers (Orthoptera: Caelifera) that were abundant in the grass. Other remains found, of insect larvae, a hemipteran and a mantis, may have been prey taken from bushes or trees. Grass seeds appeared to be eaten but were not identified in faeces. Patas ate the leaves, buds, flowers, or fruits of 11 species of trees and large bushes at Assirik. Fruits not seen to be eaten by patas were found mainly in gallery forest or in woodland.

When approaching a waterhole, patas moved cautiously, and only one or two individuals usually drank at a time, while the rest waited nearby on rocks or in bushes. Similar caution occurred while drinking: short bursts of lapping were interspersed with looking around in vigilance. Once, a group of eight patas took 6 min for all members to drink and leave. Often the monkeys spent about half an hour idling in nearby trees after drinking. Even in the dry season, there were probably several waterholes (all natural) within the day-range of patas groups. Patas were seen 18 times on 11 days to drink at the waterhole near camp, over 17 days spent monitoring it.

## Habitat Use

Observers were asked to record vegetation types as short-grass plateaux, tall grassland, deciduous woodland, or gallery forest. Patas were more often seen on plateaux, while green monkeys predominated in woodland and forest (Harrison 1983b). This difference was not explained by differential observability between the species.

The habitat where patas were most often encountered was an inter-gradation between plateau and woodland, although such a category was not in the original coding system. Such transitional zones (ecotones) occurred between plateau and woodland but not between plateau and forest. Patas seemed to favour plateau/woodland edges, so, to cope with this complication, we created post hoc three further categories:

1. Ecotone: Plateau and woodland, where a graded, intermediate band of open bushland with scattered trees merged into intermixed open spaces and small belts or copses of trees.
2. Fringe: Woodland and plateau were well-defined and monkeys were seen close to the boundary, usually not more than 20 m into one habitat and never more than 100 m. Only short stretches of such well-defined fringe occurred in the study area.
3. Bushy marigot: Dry rocky beds of temporary streams crossing plateaux that often had scattered bushes and trees or strips of woody vegetation less than about 20 m wide.

Soon after the project finished, five SAPP members consulted field notes and applied independently and retrospectively this enlarged habitat classification to encounters with patas that they remembered well. When patas moved from one habitat to another, both data-points were used, but we kept the distinction between the first habitat recorded versus later ones. No differences existed across putative breeding groups, uncertain records, and all-male groups, so these data were pooled. First encounters (n=160) occurred most often in ecotone (n=61, 38%) and plateau (32.5%) habitats, followed by bushy marigot (13%) and woodland (11%). Few first sightings occurred in forest (3%) or fringe (2.5%).”Later” records (n=80), of when monkeys moved into another habitat type, showed woodland (n=35, 44%) as by far the most common habitat entered, followed by ecotone and plateau (each at 24%). Fringe (4%), bushy marigot (4%) and forest (1%) were almost never entered.

No evidence emerged that breeding groups normally penetrated beyond the edge of woodland. Five areas existed near camp where extensive woodland stretched for at least 800 m without a break. These areas were covered regularly by observers searching for chimpanzees or baboons. Only four times were breeding groups found to be more than about 200 m within such extensive woods. Patas at Assirik spent most of their time foraging and resting in ecotones between plateau and woodland or just within the woodland fringes. They made occasional forays across open plateaux (where they were very conspicuous) and went into gallery forest only to drink or to use trees that were close to a plateau edge. They avoided areas of tall elephant grass, even after it had burned.

## Group Composition

Groups of females with infants or juveniles usually were accompanied by one adult male (n =79 sightings), but twice two adult males were noted.

Sub-adult males sometimes were hard to distinguish from fully-grown females; we sometimes saw identifiable immature males in breeding groups but never more than one per group. Since juveniles (excluding dependent infants) often comprised half the membership of a breeding group, it seems likely that most males left their natal group before becoming strikingly different in appearance to females.

At least seven times, groups of three to five patas were seen to contain at least two adult males, with the others being confirmed subadult males. All-male groups usually behaved as a coherent unit, but sometimes individuals arrived and left in quick succession.

Lone males appeared regularly (n=15 sightings), but some of these apparently solitary males may have been associated with groups of females that were out of sight. Some may have been truly solitary, but several records of a lone male described an individual identical to the known male of a breeding group often seen near camp. Thus, it is likely that temporary separations (as noted above) between a group and its adult male may extend for longer periods. In 1979, we recorded female groups apparently lacking an adult male; these were concentrated in one area, suggesting that attachment between adult male and breeding group varies greatly.

## Size of Breeding Groups

For this analysis, only records in which the observer had counted most (but not necessarily all) individuals were used. Infants carried ventrally were excluded. To avoid recounting the same group, the data first were separated into seven periods for which each period (usually centred on the early or late dry season) was separated from the rest by an interval without data. Then, in each period, the probable number of groups was calculated by using locality, distinctive features, and group size. Sets of data that differed in median group size by four or more members were taken to indicate different groups, as were cases in which one record differed from a series by six or more individuals. This procedure yielded 26 "independent" breeding groups ranging in size from 7-28 (median = 13, with two-thirds of records = 10-22). Less restrictive criteria allowed one set of data to be assigned to two groups; this added six more units with a median of 12 and range of 5-28.

### Overlap of Group Range and Overall Density

In the SAPP study area, patas seemed to move between localities at least 2 km apart. However, there was no reason to suspect regular interchange between the plateau around camp and another large plateau 4 km away, separated by at least 800 m of unsuitable habitat. Day-to-day patterns of encounters of groups during the two periods of intensive study strongly suggested that a group often spent several days in one part of its home range and then shifted to another part, although the monkeys easily could traverse the whole of the home range any day. Conservative estimates suggest that two or three groups regularly used the plateaux and open woodland within 700 m of camp. The groups rarely seemed to come into direct contact.

Thus, we tentatively estimated the density of the patas population in the best-monitored area, that is, within ca. 20 km$^2$ around camp. This area usually yielded a local population of 40-50 monkeys, with a minimum figure, over all four years, of 20. So, computed density in a sample area with typical proportions of all types of habitat ranged from 1-2.5 monkeys per km$^2$. The entire study area had about 625 ha of plateaux and open woodland (including ecotone between the two), so that densities in those combined habitat-types were about 3-8 km$^2$.

Within the SAPP study area, only one large plateau yielded no sightings of patas. It was the only one lacking surface water during the late dry season. To get to its nearest source of drinking water entailed crossing 500 m of elephant grass and scrub, then 1000 m across the next plateau.

## DISCUSSION

The overwhelming conclusion from this limited and fragmentary data-set is the Assirik patas resemble those found further east in Africa (Isbell 2013). Repeatedly, our limited findings agree with those from Cameroon, Kenya and Uganda. This is reassuring, given that Assirik's patas appear to live in the most natural surroundings of any population studied so far, and that our data were collected opportunistically.

The 'spaced-out' dispersion and low frequency of sociosexual interaction found here echoes that noted at all other patas study sites (Hall 1965; Gartlan 1975; Isbell 2013). Similarly, the short, seasonal birth season is species-typical (Struhsaker & Gartlan 1970; Chism & Rowell 1988). Only the apparently high frequency of play, especially among adults, seems notable, and bears further investigation (but see Struhsaker & Gartlan 1970).

Few data have been presented on progression order in patas, but what we saw at Assirik seems to differ from elsewhere. At Laikipia, females typically initiated group movement and led progressions (Chism & Rowell 1988), whereas at Assirik, females were randomly placed in progressions. The widespread roving of a mixed sex group's adult male at Assirk resembles that seen elsewhere.

For relations with other species, most studies concentrate on patas and their potential predators. We found the same vigilance and alarm at large carnivores, but surprisingly little regard for jackals (cf. Gartlan & Gartlan 1973), which elsewhere prey on patas (Struhsaker & Gartlan 1970; Chism & Rowell 1988; Nakagawa 1999; cf. Burnham & Riordan 2012). Assirik patas never met the domestic counterpart of jackals, dogs (*Canis familiaris*), unlike elsewhere, where they kill patas (Chism & Rowell 1988; Enstam & Isbell 2004). As elsewhere, patas at Assirik distinguished between vervets and baboons, being tolerant of the former but wary of the latter (Hall 1965; Struhsaker & Gartlan 1970; Enstam & Isbell 2002). Assirik patas's responses to humans were like those elsewhere: they fled on the ground into cover, usually nearby woodland. Also, it seems to be a patas universal that much time is spent in vigilant scanning, often from elevated vantage points (Hall 1965; Gartlan & Gartlan 1973; Enstam & Isbell 2004).

Relations with 'savannah monkeys' (*Cercopithecus/Chlorocebus* spp.) seem to be peaceful everywhere that the two species coincide (Struhsaker & Gartlan 1970; cf. Gartlan & Gartlan 1973; Pruetz & Marshack 2009). This holds despite the fact that their dietary ranges overlap greatly, but inter-species competition seems to be ameliorated by their different habitat and food preferences, as studied in detail elsewhere (Nakagawa 1999). Harrison (1983a) showed that every plant taxon exploited by patas also was eaten by green monkeys; thus, any ecological segregation between the species was likely to be quantitative, not qualitative.

Only in southeastern Senegal are patas sympatric with chimpanzees. We saw no contacts between the two species at Assirik (McGrew *et al.* 2014), but at nearby Fongoli the predator-prey relationship is clear, as chimpanzees prey on patas (Pruetz & Marshack 2009). At Assirik we saw patas and chimpanzees use the same waterhole on the same days, but at different times.

Patas everywhere seem to be relatively quiet (Hall 1965; Gartlan & Gartlan 1973), and Assirik's population is no exception. None of the calls that we heard at Assirik was unique (for our 'squeal', see 'scream-squeal' at Waza, Gartlan & Gartlan 1973; for our 'growl', see 'nyow' call and 'bark-grunt' at Laikipia, Enstam & Isbell 2002).

Patas diet seems to be much the same everywhere, emphasising insects and reproductive plant parts, such as fruit or seeds (Hall 1965; Nakagawa 1989, 1999, 2000, 2003; Isbell 1998). The importance of grass in the patas diet is unclear, being largely absent in some populations but more important elsewhere (Hall 1965). At Kala Maloue, patas harvested insect larvae from grass stems (Nakagawa 1999). Daily rhythms in feeding and drinking resembled those of patas elsewhere (Hall 1965; Nakagawa 1989).

Patas seem to drink every day if possible (Gartlan 1975; Nakagawa 1999), but some studies never saw drinking, even over many days of observation (Hall 1965). Gartlan (1975) reported multiple deaths from dehydration, when waterholes dried up. Some studies are complicated by the availability of artificial water sources, especially stock tanks (Isbell & Chism 2007; Burnham & Riordan 2012); even natural waterholes may be improved by human excavation (Struhsaker & Gartlan 1970). At Assirik, the saving grace for the patas are the steep-sided, narrow gorges formed by erosion of faults in the laterite plateaux; these offer year-round water long after exposed areas have dried out. These water sources are the reason that patas venture into closed canopy gallery forest, as otherwise these areas are avoided (cf. similar recessed water source amongst boulders, Chism & Rowell 1988). Patas at Laikipia avoid forested areas, which present the highest risk of encountering leopards, but sometimes the need for water overrides this preference (Burnham & Riordan 2012). We saw none of the crowded, multi-species aggregations at waterholes that were commonplace at Waza (Struhsaker & Gartlan 1970).

At Assirik, vegetation types intermediate between grassland and woodland seem to be favoured by patas, especially ecotone at plateau edges. Grassland at Assirik comes in two forms: tall, dense, monospecific stands of 'elephant grass' in low-lying basins are avoided, while swathes of short (< 75 cm tall) grass on plateaux are not. Plateau grassland is easily scanned by going bipedal (Enstam & Isbell 2004). Penetration into woodland seems to be minimal, temporary and largely enforced by disturbance. Closed-canopy forest seems to be avoided everywhere by patas (Hall 1965; Chism & Rowell 1988; Nakagawa 1999; Enstam & Isbell 2002). Overall, the driving force behind patas monkey habitat use seems to be carnivore predation, perhaps especially from leopards in forest (Enstam & Isbell 2002, 2004; Burnham & Riordan 2012).

Social organisation of Assirik patas mirrors that found elsewhere: one-male-multi-female breeding groups, all-male groups of adults and subadults, and solitary adult males (Hall 1965; Gartlan & Gartlan 1973; Chism & Rowell 1986; Nakagawa 1999; cf. Ohsawa 2003). In both East and Central Africa, males immigrate into groups during the breeding season (Chism & Rowell 1986; Ohsawa *et al.* 1993), but we had too few data to corroborate this at Assirik.

Assirik's breeding groups were smaller than the averages elsewhere, at 12/13 members (Hall 1965; Struhsaker & Gartlan 1970, Galat-Luong *et al.* 1994; cf. Nakagawa 1999; Enstam & Isbell 2002; Isbell & Chism 2007), as was the upper range of sizes (Struhsaker & Gartlan 1970; Galat-Luong *et al.* 1994). Size and age-class composition of all-male groups was as elsewhere (Gartlan & Gartlan 1973; Gartlan 1975; Galat-Luong *et al.* 1994). Population density is hard to calculate in a mosaic habitat, but both figures computed here fall within patas norms elsewhere.

All in all, we found that Assirik patas are much like their counterparts in East and Central Africa. Only longer-term detailed study of habituated monkeys that can be followed all day at Assirik will reveal if some of the differences noted here, such as in progression order, interaction with jackals, small group size, are real or not.

## ACKNOWLEDGEMENTS

We thank: B Alexander, P. Baldwin, J. Anderson, S. Broadbent, R. Byrne, S. Chambers, S. Hall, M. Harrison, S. Harrison, N. Orbell, M. Sharman, E. Starin, C. Tutin, and A. Whiten for collecting opportunistic data on patas monkeys; S. Brewer, M. Fernandez, G. Gandini, C. Lucazeau, P. Marty, and R. Savinelli for assistance in the field; Service des Parcs Nationaux for permission to do research in the Parc National du Niokolo-Koba and Delegue General de Recherche Scientifique et Technique for permission to do research in Senegal; American Philosophical Society, Carnegie Trust for the Universities of Scotland, LSB Leakey Foundation, Science Research Council (UK), Wenner-Gren Foundation for Anthropological Research, and University of Stirling for research funding for field work; Leverhulme Trust for supporting analyses of these data; three reviewers for helpful comments; C. Tutin for French summary.

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*Received:* 12 August 2013
*Accepted:* 12 June 2014

*African Primates* 9:45-50 (2014)

Brief Communication:

# Vaginal Prolapse in a Handicapped, Multiparous Wild Chimpanzee in Budongo Forest Reserve, Uganda

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**Abstract**: The propensity of human females to develop vaginal prolapse is related to age, number of births, neonatal birth weight, genetics and other factors. Here, we report on a vaginal prolapse in a 33-year old, multiparous, handicapped wild chimpanzee (*Pan troglodytes schweinfurthii*), following her sixth delivery. Compared to the other 22 parous females of the Sonso community, the subject exhibited a high number of births within a short time period. Thus, the possible cause for her condition may have been the high number of vaginal births combined with the size and weight of the neonate. Additional possible factors not investigated here are: the impact of prolonged stage-two labour, persistent straining and genetic factors. The female fully recovered within 15 days and exhibited no unusual behavioural patterns or physiological abnormalities during recovery. We conclude that vaginal prolapse is not restricted to humans but also occurs in our closest relatives, the chimpanzees.

**Key words: *Pan troglodytes schweinfurthii,* vaginal prolapse, parity, health monitoring, Budongo Forest Reserve**

## INTRODUCTION

Vaginal prolapse is a clinical condition characterised by bulging of the top of the vagina into the lower vagina or outside the opening of the vagina due to disruption in the functionality and strength of the levetar ani muscles, endopelvic fascia and ligaments or the uterosacral–cardinal ligament complex (Otto *et al.* 2002; Hunskaar *et al.* 2005; Cole *et al.* 2006). Here, we report on a handicapped adult female chimpanzee of the habituated Sonso community of Budongo Forest Reserve, Uganda, which developed a vaginal prolapse following her sixth delivery. To our knowledge, this condition has not been reported in wild chimpanzees. Our observations suggest that our closest living relatives, the chimpanzees (*Pan troglodytes*), can also suffer from a condition that so far has only been studied in humans and more distantly related animals (rhesus macaques: Otto *et al.* 2002; Shahryarinejad & Vardy 2008; squirrel monkeys: Couri *et al.* 2012; rats: Moalli *et al.* 2005a). Our findings also have implications for veterinarian decisions relating to the management of vaginal prolapse in wild chimpanzees, specifically whether or not intervention should be considered.

### Case description

Our subject, Kalema (KL), was an adult female chimpanzee, first identified on 28 April 1992 at an estimated age of about 13 years. Most likely, she had immigrated into the Sonso community around that time since habituation of this community for

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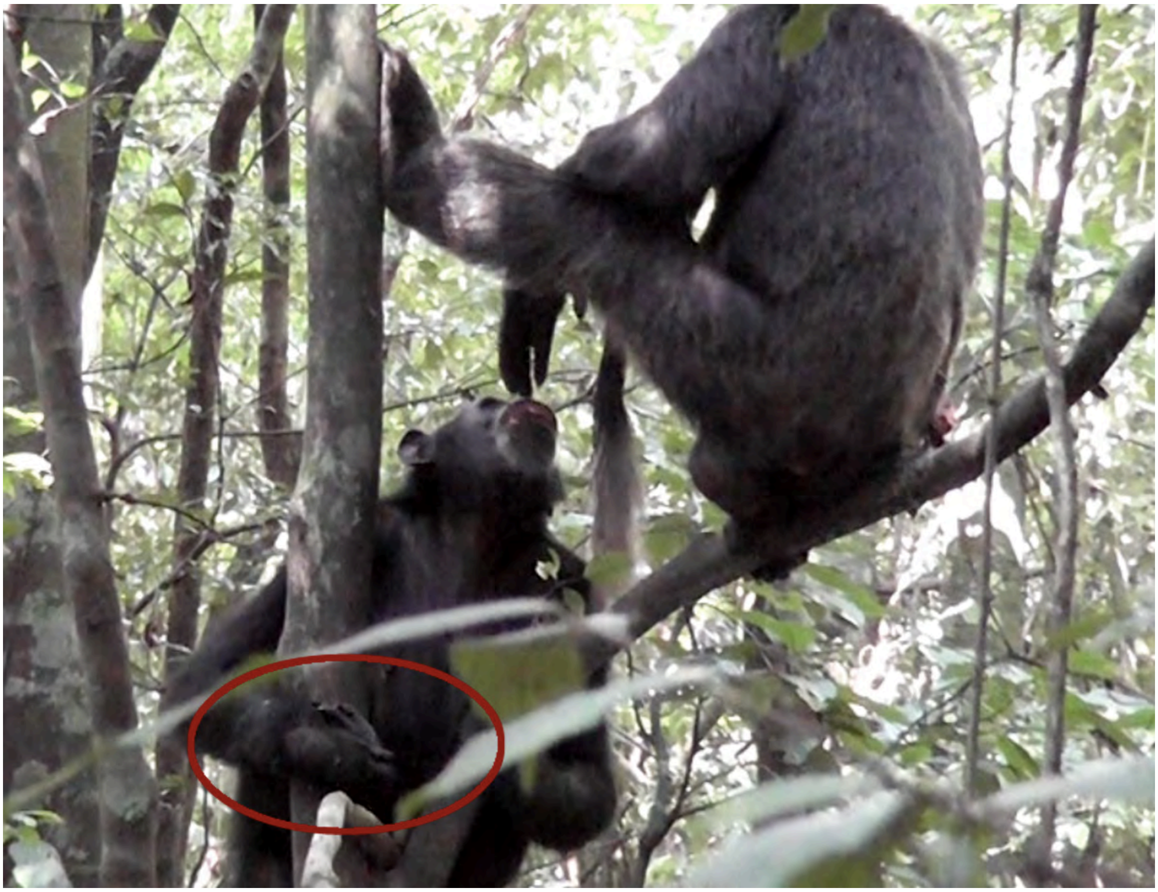

**Figure 1.** The focal animal, Kalema (KL), a 34-year old, multiparous female of the Sonso community, Budongo Forest, Uganda, interacting with another group member. KL is severely handicapped by a hairless, inwardly hooked right hand, caused by a snare injury. Photograph by B. Fallon.

research had started in 1990. However, identification of individuals was gradual so it is possible that she had been part of the community for a longer time. Her hairless, inwardly hooked right hand caused by a snare injury (Figure 1) made her identification easy. KL had her first infant at the estimated age of 14, followed by five more vaginal deliveries (Table 1). She lost two of her infants immediately after birth, which contributed to her short inter-birth intervals. As a consequence, KL was the first multiparous female in the Sonso community to deliver six infants by the age of 33 years (Figure 2).

On 12 September 2012, eight months after having tested positive for pregnancy, KL was seen carrying her sixth infant. The infant was estimated to weigh approximately 2.5 kg, based on the size of another female's infant that had been killed within 24 hours after birth by another group member. On that occasion, an exact weight was obtained and, therefore, visual comparison could be made

**Table 1. Parity history of the adult female chimpanzee, Kalema (KL).**

| Birth | Infant Name | Infant Sex | Comment |
|---|---|---|---|
| Dec 1993 | Unnamed | Unknown | Disappeared, cause unknown |
| Dec 1994 | Bahati | Female | Emigrated |
| Sept 2000 | Kumi | Female | Emigrated, occasional re-visits |
| Sept 2005 | Unnamed | Unknown | Disappeared after 2 weeks, cause unknown |
| Sept 2006 | Klauce | Male | Present in community |
| Sept 2012 | Unnamed | Female | Died after 1 day, cause unknown |

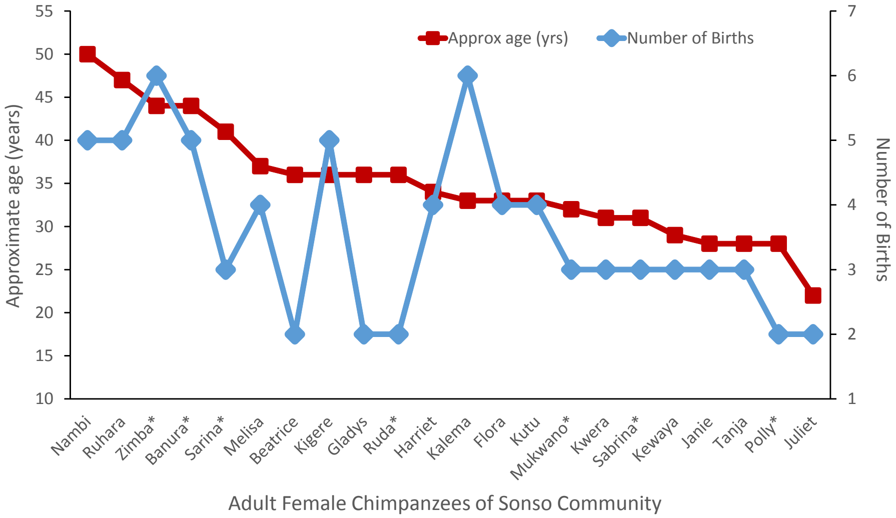

**Figure 2.** Graphical representation of the Sonso multiparous female chimpanzees according to age and number of births by 2012. *Subject was deceased by 2012.

(Asiimwe 2012; average birth weight = 1.78 kg; Morais 2013). We also noticed bloody mucoid discharge from KL's genital area, which she cleaned off with leaves, suggesting that the infant was born on the same morning or during the previous night. KL's genital area was bulging and we initially assumed this was caused by the placenta. Upon closer inspection it became apparent that the vaginal wall was protruding with the area very inflamed and congested. Due to her posture, additional pressure was exerted on the prolapsed vagina, which made it look extremely turgid (Figure 3). We were unable to identify the cause of the prolapse but it may have been related to her having a history of frequent vaginal births or the apparently large size of her infant. Other possible explanations are: prolonged second stage of labour, repetitive straining caused by constipation, or genetic factors.

We decided against medical intervention, which would have necessitated invasive chemical restraint followed by surgery, and instead opted for non-invasive observational data and sample collection to monitor the natural progress of the condition. To this end, we collected general behavioural data, faecal samples to estimate body temperature, and urine to test for liver, kidneys and metabolic function, level of infection, dehydration and pH.

In all, 18 urine samples were collected and analysed using URIPATH urinary dip-stick tests (Plasmatec Laboratory Products LTD, UK) in the field from 12th to 26th September 2012 (n=9 early morning, n=9 mid-morning).

We found blood in KL's urine on day 1 postpartum, which we considered normal. Urine samples of subsequent days were negative for blood. From day 1 to 5 postpartum,

**Figure 3.** Kalema's vaginal prolapse during the early stages. The vaginal wall was turgid and prone to bleeding on day 2. Photograph by M. Laporte, BCFS.

proteins were at trace levels, probably due to her recent pregnancy or the increased physical activity during parturition, suggesting that kidney function was normal. KL started testing positive for leucocytes on day 3 postpartum, perhaps due to an infection in relation to her prolapsed vagina. Leucocyte concentration was higher in the early morning samples (n=5) compared to the mid-morning ones (n=5). All samples were negative for glucose, ketones, urobilinogen, bilirubin and nitrites. The specific gravity measurements were between 1.000 and 1.005. pH was alkaline with an average of 9.0 (range between 8 and 9). From day 6 to 15 post-partum all samples were negative or within the normal range (Leendertz *et al.* 2010).

KL's average faecal temperature was 36.6°C, thus within the normal range of 35.5 - 37.8°C (Jensen *et al.* 2009). This suggested that the infection was localised to the prolapsed vagina, rather than having caused a systemic infection, which could have resulted in pyrexia.

KL continued to behave normally in terms of her basic behaviour, such as feeding, locomotor activity, and vocalization. Her social behaviour also remained normal as she continued to travel with the main group, including the alpha male. However, she was observed several times to drink water with the use of a leaf-sponge, a relatively rare behaviour in healthy chimpanzees, and to have longer rest periods compared to other individuals.

We continued to monitor the vaginal wall and found that it lost its turgidity on day 6. On day 8, we noticed localised areas of necrosis but the vaginal wall had started to retract. By day 12, only a small swelling was seen at the vulva and full recovery was recorded on day 15.

## DISCUSSION

We have described an unusual case of vaginal prolapse in a free-ranging chimpanzee. Although chimpanzees have been observed for decades in the wild, we are not aware of any published records of a vaginal prolapse, although this could have been due to the lack of veterinary expertise of primate field researchers.

In humans, vaginal prolapse is caused by ligament weaknesses, which has been associated with high numbers of vaginal childbirths, advanced age, and high body-mass index as the most common risk factors (Hendrix *et al.* 2002; Schaffer *et al.* 2005; Swift *et al.* 2005; Kudish *et al.* 2009; Slieker-ten Hove *et al.* 2009). Compared to nulliparous women, the relative risk increases by a factor of 8.4 for women with two children, and by 10.9 for women with four or more children (Swift *et al.* 2005). In fact, because she has suffered early infant death in two cases, KL has had the highest number of pregnancies and vaginal births of all multiparous females in the Sonso community (Figure 2). Another possible contributing factor to her condition is the apparently large birth weight of her infant. The average neonate birth weight in chimpanzees has been determined at 1.78 kg (Morais 2013), indicating that KL's infant, estimated to be approximately 2.5 kg, was considerably overweight, which may have contributed to the vaginal prolapse. Other known risk factors in humans include prolonged second stage labour and repetitive straining (Chiaffarino *et al.* 1999; O'Boyle *et al.* 2002; Schaffer *et al.* 2005; Drutz & Alarab 2006). For wild chimpanzees, it is difficult to collect the relevant data to study these contributing factors, since females tend to give birth in tree nests and at night.

In humans, the ligaments eventually recover due to collagen scarring, but the connective tissue responsible for pelvic support can become elongated with reduced elasticity and strength, due to weaker type-3 collagen (Yamamoto *et al.* 1997; Kökçü *et al.* 2002; Moalli *et al.* 2005b). Whiteside *et al.* (2004) also found that women who had had a prolapse were likely to relapse after surgery with an odds ratio of 3.2. If these processes also play a role in chimpanzees, then a recurrence of a prolapse during KL's next delivery is likely.

In humans, vaginal prolapses are usually managed surgically (Randall & Nichols 1971; Adams *et al.* 1985; Morley & DeLancey 1988; Sauer & Klutke 1995). In our case, we opted against intervention because of the dangers associated with the use of anaesthetics and surgery in the field. Specifically, after delivery chimpanzee females may not be strong enough to cope with surgical intervention. Moreover, there is a considerable risk of hostile responses from other group members to anaesthetised individuals (and toward the human involved in the intervention). As a high-ranking group member, KL was almost always associated with other group members, including the alpha male, and it would have been very difficult to treat her in isolation. In addition, KL had a six-year old offspring that was still dependent, which would have complicated matters. For these reasons, we decided against surgical intervention and in favour of non-invasive monitoring. The favourable outcome suggests that surgical intervention can be avoided in wild chimpanzees.

## ACKNOWLEDGEMENTS

We acknowledge the Uganda Wildlife Authority, the National Forest Authority and the Uganda National Council for Science and Technology for supporting our research and conservation activities at the Budongo Conservation Field Station (BCFS). We are thankful to the Royal Zoological Society of Scotland (RZSS) for providing core funding for the station. The 'Chimpanzee Health Monitoring Programme' in the Albertine Rift has been funded by the ARCUS foundation, the Great Ape Conservation Fund of the U.S. Fish & Wildlife Department and APE Tag, for which we are very grateful. We thank the Oakland Zoo for funding the snare removal program. Finally, we would like to thank our partners in the region, particularly the Jane Goodall Institute Uganda and the other chimpanzee study sites across the Albertine Rift. We thank the BCFS staff and management, our field assistants, the veterinary team and all researchers at BCFS for their support.

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*Received:* 6 July 2013
*Accepted:* 19 August 2014

*African Primates* 9:51-56 (2014)

Brief Communication:

# Toward Taking the Front Seat in African Great Ape Conservation

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## BACKGROUND

Africa is home to four of the six extant species of great apes: bonobo (*Pan paniscus*), chimpanzee (*Pan troglodytes*), Western gorilla (*Gorilla gorilla*) and Eastern gorilla (*Gorilla beringei*). Across their range these animals, our closest relatives, are facing increasing threat of extinction (Kormos *et al.* 2003; Bakarr *et al.* 2004; Hicks *et al.* 2010; Plumptre *et al.* 2010; Morgan *et al.* 2011; ICCN & IUCN 2012; Mittermeier *et al.* 2012; Dunn *et al.* 2014), their fate highly depending on the anthropomorphic pressure. Many hold the view that the long term conservation of African great apes lies largely in the hands of Africans (Adams & McShane 1997; Nelson 2012). Fulfilling this obligation requires that Africans, especially upcoming researchers and conservationists, must become more actively involved and even lead efforts to protect what still remains of African great apes and their habitat.

While it is encouraging that an increasing number of young Africans are taking greater interest in great ape research and conservation, and making valuable contributions, a lack of information sharing and coordination limits effectiveness. In an effort to address this problem, a “Gorillas Across Africa” workshop was held in 2011 in Ruhija, Uganda, organized by Dr. Martha Robbins of the Max Planck Institute for Evolutionary Anthropology and Dr. Richard Bergl of North Carolina Zoo (Imong *et al.* 2011). This workshop brought together early to mid-career professional researchers and conservationists from gorilla range countries and provided a platform for them to share their work and develop professional relationships that would promote gorilla research and conservation. Building on the success of this first effort, a second workshop was held in Musanze, Rwanda, in 2012, with increased participation (Ndagijimana *et al.* 2013). With growing interest in the forum, the “Gorillas Across Africa” workshop evolved into “Apes Across Africa” workshop which was held from 26th to 30th of May 2014 at the Lesieux Hotel in Fort Portal, Uganda. This broader meeting, organized by Cleveland Metro-parks Zoo, Dian Fossey Gorilla Fund International, Max Planck Institute for Evolutionary Anthropology and North Carolina Zoo, and partially funded by Arcus Foundation, was attended by 48 African great ape researchers and conservationists from 14 range countries: Cameroon, Central Africa Republic (CAR), Democratic Republic of Congo (DRC), Gabon, Ghana, Ivory Coast, Liberia, Nigeria, Republic of Congo, Rwanda, Senegal, Sierra Leone, Tanzania and Uganda (Figure 1).

## WORKSHOP

The workshop was opened by the Deputy Director of Conservation at the Uganda Wildlife Authority, Mr. Charles Tumwesigye (the 2013

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**Figure 1.** Participants at the 2014 Apes Across Workshop, Fort Portal, Uganda. Photograph by O. Doumbé.

recipient of National Geographic Buffet Award for leadership in conservation) who gave an overview of wildlife conservation in Uganda with a focus on great apes. While acknowledging that many challenges remain, he also highlighted the success recorded in great ape conservation in Uganda in the past two decades, which saw an increase in the number of great apes. Other presentations highlighted conservation education projects targeting children, and ape-based tourism as areas where successes have been recorded (Figure 2). The increasing habituation of chimpanzees and gorillas for tourism in the DRC, Republic of Congo, the CAR, Uganda and Tanzania was cited as indication of the success of great ape-based tourism in Africa. Revenues from great ape viewing and tracking have provided significant incomes for the management of protected areas, especially in East Africa, as well as the populations surrounding these protected areas. Bold law enforcement initiatives such as LAGA (Last Great Ape organization) were identified as holding promise for improving protection of African great

**Figure 2.** Mr. Charles Tumwesigye, Deputy Director of Conservation, Uganda Wildlife Authority gives the opening lecture of the meeting. Also note that some participants are wearing headphones as simultaneous French/English translation was provided to help bridge language boundaries among the participants from 14 countries. Photograph by O. Doumbé.

apes. In total, 38 presentations were made covering a wide range of topics, including:

- Research, surveys and monitoring
- Threats, disease, and health
- Tourism and community-based conservation
- Conservation education and capacity building
- Law enforcement and protected area management

From the presentations a number of challenges to great ape conservation in Africa were identified and discussed, affording participants the opportunity to learn about how shared challenges were addressed in other regions or sites. While a few of the challenges identified were region-specific, many were shared throughout the range of African great apes:

- Bushmeat hunting and trade, and associated disease risks
- Unfavorable political climate and unrest
- Corruption and poor governance
- Weak law enforcement
- Rapidly growing human population
- Poor infrastructure (e.g., poor state of roads limiting access to conservation sites)
- Oil exploration, logging and extraction of other natural resources
- Increasing habituation of great apes for tourism
- Lack of harmonized research methods
- Low capacity for great ape research and conservation
- Human-great ape conflict (crop raiding, attacks, and disease transmission between great apes and humans)
- Increasing isolation of protected areas (need for intervention in surrounding areas)
- Lack of opportunities for alternative livelihood activities for local communities and negative attitude to conservation

It was recommended for future meetings to focus on a specific identified challenge and conduct a more detailed analysis of it with a view to identifying practical solutions and making concrete recommendations to policy makers and conservation managers.

## FIELD VISITS

A field trip to the Makerere University Biological Field Station (MUBFS) in Kanyawara was organized. This provided a great opportunity for participants to learn about the value of long-term research for conservation. The visit was especially useful for participants from countries or sites where long-term research such as that conduced at MUBFS has yet to be established. The visit also provided the opportunity for participants to observe some diurnal primates of Kibale National Park including Western guereza (*Colobus guereza occidentalis*), olive baboons (*Papio anubis*), Schimdt's red-tailed monkey (*Cercopithecus ascanius schmidti*) in their natural habitat. During another field trip, some participants tracked habituated chimpanzees (*Pan troglodytes schweinfurthii*). The experience served as motivation for participants from regions where protected areas are less well managed and direct observations of wildlife are rare. Participants also visited the Bigodi community forest managed by the Kibale Association for Rural and Environment Development (KAFRED) for conservation and community development through tourism. At Bigodi village, participants visited three community projects implemented under the Uganda and North Carolina International Teaching for the Environment (UNITE) program. The first was a project testing different fuel-wood efficient cooking stoves for adoption by households (Figure 3). An encouraging number of households in Bigodi village have already adopted these improved cooking stoves, requiring less firewood. If widely adopted, these stoves could drastically reduce the fuel-wood needs of local communities and therefore ease pressure on the park. The second was a beekeeping project aimed at building the capacity of the local people to produce honey for both household consumption and income generation (Figure 4). The third, called "keyhole garden", was a backyard-gardening project aimed at reducing land requirements and improving crop yield (Figure 5).

At Bigodi Secondary School participants met a "Great Ape Super Hero", a highly motivated student of the school so recognized for his exemplary active participation and interest in great ape conservation education activities around Kibale National Park who is helping to inspire other students. With increasing human pressure on great ape habitat, it is critical to build the capacity of local people and to support them to engage in alternative livelihood activities. The knowledge gained from visiting these projects would help participants develop similar projects at their sites.

## FUTURE OUTLOOK

Encouraging results of new surveys on poorly known ape populations [such as the critically endangered Cross River gorilla (*Gorilla gorilla*

**Figure 3.** A demonstration fuel-efficient stove in Bigodi village being promoted in communities around Kibale National Park to reduce to reduce pressure on the Park. Photograph by O. Doumbé

**Figure 4.** A beehive at the Bigodi Primary School bee-keeping project. Photograph by O. Doumbé.

**Figure 5.** "Keyhole Garden" at Bogodi village, Uganda. Photograph by O. Doumbé

*diehli,* Figure 6) and the Nigeria-Cameroon chimpanzee (*Pan troglodytes ellioti*)] and other new findings of their ecology, behavior and health were presented by enthusiastic young African primatologists. Passionate presentations from representatives of community-based organizations, such as the young Mbou-Mon-Tour NGO in the DRC, also demonstrated the growing interest of Africa's new generation for the conservation of great apes.

Another positive outcome from this workshop was a proposal by participants to form a professional group or society to promote African great ape research and conservation. Such a group/society was described as necessary to provide a platform for building and strengthening professional relationships and collaborations to advance great ape research and conservation in Africa. A discussion about forming a continental primate society styled after the International Primatological Society (IPS) was also started at the IPS conference in Cancun, Mexico in 2012 in recognition of the poor representation of Africans at the conference and, therefore, a lack of a strong African voice. Perhaps these two proposed groups could be merged since they both would serve the same overall goal. The formation and establishment of such a group would greatly benefit great ape conservation in Africa.

If the passion, energy, interest and enthusiasm displayed at this Apes Across Africa Workshop is anything to go by, one could say Africans are hungry for a front seat in the efforts to save their heritage and some of the world's most magnificent creatures.

## ACKNOWLEDGEMENTS

We thank Dr. Martha Robbins, Dr. Richard Bergl, Dr. Kristin Lukas, Dr. Tara Stoinski, Michelle Slavin, and Tinka John for organizing the workshop and for providing comments on this report. This workshop was kindly funded by the Max Planck Institute for Evolutionary Anthropology, North Carolina Zoo,

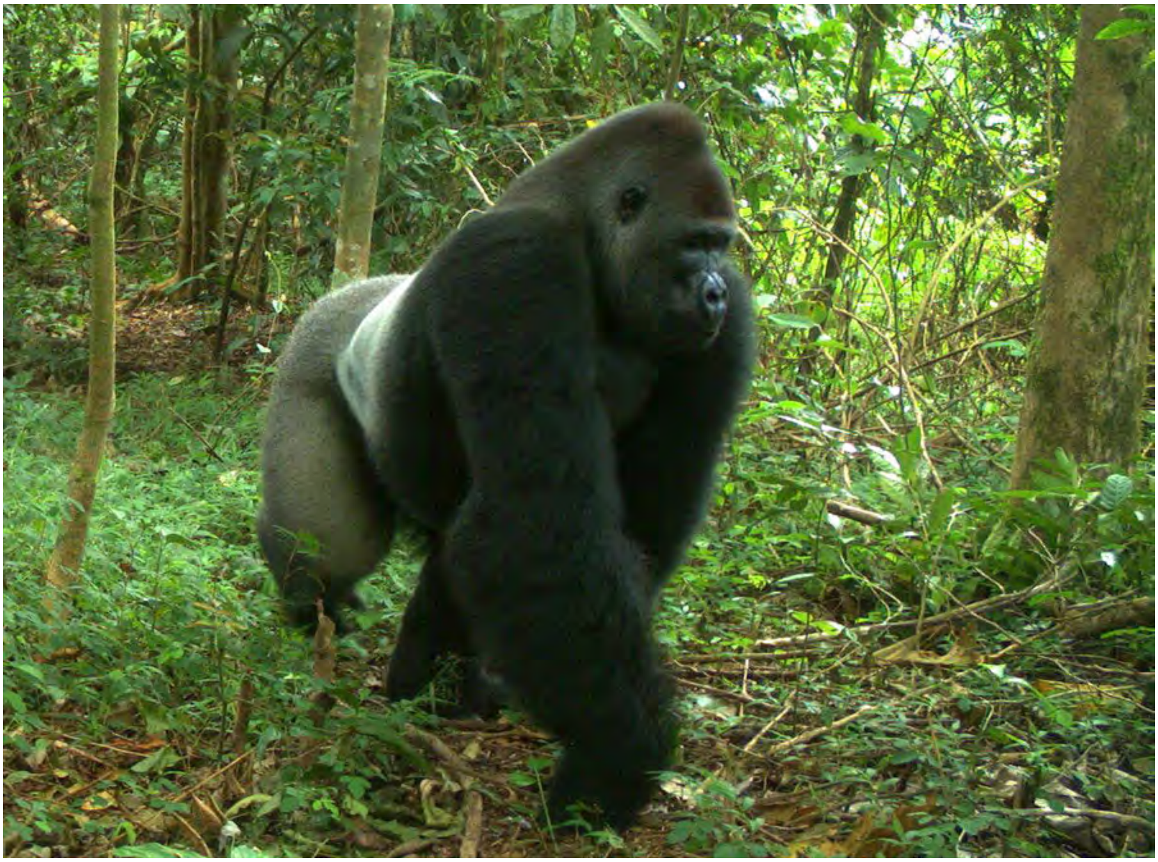

**Figure 6.** A Cross River Gorilla (*Gorilla gorilla diehli*) in the Afi Mountain Wildlife Sanctuary in Nigeria. Photograph courtesy of WCS Nigeria Program (camera trap).

Cleveland Metroparks Zoo, the Dian Fossey Gorilla Fund International, and Arcus Foundation. Thanks also to Uganda Wildlife Authority, the Uganda and North Carolina International Teaching for the Environment (UNITE) Program, Bigodi Primary School, and the Makerere University Biological Field Station in Kanyawara for their warm hospitality during our field visits.

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*African Primates* 9:57-60 (2014)

Brief Communication:

# Industrial Oil Palm Expansion in Great Ape Habitat in Africa

## A Policy Statement from the Section on Great Apes (SGA) of the IUCN SSC Primate Specialist Group

We, the members of the Section on Great Apes (SGA) of the IUCN SSC Primate Specialist Group, are a team of experts engaged in research, management, monitoring and conservation of the great apes. Although we recognize the importance of the oil palm industry for socio-economic development, we are deeply concerned that the rapid development of industrial-scale oil palm (*Elaeis guineensis*) plantations in tropical Africa at the current time is taking place in the absence of strategic land-use planning and without sufficient consideration for the negative environmental and social impacts it can cause.

In Sub-Saharan Africa there are two subspecies of western gorilla *Gorilla gorilla* (the western lowland gorilla *G. g. gorilla* and the Cross River gorilla *G. g. diehli*), two subspecies of eastern gorilla *Gorilla beringei* (the mountain gorilla *G. b. beringei* and Grauer's gorilla *G. b. graueri*), and two species of chimpanzee, the bonobo *Pan paniscus*, and the robust chimpanzee *Pan troglodytes*. The robust chimpanzee has four recognised subspecies: the eastern chimpanzee *P. t. schweinfurthii*; the central chimpanzee *P. t. troglodytes*; the western chimpanzee *P. t. verus;* and the Nigeria-Cameroon chimpanzee *P. t. ellioti*.

All African apes are highly threatened by poaching, deforestation and habitat loss, and disease. The mountain gorilla and both western gorilla subspecies are Critically Endangered, while Grauer's gorilla and all chimpanzee species and subspecies are Endangered.

In South-east Asia, the establishment and expansion of oil palm plantations endangers wildlife and results in the direct killing of orangutans and even the local extinction of their populations. Large-scale agro-industrial development has caused deforestation, forest fragmentation, peatland degradation, biodiversity loss, forest fires, carbon dioxide emissions, and a range of social issues. Oil palm is the most productive (per hectare) commercially grown vegetable-oil crop, but despite this, the economic benefits of oil palm development for tropical countries are offset by negative and costly impacts on the environment. The SGA believes that many of these negative impacts are avoidable or could be mitigated.

The SGA calls for the appropriate national authorities and national and international stakeholders to insist that plantation development in Africa is undertaken in a manner that ensures equitable economic development, poverty alleviation, and the maintenance of ecological

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integrity. This includes avoiding forested areas that contain populations of chimpanzees, bonobos or gorillas.

Based on the spirit of agreement in the Kinshasa Declaration on Great Apes[1], we also urge:

- African government institutions to undertake national and transnational strategic spatial-planning to maximize economic returns without jeopardizing environmental resources and functionality;
- African government institutions to create policy frameworks, supported by relevant legal instruments, to ensure that environmental and social concerns are sufficiently addressed in all agricultural and industrial development projects;
- African government institutions and producers to establish new concessions and expand existing concessions in degraded ecosystems that can be considered "long-term degraded" – land that is ecologically degraded, principally through anthropogenic activity such as agricultural expansion, and which has resulted in a reduction in vegetation cover, standing biomass or species diversity[2]; incapable as such of supporting significant populations of great apes[3];
- Producers to consistently comply with relevant social and environmental laws;
- Producers to comply with the Roundtable on Sustainable Palm Oil (RSPO) initiative by becoming members of RSPO, implementing and operationalizing the RSPO Principles and Criteria (P&C), and protecting High Conservation Values (HCV) and High Carbon Stocks (HCS) through comprehensive assessments that are third-party peer reviewed by internationally accredited reviewers and made accessible for public scrutiny;
- Government institutions to support this process by suspending oil palm concession development until HCV and HCS areas are identified;

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[1] GRASP. 2005. The Kinshasa Declaration. Great Ape Survival Partnership (GRASP), United Nations Environment Programme (UNEP), Nairobi. www.cites.org/eng/news/sundry/2005/kinshasa_declaration.pdf <http://www.cites.org/eng/news/sundry/2005/kinshasa_declaration.pdf>

[2] Existing methodology for the identification of degraded lands for sustainable agricultural expansion should be used and developed.

[3] This definition of "long-term degraded" does not include secondary forest, forest that has been selectively logged, or recently cleared/degraded land or land that has not qualified as High Carbon Stock forest, since at least one African great ape, the chimpanzee, may use such forest. Instead, it refers to land where oil palm development would not have negative impacts on biodiversity and ecosystem integrity in general, and may even contribute to a partial recovery of some ecological functions.

- Producers to implement and enforce NO KILL policies for great apes and other wildlife in their concessions;
- Producers to take responsibility to not just set aside HCV and HCS forest, but to also facilitate effective protection of these forests and their wildlife, requiring governments, therefore, to develop regulatory frameworks that makes such protection possible;
- Purchasers of crude palm oil (CPO) originating or operating from Africa to undertake due diligence in identifying the source companies and plantations of the product they are buying, and demand these companies provide evidence that their permits are fully legal and they are operating in full compliance with all relevant national laws;
- Purchasers to preferentially select RSPO-certified producers and to be transparent with regard to the companies from which they are purchasing CPO, and to make such information available to the public;
- Financial institutions to terminate partnerships with producers that are not RSPO compliant, unless they are using other internationally-recognized standards such as IFC Performance Standards; and
- The Roundtable on Sustainable Palm Oil (RSPO) to monitor existing P&C, strengthen protocols and procedures, and engage independent third-party auditors/reviewers to review RSPO-approved HCV assessments.

Further, we urge government organizations, the Interprofessional Palm Oil Association (AIPH), and other palm oil advocacy groups to work with IUCN and other partners to strengthen current RSPO standards and identify important conservation areas to be exempt from oil palm development in Africa.

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**Photo credits:**

A chimpanzee feeding in a wild oil palm in natural forest, Gombe National Park, Tanzania © Michael L. Wilson

Oil palm plantation in Guinea © Tatyana Humle

Plantation of young oil palms adjacent to natural forest © Fauna & Flora International

*African Primates* 9:61-64 (2014)

Brève Communication:

# L'expansion de la Culture Industrielle de Palmier à Huile dans l'Habitat des Grands Singes en Afrique

## Déclaration de Principes du Groupe de Spécialistes des Primates de la CSE/UICN

Nous, membres de la section sur les grands singes (SGS) du Groupe de spécialistes des primates de la CSE/UICN, formons une équipe d'experts impliqués dans la recherche, la gestion, le suivi et la conservation des grands singes. Bien que nous reconnaissions l'importance de l'industrie du palmier à huile pour le développement socioéconomique, nous sommes profondément préoccupés par le développement rapide des plantations industrielles de palmier à huile (*Elaeis guineensis*) actuellement observé en Afrique tropicale, qui a lieu en l'absence de toute planification stratégique et d'une prise en compte suffisante de leurs impacts négatifs potentiels environnementaux et sociaux.

L'Afrique subsaharienne abrite deux sous-espèces de gorille de l'Ouest *Gorilla gorilla* (le gorille de plaine de l'Ouest *G. g. gorilla* et le gorille de la rivière Cross *G. g. diehli*), deux sous-espèces de gorille de l'Est *Gorilla beringei* (le gorille de montagne *G. b. beringei* et le gorille de Grauer *G. b. graueri*) et deux espèces de chimpanzés, le bonobo *Pan paniscus* et le chimpanzé commun *Pan troglodytes*. Le chimpanzé commun a quatre sous-espèces reconnues: le chimpanzé de Schweinfurth *P. t. schweinfurthii*; le chimpanzé d'Afrique centrale *P. t. troglodytes*; le chimpanzé d'Afrique occidentale *P. t. verus* et le chimpanzé du Nigeria-Cameroun *P. t. ellioti*.

Tous les grands singes africains sont fortement menacés par le braconnage, la déforestation, la disparition de l'habitat et les maladies. Le gorille de montagne et les deux sous-espèces de gorille de l'Ouest sont en danger critique d'extinction tandis que le gorille de Grauer et toutes les espèces et sous-espèces de chimpanzé sont dans la catégorie « en danger ».

En Asie du Sud-Est, l'établissement et l'expansion des plantations de palmier à huile mettent en péril la faune et la flore sauvages, entrainant l'abattage volontaire d'orangs-outans voire une extinction locale de leurs populations. Le développement agroindustriel à large échelle est une source de déforestation, de fragmentation des forêts, de dégradation des tourbières, de disparition de la biodiversité, de feux de forêts, d'émissions de dioxyde de carbone et d'un ensemble de problèmes sociaux. La culture de palmier à huile est la plus productive (par hectare) d'un point de vue commercial de tous les oléagineux mais ses bénéfices économiques dans les pays tropicaux sont neutralisés par les impacts négatifs et coûteux sur l'environnement. Il est de l'opinion de la SGS que ces impacts négatifs peuvent être évités ou atténués.

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La SGS demandent aux autorités nationales applicables et aux parties prenantes nationales et internationales d'insister afin que le développement des plantations en Afrique soit réalisé de manière à garantir un développement économique équitable, la réduction de la pauvreté et la préservation de l'intégrité écologique. Ceci suppose d'éviter les zones de forêts qui abritent des populations de chimpanzés, de bonobos ou de gorilles.

Dans l'esprit de l'accord contenu dans la Déclaration de Kinshasa sur les grands singes[1], nous exhortons :

- Les institutions gouvernementales africaines à effectuer une planification spatiale stratégique nationale et transnationale afin d'optimiser les rendements économiques sans mettre en danger les ressources et les fonctions environnementales;
- Les institutions gouvernementales africaines à mettre en place des cadres politiques, appuyés par les instruments juridiques applicables afin de répondre de façon adéquate aux préoccupations environnementales et sociales liées aux projets de développement agricole et industriel;
- Les institutions gouvernementales africaines et les producteurs à établir les nouvelles concessions et à étendre les concessions actuelles dans des écosystèmes dégradés, considérés comme « dégradés à long terme », c'est-à-dire des terres dégradées d'un point de vue écologique principalement à cause d'activités humaines telles que l'expansion agricole qui ont réduit la couverture végétale, la biomasse aérienne ou la diversité spécifique[2] et qui ont rendu ces terres inaptes à la présence de populations importantes de grands singes[3];
- Les producteurs à respecter systématiquement les lois sociales et environnementales applicables;
- Les producteurs à se conformer à l'initiative de la Table ronde pour la production durable de l'huile de palme (Roundtable on Sustainable Palm Oil ou RSPO) en devenant membres de la RSPO, en mettant en œuvre et en opération les principes et

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[1] GRASP. 2005. The Kinshasa Declaration. Great Ape Survival Partnership (GRASP), United Nations Environment Programme (UNEP), Nairobi. www.cites.org/eng/news/sundry/2005/kinshasa_declaration.pdf <http://www.cites.org/eng/news/sundry/2005/kinshasa_declaration.pdf>

[2] La méthodologie existante pour l'identification des terres dégradées pour l'expansion durable de l'agriculture doit être utilisé et développé.

[3] La définition de la « dégradation à long terme » n'inclut pas les forêts secondaires, les forêts ayant fait l'objet d'une exploitation sélective, les terres récemment défrichées/dégradées ou les terres qui ne sont pas des forêts riches en carbone car au moins un grand singe africain, le chimpanzé, peut utiliser ces types de forêts. Il s'agit plutôt de terres sur lesquelles les cultures de palmier à huile n'auraient aucun impact négatif sur la biodiversité et sur l'intégrité des écosystèmes en général ou pourraient même contribuer à une récupération partielle de certaines fonctions écologiques.

les critères (P&C) de la RSPO et en protégeant les zones de haute valeur pour la conservation (HVC) et les zones riches en carbone (High Carbon Stock ou HCS) à l'aide d'évaluations détaillées, soumises à l'examen de tierces parties agréées sur le plan international et disponibles à un examen public;

- Les institutions gouvernementales à appuyer ce processus en suspendant la mise en place de concessions de palmiers à huile jusqu'à ce que les HVC et les HCS soient identifiés;
- Les producteurs à mettre en place et à faire respecter des politiques de non élimination des grands singes et d'autres espèces de faune sauvage dans leurs concessions;
- Les producteurs à prendre la responsabilité de ne pas se contenter d'écarter les forêts contenant des HVC et des HCS, mais de faciliter la protection de ces forêts et de leur faune, en demandant aux gouvernements de développer des cadres réglementaires pour permettre cette protection;
- Les acheteurs d'huile de palme brute établis ou opérant en Afrique à effectuer un devoir de diligence pour identifier les compagnies et les plantations d'où proviennent le produit acheté et pour exiger de la part de ces compagnies des preuves de légalité de leurs permis et du respect total de toutes les lois nationales applicables;
- Les acheteurs à sélectionner de préférence des producteurs certifiés RSPO, à faire preuve de transparence en ce qui concerne les compagnies auprès desquelles ils achètent l'huile de palme brute et à mettre ces informations à disposition du public;
- Les institutions financières à mettre fin aux partenariats avec les producteurs qui ne sont pas conformes à la RSPO à moins que ces derniers n'appliquent d'autres normes reconnues internationalement telles que les normes de performance de la SFI; et
- La Table ronde pour la production durable de palmier à huile (RSPO) à effectuer un suivi des P&C existants, à renforcer les protocoles et les procédures et à engager des auditeurs/examinateurs tiers pour revoir les évaluations de HVC approuvées par la RSPO.

En outre, nous exhortons les organisations gouvernementales, l'Association interprofessionnelle de la filière palmier à huile (AIPH) et d'autres groupes de pression pour le palmier à huile à collaborer avec l'UICN et d'autres partenaires au renforcement des standards actuels de la RSPO et à l'identification des zones importantes pour la conservation qui doivent être écartées du développement de la culture du palmier à huile en Afrique.

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**Crédits photographiques:**

Un chimpanzé mangeant des fruits de palmier à huile dans la forêt naturelle, Parc National de Gombe, Tanzanie © Michael L. Wilson

Un plantation de palmiers à huile en République de Guinée © Tatyana Humle

Plantation de jeunes palmiers à huile à côté de la forêt naturelle © Fauna & Flora International

# News

## The African Primates Working Group

We wish to announce the formation of the African Primates Working Group, APWG for short. APWG came out of discussions between Drs. John Oates and David N. M. Mbora at the IPS conference in Cancun Mexico in 2012. After their discussions in Cancun, John and David contacted many potential members by email, and it was quickly evident that there was overwhelming support for such a group. The articles of association of the APWG are yet to be fully codified. But, the Group will provide a forum for exchanging ideas and information on research and conservation of African primates. It is expected that the Group will facilitate the mentoring of Africans who can then become conservation leaders and advocates for nonhuman primates within African governments and society, and across the globe.

The first ever meeting of APWG was convened at the 2014 IPS congress in Hanoi, where it was agreed that the inaugural conference of APWG will be in July 2015. The conference will be in Abidjan, Côte-d'Ivoire, hosted by the Swiss Centre for Scientific Research. The inaugural conference will focus on showcasing research and conservation activities by Africans across the continent. It will also be the forum to discuss and ratify the articles of association for the African Primates Working Group.

Anyone wishing to be included on the mailing list of the APWG should direct a request to Dr. David N M Mbora, dmbora@whittier.edu.

Submitted by APWG interim steering committee.

- Southern Africa: Riashna Sithaldeen, PhD
- Eastern Africa: David N. M. Mbora, PhD.
- Central Africa: Augustin K. Basabose, PhD
- Central Africa: Denis Ndeloh Etiendem, PhD
- Western Africa: Inza Kone, PhD
- Western Africa: Mr. Inaoyom Imong Sunday
- Madagascar: Jonah Ratsimbazafy, PhD.
- North Africa: *vacant*

## IPS Grants and Awards for Primate Work

The International Primatological Society (IPS) has three grant and award programs. See the IPS web site for details about conservation, research, and education grants (be sure you submit applications to the grant program that fits your goal to maximize chances for funding). http://www.internationalprimatologicalsociety.org. **Deadline for most grants: March 1, 2015**.

## Society for Conservation Biology (SCB) Africa Section Communications/E-mentoring Program: Call for Applications

The Africa Section of the Society for Conservation Biology (SCB) is working to maximize through capacity building with a communications/e-mentoring program. A successful pilot of the program occurred from August 2007- March 2008 and its goal is to increase the capacity of African student conservation biologists to publish and disseminate their research in international peer review journals. This is a call for applicants who want to participate in the 2014/2015 phase of the SCB Africa Section Communications/E-mentoring Program. For more information and requirements for would be mentors and mentees e-mail Mary Molokwu (mary.molokwu@gmail.com) or Stephen Awoyemi (sawoyemi@gmail.com). **Deadline for receiving applications is September 15, 2014**.

## The Critical Ecosystem Partnership Fund (CEPF) Programme for the Eastern Afromontane Hotspot announces the 7th and 8th Call for Proposals

The 7th Call is for small grants (up to USD $10,000) in Ethiopia, Kenya, Uganda, Rwanda, Burundi, DRC, Tanzania, Malawi, Zambia, Zimbabwe and Mozambique. For projects that will contribute to the application of site safeguard policies and procedures (from World Bank, Equator Principals, etc.).

**Deadline: Open** (applications can be submitted at any time until further notice)

The 8th Call is for both large grants (of more than USD 20,000) and small grants (of USD 20,000 or less) in Ethiopia, Rwanda, DRC, Tanzania and Zambia. For projects that will contribute to CEPF Strategic Direction 1, Investment Priority 1.1, 1.2 and 1.3; and Strategic Direction 2, Investment Priority 2.1.

**Deadlines: For large grants: Monday 15 September 2014; For small grants: Monday 29 September 2014**.

More information about both calls for proposals is available at: http://ow.ly/zKCzC. - Jean Paul Ntungane.

# News

## 2015 YWCB Award Call for Nominations

The Young Women Conservation Biologist group of the Africa Section of SCB is pleased to announce the call for nominations for the 2015 Young Women in Conservation Biology Award (YWCB). African women are underrepresented in the field of conservation science on the African continent. To help bridge this gap, the Africa Section of SCB created the Young Women Conservation Biologists group in 2005 and established the YWCB award to recognize the achievements of young women in Africa who advance the discipline of conservation biology on the continent. **The deadline to submit nominations and supporting materials for the 2015 YWCB Award is 30 January 2015**. Go to http://www.conbio.org/images/content_2014scholarships/SCB_-_YWCB_Merit_nominations-2015-B_%283%29.doc to download the 2015 YWCB Nomination Form.

The YWCB Award for professional African women is a non-monetary incentive award aimed at recognizing the contributions of early to mid-career African professional women in conservation. The nominees should have demonstrated:

- Evidence of leadership, creativity, self-motivation and enthusiasm in the execution of conservation work;
- Evidence of service (educational, managerial, research etc.) to conservation biology; and
- Ability to work with others across gender, social class and ethnicity to achieve concrete conservation outcomes.

The scope of the award is open to any area of conservation science directed towards practical conservation action. A nominator of high professional standing should submit the application on behalf of an exceptional nominee. This should be supported by at least two letters of recommendation by additional referees. Under unusual circumstances only, if a highly accomplished candidate works in such isolation that a nominator is not available, the Awards Panel may consider self-nominations.

To submit a nomination, please download the nomination form and e-mail the completed form to the chair of the Awards Panel, Dr. Phoebe Barnard. No incomplete nominations will be processed.

## Project to End Great Ape Slavery (PEGAS)

Ol Pejeta Conservancy is pleased to announce the launch of a new initiative to address the serious problem of great ape trafficking: Project to End Great Ape Slavery (PEGAS).

Every year thousands of great apes – chimpanzees, bonobos, gorillas and orangutans – are stolen from the wild and trafficked. To capture one or two infants for the great ape slave trade, poachers annihilate whole groups. The adults are killed and used as bushmeat, trophies and juju charms, leaving behind frightened and traumatized orphans.

The poachers sell the great ape orphans to wildlife traffickers who keep them on chains or in cages until a buyer can be found, usually in the Middle East, the Russia area or East Asia.

The stolen apes are usually trained to perform in circuses or safari parks, or they become a plaything for a rich oligarch or business potentate. They are often kept alone in dark, barren cells when not performing for the public or amusing their masters. When they grow too old to be 'cute', they are usually moved to a zoo where they are expected to mate and produce valuable offspring, while also making money for their masters through zoo entrance and payment for photos with the apes.

The Convention on International Trade in Endangered Species (CITES) lists all great apes in Appendix I. "Appendix I shall include all species threatened with extinction, which are or may be affected by trade. Trade in specimens of these species must be subject to particularly strict regulation in order not to endanger further their survival and must only be authorized in exceptional circumstances" (Article II, paragraph 1 of the Convention).

Appendix I species should not be traded for commercial purposes, yet it happens frequently in Africa and Asia. Corrupt national CITES officials sell fraudulent permits to traffickers to enable the illegal export of infant great apes. Airline staff and customs officers are bribed, and import country CITES officers sometimes make money from this trafficking.

PEGAS aims to investigate great ape trafficking and identify those involved in the trafficking, as well as use information gathered to create a platform to lobby for enhanced law enforcement. Where opportunities exist to repatriate illegally exported chimpanzees or other apes to Africa, PEGAS will work with Ol Pejeta Conservancy, the Pan African Sanctuary Alliance and other partners to achieve this. We are grateful to the Arcus Foundation for providing core funding for PEGAS.

We hope that you will become a cooperative partner with PEGAS so that we can work together to put a halt to this illegal and unethical trafficking of our closest biological relatives. Please send us feedback to let us know what you think about this project and suggest areas where we can act in a coordinated and concerted manner to achieve our ultimate goal: the end of great ape slavery. Please also send any information you have on great ape trade to pegas@olpejetaconservancy.org. - Daniel Stiles, Ph.D., Project Manager, PEGAS

# *Recent Publications*

Abernethy K. & L.J.T. White. 2013. *Mandrillus sphinx* Mandrill. In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 192-197.

Altmann, J., S.L. Combes & S.C. Alberts. 2013. *Papio cynocephalus* Yellow Baboon. In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 228-233.

Ambrose, L. 2013. *Arctocebus aureus* Golden Angwantibo (Southern Golden Potto). In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 402-404.

Ambrose, L. 2013. *Euoticus elegantulus* Southern Needle-clawed Galago (Elegant Galago). In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 442-444.

Ambrose, L. 2013. *Sciurocheirus gabonensis* Gabon Squirrel Galago. In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 422-424.

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Ambrose, L. & T.M. Butynski. 2013. *Galagoides thomasi* Thomas's Dwarf Galago. In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 462-467.

Ambrose, L. & J.F. Oates. 2013. *Euoticus pallidus* Northern Needle-clawed Galago (Pallid Galago). In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 444-446.

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Bailey, A.L., M. Lauck, A. Weiler, S.D. Sibley, J.M. Dinis, Z. Bergman, C. W. Nelson, M. Correll, M. Gleicher, D. Hyeroba, A. Tumukunde, G. Weny, C. Chapman, J.H. Kuhn, A.L. Hughes, L. Austin, T.C. Friedrich, T.L. Goldberg & D.H. O'Connor. 2014. High genetic diversity and adaptive potential of two simian hemorrhagic fever viruses in a wild primate population. *PloS One* 9(3): pp.e90714.

Bearder, S.K. 2013. Genus *Otolemur* Greater Galagos. In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 407-409.

Bearder, S.K. & N.S. Svoboda. 2013. *Otolemur crassicaudatus* Large-eared Greater Galago (Thick-tailed Greater Galago, or Bushbaby). In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 409-413.

Bergman, T.J. & J.C. Beehner. 2013. *Theropithecus gelada* Gelada (Gelada Baboon). In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 240-245.

Bocian, C.M. & J. Anderson. 2013. *Colobus angolensis* Angola Colobus (Angola Black-and white Colobus, Angola Pied Colobus). In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 103-109.

Butynski, T.M. 2013. *Allochrocebus preussi* Preuss's Monkey. In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 292-296.

Butynski, T.M. 2013. *Cercopithecus dryas* Dryad Monkey (Salongo Monkey). In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 306-309.

Butynski, T.M. 2013. *Cercocbus lunulatus* White-naped Mangabey (Whitecrowned Mangabey). In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 182-186.

Butynski, T.M. 2013. Genus *Perodicticus* Potto. In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 393.

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Butynski, T.M. & Y.A. de Jong. 2013. *Galago gallarum* Somali Lesser Galago (Somali Bushbaby). In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 434-437.

Butynski, T.M. & Y.A. de Jong. 2013. *Galago matschiei* Spectacled Lesser Galago (Eastern Needle-clawed Galago). In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 437-441.

Butynski, T.M., P. Grubb & J. Kingdon. 2013. *Procolobus badius* Western Red Colobus (Bay Colobus). In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury

# Recent Publications

Publishing, London. Pp. 128-134.

Butynski, T.M., P. Grubb & J. Kingdon. 2013. *Procolobus pennantii* Pennant's Red Colobus (Bioko Red Colobus). In *Mammals of Africa. Volume II: Primates.* T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 137-142.

Butynski, T.M. & J. Kingdon. 2013. *Cercopithecus erythrotis* Red-eared Monkey (Red-nosed Monkey). In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 371-375.

Butynski, T.M. & J. Kingdon. 2013. *Chlorocebus aethiops* Grivet Monkey. In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 267-271.

Butynski, T.M. & J. Kingdon. 2013. *Procolobus preussi* Preuss's Red Colobus. In *Mammals of Africa. Volume II: Primates*. T.M. Butynski, J. Kingdon & J. Kalina, eds. Bloomsbury Publishing, London. Pp. 134-137.

Butynski, T. M., Kingdon, J. & Kalina, J. (eds) 2013. *Mammals of Africa. Volume II: Primates.* Bloomsbury Publishing, London. **(NOTE: Only select entries of this volume (e.g., genus, subgenus, species) are provided in the current list. Refer to the book for higher taxonomic profiles.)**

Chapman, C.A., T.V. Snaith & J.F. Gogarten. 2014. How ecological conditions affect the abundance and social organization of folivorous monkeys. In *Primates and Cetaceans: Field Research and Conservation of Complex Mammals*, Primatology Monographs. J. Yamagiwa & L Karczmarski, eds. Springer Japan. Pp 3-23.

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# *Connections: E-News, Web Sites, and Social Media*

**Africa Biodiversity Collaborative Group**
- Website: www.abcg.org
- E-newsletter contact: Kamweti Mutu (kmutu@abcg.org)
- Facebook: www.facebook.com/ABCGconserve
- Twitter: http://twitter.com/ABCGconserve

**African Primates (for journal and group)**
- Website: www.primate-sg.org/african_primates/
- Facebook: www.facebook.com/groups/232900723505713/
- Twitter: http://twitter.com/africanprimates

**African Wildlife Foundation**
- Website: www.awf.org
- Facebook: www.facebook.com/AfricanWildlifeFoundation?ref=stream&hc_location=stream
- Twitter: http://twitter.com/AWF_Official

**Barbary Macaque Awareness and Conservation**
- Newsletter: Contact: sian@barbarymacaque.org
- Facebook: www.facebook.com/BarbaryMacaqueAwarenessandConservation
- Twitter: http://twitter.com/BMCRif

**The Bioko Biodiversity Protection Program (BBPP)**
- Website: www.bioko.org
- Facebook: English - www.facebook.com/pages/Bioko-Biodiversity-Protection-Program/107673299261496; Spanish - www.facebook.com/BiokoBiodiversidad
- Twitter: http://twitter.com/Bioko_BBPP

**The Bonobo Conservation Initiative (BCI)**
- Website: www.bonobo.org
- Facebook: www.facebook.com/bonobodotorg
- Twitter: http://twitter.com/Bonobodotorg

**Budongo Conservation Field Station**
- Website: www.budongo.org
- Facebook: www.facebook.com/pages/Budongo-Conservation-Field-Station/111160629076237

**Centre for Education, Research and Conservation of Primates and Nature (CERCOPAN)**
- Website: www.cercopan.org
- Facebook: www.facebook.com/CERCOPAN
- E-newsletter contact: webmaster@cercopan.org
- Twitter: http://twitter.com/CERCOPANHQ

**Chimpanzee Sanctuary & Wildlife Conservation Trust (Ngamba Island)**
- Website: www.ngambaisland.com/
- E-newsletter contact: info@ngambaisland.org
- Facebook: www.facebook.com/ngambaisland
- Twitter: http://twitter.com/ngambachimps

**Colobus Conservation**
- Website: www.colobusconservation.org
- Facebook: www.facebook.com/pages/Colobus-Conservation/137445029669543
- Twitter: http://twitter.com/ColobusConserva

**Conservation through Public Health**
- E-newsletter contact: info@ctph.org
- Facebook: Conservation Through Public Health https://www.facebook.com/pages/Conservation-Through-Public-Health/115176086614; CTPH Gorilla Conservation Camp: https://www.facebook.com/pages/CTPH-Gorilla-Conservation-Camp/239975179417714
- Twitter: http://twitter.com/CTPHuganda

**East Africa Primate Diversity and Conservation Program**
- Website: www.wildlifesolutions.nl

**Ebo Forest Research Project**
- Website: www.eboforest.org
- E-Newletter contact: ekwoge@eboforest.org

**Faléme Chimpanzees**
- Twitter: http://twiiter.com/FalemeChimps

**Great Ape Survival Partnership (GRASP)**
- Website: www.un-grasp.org
- Facebook: www.facebook.com/graspunep?ref=stream
- Twitter: http://twitter.com/graspunep

**Guenon Conservation Community**
- Facebook: www.facebook.com/pages/Guenon-Conservation-Community/203180009723143?ref=stream

**International Gorilla Conservation Programme**
- Website: www.igcp.org
- Twitter: http://twitter.com/IGCP

**International Primate Protection League**
- Website: www.ippl.org
- Facebook: www.facebook.com/InternationalPrimateProtectionLeague
- Twitter: http://twitter.com/ipplprimate

**International Primatological Society – Conservation**
- Website: www.internationalprimatologicalsociety.org
- Twitter: http://twitter.com/ipsconservation

# Connections: E-News, Web Sites, and Social Media

**Kasanka Baboon Research Project**
- Website: www.kasankababoonproject.com
- Twitter: http://twitter.com/KindaCamp

**KasokwaForestProject**
- Facebook: www.facebook.com/pages/Kasokwa-Forest-Project/159230490821336
- Twitter: http://twitter.com/KasokwaForest

**Lesula-DR Congo Research Project**
- Facebook: www.facebook.com/pages/LesulaDRC
- Twitter: http://twitter.com/LesulaProject

**LimbeWildlifeCentre**
- Facebook: www.facebook.com/pages/Limbe-Wildlife-Centre/504832002861894
- Twitter: http://twitter.com/LimbeWildlife

**Lukuru Foundation**
- Website: www.lukuru.org
- Facebook: www.facebook.com/#!/LukuruFoundation

**Lwiro Sanctuary**
- Website: www.lwiroprimates.org
- Facebook: www.facebook.com/lwiro
- Twitter: https://twitter.com/lwirosanctuary

**Pan African Sanctuary Alliance**
- Website: www.pasaprimates.org
- E-newsletter contact: info@pasaprimates.org
- Facebook: www.facebook.com/pages/PASA-Primates/150322194563
- Twitter: http://twitter.com/pasaprimates

**Red-bellied Guenon**
- Facebook: www.facebook.com/Cercopithecuserythrogastererythrogaster

**Samango Monkey Project**
- Facebook: www.facebook.com/groups/samango/

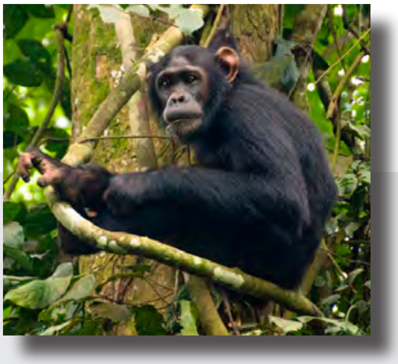
**Society for Conservation Biology – Africa Section**
- E-mail list contact: Beth Kaplin bkaplin@anticho.edu

**Tai Chimp Project**
- Website: www.wildchimps.org
- Twitter: http://twitter.com/TaiChimpProject

**Ugalla Primate Project**
- Website: www.ugallaprimateproject.com

**Vervet Monkey Foundation**
- Facebook: www.facebook.com/groups/vervet/
- Twitter: http://twitter.com/VervetMonkeys

**West African Primate Conservation Action (WAPCA)**
- WAPCA News contact: jeannemarie.pittman@wapca.org
- Facebook: www.facebook.com/pages/West-African-Primate-Conservation-Action/427913537273055



## *Send us your contributions!*

**Research Articles and Brief Reports:** See the inside back cover for details.

**News:** *African Primates* lists grant opportunities, conferences, job announcements, etc. However, please keep in mind that the journal is published only once or twice per year. Thus, time-sensitive announcements should be adjusted accordingly.

**Recent Publications:** Send the details any new papers, books, reports published since the last publication of *African Primates*.

**Connections - E-News, Web Sites, Social Media:** The last two pages of this issue lists ways you can stay connected with the African primatology community. Have we listed your information? Help keep this list up to date and accurate!

All correspondence should be sent to: wallis@africanprimate.net

# *AFRICAN PRIMATES* - Instructions to Contributors

*African Primates*, a journal of the IUCN SSC Primate Specialist Group, publishes research articles, field reports, review articles, position papers, book reviews, and other news focused on the nonhuman primates of Africa. We welcome submissions focused on behavior, ecology, taxonomy, or conservation. The journal is produced in both print and digital versions and is provided free of charge. The aim of *African Primates* is to promote conservation of Africa's primates by:

1) enhancing interest in Africa's primates and increasing knowledge about them that is relevant to their survival;
2) transmitting information about factors and situations that promote or work against conservation of African primate species or populations; and
3) providing a forum for discussion and debate regarding all aspects of knowledge relevant to conserving Africa's primate fauna and their habitats.

*African Primates* encourages submission of relevant information in the form of research findings, field survey results, advances in field and laboratory techniques, field action alerts, and book reviews, as well as notification of events, funding opportunities, grassroots efforts such as letter-writing campaigns, and recent publications in other formats (including reports and theses). All submissions should be sent to the Editor-in-Chief; research articles will be peer-reviewed before acceptance for publication. Contributors may consult past issues of *African Primates* for stylistic guidance. (Previous volumes are accessible through the PSG website. See http://www.primate-sg.org/african_primates/.)

The following guidelines are recommended:

- Manuscripts (not to exceed 15 pages) should be in English or French, double-spaced, with 1-inch margins. All articles must include an English abstract. If possible, please provide a French abstract for English manuscripts.
- Authors submitting manuscripts in a language that is not their first are encouraged to seek guidance from a speaker of that language to insure the manuscript is well-written.
- Manuscripts should be produced with PC-compatible software (e.g., Microsoft Word) and submitted as an e-mail attachment in *.doc; *docx, or *.rtf format. All reviews and revisions will be conducted via e-mail.
- Use metric units only and define all abbreviations.
- Current taxonomic classifications should be used. However, if species or subspecies' names have undergone recent revision, include mention of recent names as a service to readers adjusting to new naming conventions.
- Tables, figures, and photographs are encouraged. All require accurate and concise captions listed on a separate sheet.
- Research articles should be accompanied by a map indicating location of any place names mentioned in the text. Please include a map legend.
- All photographs must be of high quality and submitted electronically. Each should be labeled on a separate page with a caption and photographer credit.
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**Unpublished Report:**
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**Government Document:**
Ministry of Environment and Natural Resources. 1994. *The Kenya National Environment Action Plan (NEAP)*. Ministry of Environment and Natural Resources, Nairobi, Kenya.

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*African Primates*
**A Journal of the IUCN SSC Primate Specialist Group Africa Section**
**Vol. 9, 2014**

## Research Articles

## Brief Communications