

The fruit of discord? *Saba senegalensis* use by Critically Endangered Western chimpanzees (*Pan troglodytes verus*) and local people at the Dindefelo Community Nature Reserve (RNCD), southeastern Senegal



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INTRODUCTION

Western chimpanzees (*Pan troglodytes verus*) have been upgraded to Critically Endangered (Humble, et al., 2016), and are facing extinction in Senegal, with fewer than 400 individuals (Kormos & Boesch, 2003). This region is part of the Manding Plateau, classified as an Exceptionally Important Area for the conservation of Western Chimpanzee, as it is an ecological margin of chimpanzee distribution in West Africa (Kormos & Boesch, 2003).

In this country, chimpanzees are threatened by habitat destruction and degradation, as well as competition with humans over access to natural resources, including *Saba senegalensis* (hereafter *Saba*) (Carter, et al., 2003).

One of the main actions proposed by the IUCN Regional Action Plan for the Conservation of Chimpanzees in West Africa (Kormos & Boesch, 2003) and the IUCN Best Practice Guidelines for the Prevention and Mitigation of Conflict Between Human and Nonhuman Great Apes (Hockings & Humle, 2009) is to research chimpanzee and human competition over natural resources. In Senegal, previous research at Fongoli has shown that the fruit of *Saba* is one of the main food sources for chimpanzees during the transition between the dry and wet season (Pruetz, 2006), and it is also very important to local people, who might harvest these fruits at unsustainable levels (Knutsen, 2003).

THE AIMS OF THE STUDY

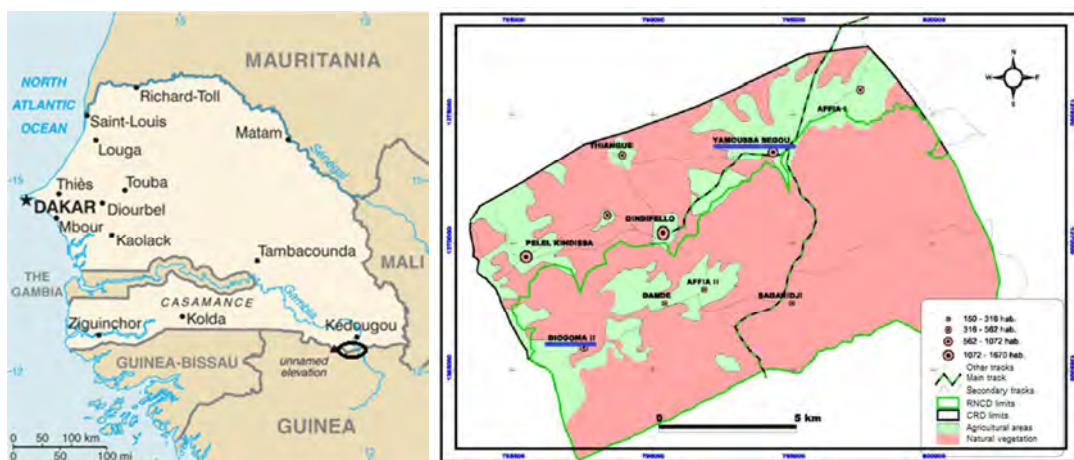
The aim of this research was to examine the co-utilisation of *Saba* by sympatric Western chimpanzees and humans in a community-based conservation reserve in Senegal, and to provide updated information on potential 'conflict' over this resource in another area within the country.

We adopted a cross-disciplinary approach to study the importance, spatiotemporal use and extraction of *Saba* by humans and chimpanzees through a combination of biological and social science data collection methods. Although this project was research-based, it was designed in collaboration with the Jane Goodall Institute Spain (JGIS) to provide useful data to inform conservation strategies.

STUDY SITE

This research took place at the Dindefelo Community Nature Reserve (*Réserve Naturelle Communautaire de Dindéfelo*, henceforth RNCD), located in the southeastern Kedougou administrative region of Senegal. This reserve, which covers an area of 14050 ha, was established in 2010 by the Rural Community of Dindefelo with the technical assistance of the JGIS (Fig. 1). Specifically, two villages within the RNCD, Segou and Djogoma, and the surrounding forests were the focus of this project.

Figure 1. Location of the RNCD. Djogoma and Segou villages underlined. Management Plan of the RNCD 2012–2016 (Jane Goodall Institute Spain & USAID/Wula Nafaa, 2011).



Segou consists of 820 people and is situated on the main road connecting Kedougou, the capital of the region, with Guinea. Segou is located in a buffer area, but its surrounding forests are part of the RNCD. Djogoma consists of several hamlets, with a total population of 343 people. This village lies within the RNCD, is more remote and has a less well-developed infrastructure than Segou.

The reserve is a mosaic of settlements, agricultural fields and savanna-forest habitats. It is home to five species of non-human primates (hereafter primates) [Western chimpanzees (*Pan troglodytes verus*), baboons (*Papio papio*), green monkeys (*Chlorocebus sabaeus*), patas monkeys (*Erythrocebus patas*) and lesser bushbabies (*Galago senegalensis*)] and approximately 7,000 people within and around the reserve. They are mainly of the Fulbe/Fulani ethnic group, speak Pular and practice Islam.

There are two distinct seasons: wet (mid May - October) and dry (November – mid May). Four main habitat types are found in the RNCD [modified from Pruetz et al. (2002)]: gallery forests, ecotones, savanna and woodlands.

METHODS

Fieldwork took place during the *Saba* season, from late April to late July, with two local research assistants (Djibril Suare in Djogoma; Djibril Diallo in Segou) and two local translators (Karim Diallo in Djogoma; Mamadou Diallo in Segou).

Social science methods

We collected information on human use of *Saba* through **semi-structured interviews** and **free-listing exercises** from different households by means of cluster sampling (Newing, 2011). We visited a total of 49 people over 6 weeks (Fig. 2).

Figure 2. Principal investigator interviewing a woman in Segou.



On three occasions we also accompanied individuals and groups of people collecting fruits of *Saba* (Fig. 3) and observed two events of *Saba* sale by villagers. We calculated the average number of fruits that a sack can hold by emptying full sacks of *Saba* fruits (N=5). **Participant observation** facilitates an improved understanding of people's actions (Bernard, 2006) and uncovers potential contradictions between people's words and actions (Drury, et al., 2011).

Figure 3. A girl ready to harvest *Saba* fruits with a bamboo pole with a sickle attached at one end.



Biological science methods

We monitored *Saba* liana patches (N = 88) along predetermined routes (Ganzhorn, et al., 2011; Marshall & Wich, 2013), including different forest types and at a varying distance to villages, paths and water sources. We recorded the geographic coordinates using a hand-held global positioning system (Garmin GPSmap 62s) and visualised them using a geographic information system (ArcGIS 10.4). We visited each patch weekly during 11 consecutive weeks, covering the *Saba* fruiting season (from May 8th to July 21st).

We collected data on fruit extraction based on visual counts and terrestrial traces by people and animals. The identification was possible because each species exploits the fruit differently: chimpanzees halve the husks and leave little tooth or scratch marks (Fig. 4), while monkeys (i.e. green monkeys and baboons) break them into small pieces, leaving identifiable scratch and tooth marks, as well as uneaten seeds. Squirrels (*Heliosciurus gambianus*) eat the fruit on the vine and do not collect it, leaving a hole in the husk and small tooth marks. Humans usually leave signs under the lianas, including traces of cut branches and discarded fruits. Weekly *Saba* counts were attributed to chimpanzees, monkeys, humans, squirrels, or unknown (Waller, 2005). After each survey, we removed *Saba* remains from the vicinity of the vine to ensure they were not recounted (Riley, 2007). Fruits eaten by squirrels, as they remained on the liana, were recounted every week to assess what fruits were newly consumed.

Figure 4. *Saba* fruit consumed by a chimpanzee.



Additionally, we analysed data on faeces collected by the JGIS (2015-2016) to determine whether *Saba* can be considered an important food for chimpanzees (if seeds were present in $\geq 50\%$ of faecal samples in one or more months, or in $>10\%$ of all samples) (McLennan, 2013). The number of independent dungs recorded was 1126 in Segou and 847 in Djogoma. Seeds of

a particular species were recorded as present with no measure of the amount of each seed in the faeces.

RESULTS TO DATE

Human data

- Of the 85 wild plants listed by respondents, ***Saba* was the second most salient plant** ($s = 0.669$) (i.e. most important and most frequently used) for local people.
- Fruits were **eaten** raw (Fig. 5a), used to prepare meals, especially during Ramadan (Fig. 5b), and **sold** to supply markets, mainly at a national level (Table 1):

Figure 5a. Child ready to lick raw *Saba* seeds after halving the husk of a fruit.

Figure 5b. Woman using *Saba* seeds coated in fruit pulp to prepare *mboiri*, a breakfast dish.



Table 1. Destination of *Saba* fruits collected for sale

Destination of fruits	n	% ^a
National markets (Dakar)	44	89.80
Regional market (Kedougou)	11	22.45
Local market (Dindefelo)	11	22.45

^aPercentage values >100% because some respondents mentioned >1 destination.

- Sale of forest products, especially *Saba*, was the **only source of income** for most respondents at the onset of the rainy season.
- Gathering fruits tends to be a **family activity**, as 72.34% of the respondents stated that at least one or more members of their household also collected *Saba*.

- Money from *Saba* sales was used to satisfy **basic needs**, e.g. food (65.31%) and clothing (36.73%).
- People harvested fruits from **May to July**, but harvesting was intensified on the days leading up to the arrival of the *bana-bana* (travelling tradesmen), who buy large quantities of *Saba* to sell at urban markets such as Dakar (Fig. 6). This year the harvest peak was in early June and coincided with Ramadan.

Figure 6. Truck full of loose *Saba* fruits, Djogoma, June 5 2017.



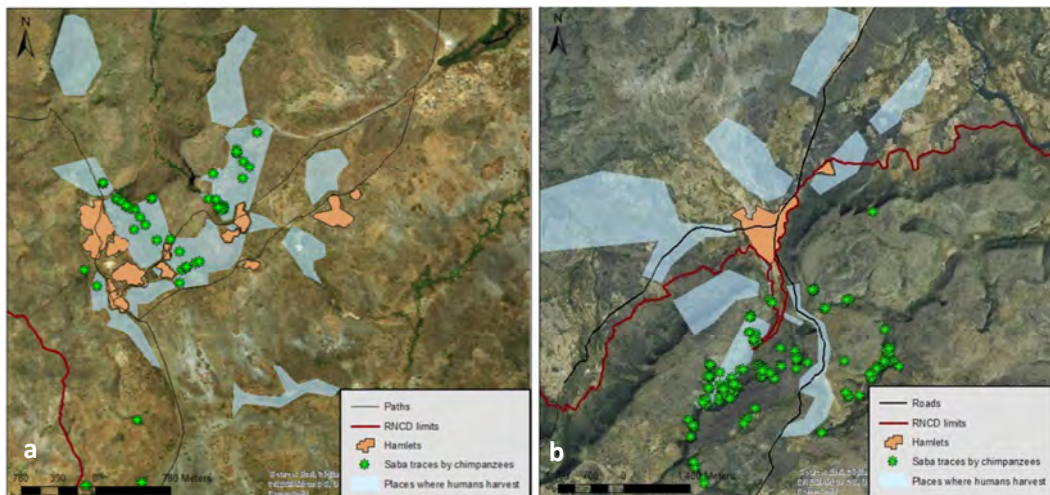
- More than half the interviewees (61.22%) reported having experienced **problems** when selling *Saba*. Among these, the most repeated complaints were related to disagreements with the *bana-bana* (e.g. not getting paid, forced to accept low prices, overripe fruit being discarded).
- Fruits were collected when **ripe** to be eaten or sold in local markets (Fig. 7), and when **unripe** to be transported to urban areas.

Figure 7. *Saba* fruits and other products for sale at the Dindéfelo local market.



- At Djogoma people collected *Saba* close to the village in areas with a high abundance of lianas, also used by chimpanzees (Fig. 8a). At Segou people also gathered fruits within the chimpanzees' home range, but mostly harvested fruits in places located outside the reserve for practical reasons, since these areas are flat, accessible by bicycle, and close to the main road and their field crops (Fig. 8b).

Figure 8. Areas used by humans and chimpanzees to collect *Saba* in Djogoma (a) and in Segou (b). *Saba* traces were collected by the JGIS researchers in 2015-2016.



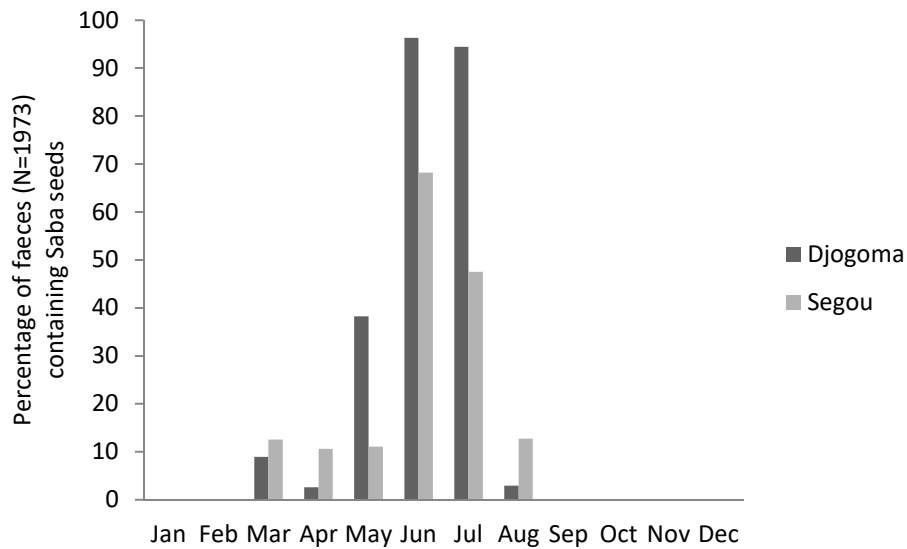
- Interviewees **generally encountered primates** while collecting *Saba*. Most of them (63.27%) cited baboons and more than half (59.18%) mentioned monkeys. A further 28.6% of interviewees reported they encountered chimpanzees.
- The amount of *Saba* gathered in Djogoma for wholesale was estimated based on one villager's records. Two and a half trucks were loaded with a total of 320 sacks. Given that each sack contains an average of 195 fruits (pers. obs.), the number of *Saba* fruits extracted was approximately **62,400 fruits**. This number is an underestimation, since fruits collected for people's own consumption and local sale were not considered. These estimates are much lower than the figures calculated in the Fongoli region (Knutsen, 2003; Waller, 2005).

Chimpanzee faecal samples

At both sites, *Saba* was an **important food** to chimpanzees, being found in more than 50% of faecal samples in at least one month (Fig. 9). *Saba* was present in 10.27% and 16.43% of the total collected faeces in Djogoma and Segou, respectively, and was found in faeces for 6

months of the year, from March to August. Chimpanzees used *Saba* at particularly high levels during the months of June and July, especially in Djogoma.

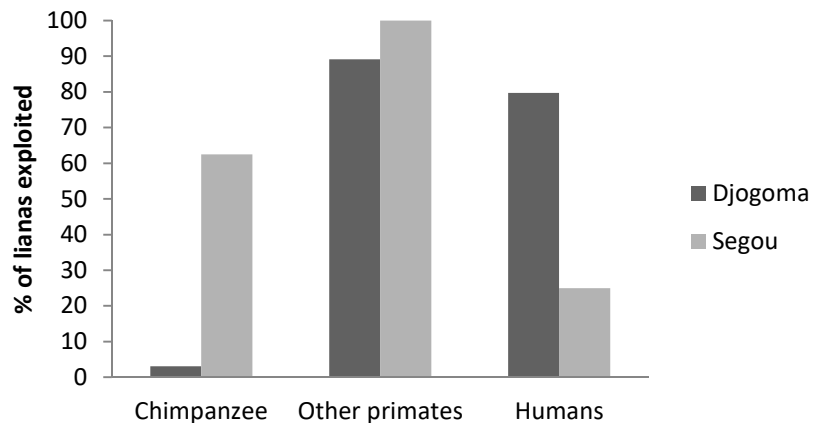
Figure 9. Importance of *Saba* in the diet of chimpanzees in Djogoma and in Segou. Values are presented as means for 2015 and 2016 (N = 23 months)



Liana data

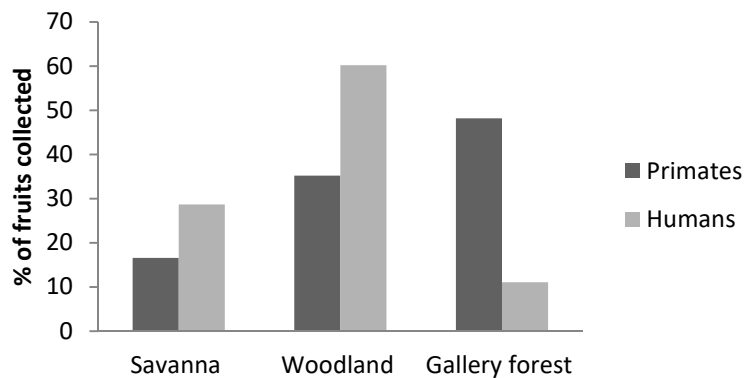
- Baboons and green monkeys exploited most of the monitored lianas at both sites (100%, n = 24 in Segou; 89.06%, n = 57 in Djogoma). Whilst chimpanzees took fruits from 60% of the lianas in Segou, we only identified feeding traces in 3.13% of lianas at Djogoma. Human use of *Saba* also differed between sites, with people confirmed to harvest 25% of lianas in Segou and nearly 80% of lianas showing signs of human use at Djogoma (Fig. 10).

Figure 10. Percentage of monitored lianas that were used by chimpanzees, other primates, and humans.



- Of the 88 monitored lianas, only 3.41% (n=3) were used by both chimpanzees and humans during the study period. Contrary to this, the overlap between other primates and humans was higher: 56.82% of the total lianas (n=50) were used by baboons and/or green monkeys and humans to a degree.
- Human extraction in Djogoma accounted for 30.37% of the total number of *Saba* fruits, while all primates combined extracted 60.03% of the fruits, with only 0.14% of feeding traces attributed to chimpanzees. While primates took more fruits from gallery forests, humans harvested more in woodland habitats (Fig. 11). This is similar to what was found by Waller (2005).

Figure 11. Percentages of fruits collected from different habitats by all primates combined and humans in Djogoma.



DISCUSSION AND CONCLUSIONS

This case-study shows how integrating social and biological methods can contribute to an increased level of understanding of the co-utilisation of a key wild plant resource by sympatric humans and primates. In particular this approach allows a balanced assessment of the level of competition to more accurately inform conservation actions.

Saba was an important food for chimpanzees and central to cultural and economic domains for local people. However, there was minor spatial overlap and some temporal overlap in the use of *Saba* by humans and chimpanzees. The estimated extraction by people was lower than expected, and the extraction levels by other primates were higher.

The overall findings indicate that the current patterns of *Saba* use may not be severely affecting chimpanzees or local people at the RNCD, but do not assure a lack of conflict long-

term due to the dynamic nature of consumption by primates and the susceptibility of the human harvest to economic and social changes.

OUTPUTS

Recommended conservation actions

Conservation actions should take a community approach to balance the needs of humans and primates:

- The JGIS could play a role by setting up a scheme which allows villagers to be paid fairly whilst also considering the needs of chimpanzees and other primates. Establishing a **partnership** between harvesters and the NGO might increase the gains of *Saba* trade, allowing them to collect fewer fruits, thereby reducing the human pressure on the forest and sympatric wildlife. Harvesters would benefit from better and more stable access to markets, and partners could require collectors did not exceed mutually agreed collection quotas (Morsello, 2006).
- Based on the findings of the present study along with **participatory mapping exercises** with community members, it would be possible to evaluate if there is a real need to **alternate specific areas for harvest**, as proposed by Carter, et al. (2003). In this case, the community should be involved in the decisions regarding the management of the forests, within the framework of **Participatory Forest Management (PFM)** (McDermott & Schreckenber, 2009).
- **Alternative income-generating projects** should be developed to reduce the dependence of people on *Saba* fruits. As suggested by Heuback, et al. (2011), this could be achieved by making crop production systems more efficient to reduce the need to gather more fruits during lean times.
- The creation of ***Saba* nurseries**, proposed as an alternative to collecting the fruits from wild lianas (Carter, et al., 2003; Pacheco, et al., 2012; Waller & Pruetz, 2016), might not be a suitable solution to decrease the rate of harvest in the short-run, due to the slow growth rate for *Saba* vines (Pruetz & Kante, 2008) and people's need for short-term revenues over long-term conservation of resources (Sambou, et al., 2002). Nevertheless, *Saba* could be included in the **Forest Gardens Programme** that already runs in several villages within the RNCD by Trees For the Future with the collaboration of the JGIS.

Impacts

By providing all our data and preliminary results to the JGIS, we will inform the development of the new Management Plan of the RNCD and discuss suitable conservation actions to be implemented at the RNCD.

We will suggest that JGIS contact the NGOs that they work with, such as USAID/Wula Naafa and Trees For the Future, to recommend that they consider these findings in their future plans in the area. We will make the results available to the Ministry of Environment and Sustainable Development in Senegal and recommend enhancing *Saba* agricultural practices at the Senegalese Institute of Agricultural Research (ISRA).

Finally, we intend to inform wider conservation strategies, such as the upcoming Western Chimpanzee Conservation Action Plan Meeting, scheduled for December 2017 in Monrovia, Liberia, where the importance of understanding human-chimpanzee co-utilisation of wild plant resources will be discussed.

Dissemination of the results

The results of this study have already been disseminated through the writing of my MSc dissertation and the production of the present report for the PSGB and the JGIS. I intend to produce a report in French for the RNCD management committee and the local NGO Neene Ladde. This project has also been presented at two conferences:



7th European Federation for Primatology Meeting, Strasbourg, France, August 21-25, 2017

Poster presentation

The fruit of discord? *Saba senegalensis* use by chimpanzees (*Pan troglodytes verus*) and local people in the Dindéfelo Community Nature Reserve (RNCD), southeastern Senegal

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**VI Iberian Primatological Conference,
Burgos, Spain, October 4-7, 2017**

Oral presentation

Human-chimpanzee botanical resource co-use at the Dindefelo Community Nature Reserve (RNCD), Senegal

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Amanda Barciela^b, Justinn Hamilton^b, Verónica
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Now I am preparing a research article to be submitted to a peer-reviewed journal. I am also exploring opportunities to continue applied research on human-primate interactions.

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This project was led by Marina Ramon for her final dissertation of the MSc in Primate Conservation (Oxford Brookes University, UK). The project was hosted by the Jane Goodall Institute Spain (JGIS), who runs the “*West African Chimpanzee Conservation and Sustainable Local Management of Natural Resources Programme*” whose long-term goal is the recovery of the West African chimpanzee population in Senegal and northern Guinea. Research, conservation, education and ecotourism activities are carried out at the RNCD.

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