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A survey of the bushmeat trade of the straw-coloured fruit bat (*Eidolon helvum* Kerr, 1792) at Maele Island (Kisangani city, Democratic Republic of the Congo)

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ABSTRACT:

Although bats carry out important beneficial ecological and agricultural functions such as pollination and dispersion of seeds, they often carry dangerous diseases. This is worrying because of the increased dependency of the urban populations in Kisangani on bats as a source of animal proteins. The straw-coloured fruit bat (*Eidolon helvum*) is one of the most notable bat species that is both important as a food source and as a host for zoonotic diseases. It is a widely distributed species, which is relatively common throughout its distribution area. Recently, it was classified as Near Threatened on the IUCN Red List due to a decreasing population trend. To evaluate the hunting pressure on this species and the supply of straw-coloured fruit bats for human consumption, we inventoried the carcasses of this species on one of the main bushmeat markets in the region of Kisangani, situated on the island of Maele. Our survey was carried out between January and December 2013 and targeted hunters as well as traders. In total, we counted 3,034 carcasses. Our preliminary results suggest that the hunting pressure on the straw-coloured fruit bat is rather stable. It is highest during the months of October, September and May and lowest in April and December. Our results do not show a decline in trade of these bats during August through November, when hunting is illegal in the DR Congo. This suggests that hunting activities are not ceased during that period. The fact that the local population consumes these bats on a regular basis throughout the year creates a very important opportunity for spill-over events that may lead to the outbreaks of zoonotic diseases.

Keyword: *Bat, bushmeat, hunting, Eidolon helvum, Democratic Republic of the Congo*

INTRODUCTION

The Democratic Republic of the Congo is a biogeographic area of high value for the conservation of the biodiversity and is very rich in plant and animal species [1-16]. Among the terrestrial vertebrates, the bats are one of the most abundant and diversified ecological groups. They belong to the mammalian order Chiroptera, which includes a large variety of species, second only to the Rodents. Worldwide, there are approximately 1,300 bat species representing about one quarter of all known mammals [17].

Bats are part of the wildlife, which is very sought for as bushmeat by societies living along the rivers in forests, such as the area around Kisangani. As such, they contribute a major part to the animal protein consumed by local communities and therefore become a source of income for numerous families of resident hunters [18], who hunt these bats year-round, neglecting the closed season.

The fierce exploitation of the frugivorous *Eidolon helvum* has a major impact on an ecological level, given the fact that this species fulfills a number of roles, including the dispersion of seeds, needed to regenerate the forests in various countries in Africa and the Paleotropics [19]. Some of these seeds are of plants with an important economic value, e.g. *Micilia excela* [20]. The excessive killing of *E. helvum* can endanger its capacity to provide these vital ecosystem services [21].

In Kisangani, bats are hunted for food, for not only personal use, but also for commercial reasons. Information on quantities or yields is completely lacking and hardly anything is known about the proportion of fruit-bat carcasses.

MATERIAL AND METHODS

Study area

Individual specimens belonging to *Eidolon helvum* (Kerr, 1792) were inventoried on the island of Maele, within the city of Kisangani, Tshopo Province, Democratic Republic of the Congo (DRC) (00° 29' 19.3" N 25° 12' 42.8" E, 376 m). It is located downstream of the island of Mbiye and upstream of the Wagenya Falls fishery, a tourist attraction near the city of Kisangani.

Situated in the equatorial zone, Maele island globally has the same climate as the city of Kisangani: Af (Köppen classification type: Tropical Rain forest [22]. The mean temperature of the coldest month is above 18 °C, and the annual temperature variation is less than 5 °C. The average rainfall during the driest month is about 60 mm [23]. In Kisangani, the rains are abundant over the year with an unequal monthly distribution, which results in two very wet seasons ("wet": from March to May and from September to November) and two seasons with lower rain intensities ("dry": December to February and June to August) [24].

Maele Island has a mainly man-made landscape. Its original vegetation is almost completely lost. From the north to the south and from the east to the west it is dominated by fields of various cultures. There is no primary nor secondary forest to speak of, only a few small young secondary forest islands dominated by *Myrianthus arboreus* P. Beauv., 1805 (Urticaceae - Giant yellow mulberry), *Pseudospondiace microcarpa* A. Rich., 1883 (Anacardiaceae - African Grape) *Musanga cecropioides* R. Brown ex Tedlie (Urticaceae - African corkwood tree or umbrella tree) and a few budding *Piptadeniastrum africanum* (Hook.f.) Brenan, 1955 (Fabaceae - African greenheart).

The fallows are dominated by lianes: *Chromolaena odorata* (L.) King & H.E. Robins (Asteraceae - Siam weed, Christmas bush, devil weed, camfhur grass, common floss flower and triffid), *Triumfetta cordifolia* A. Rich (Malvaceae - cordleaf burrbark), and *Alcornea floribunda* Müll. Arg. (Euphorbiaceae).

Furthermore, there are numerous fields with various crops: rice, corn, bananas, vegetables, cassava, etc.

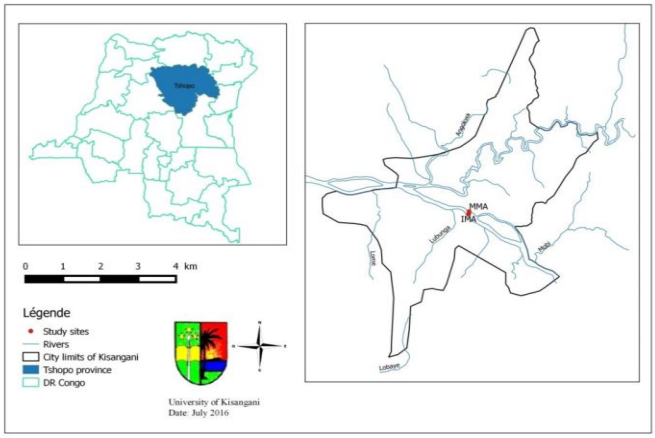

Figure 1: Map showing the study area with the location of the Maele Island (IMA) where the bats were hunted and opposite Maele market (MMA), where the bats were sold.

Hunting Method

Hunting on Maele Island is done during the entire year and the hunters use mist nets to capture bats belonging to various species. We were interested in *Eidolon helvum*, which is not only the most hunted species, but also the most abundant one and the one, which is most on sale on the market in Kisangani.

The hunters use canoes, which take them to the island in about 10 minutes.

Figure 2: (a) A bat hunter returning in his canoe from the island of Maele near the city of Kisangani. (b) A female trader waiting for the return of the hunter.

Inventory of the carcasses

3,034 carcasses of *Eidolon helvum* captured on Maele Island were inventoried on the market at Maele between January and December 2013. During that period, we were present on the landing site before the arrival of the first hunter and remained there until after the arrival of the last hunter.

At each arrival of a hunter, we checked the specimens belonging to *Eidolon helvum* and noted the following parameters: number of specimens, sex, age, weight and price. Afterwards, we also counted the number of bat specimens that were available at the trader's displays to obtain an estimate of the daily supply.

Every morning, between 7 and 10 a.m., the traders buy the bats from the hunters and they sell them in the evening. All carcasses are boiled before being sold and bats, that were not sold, are stocked in a freezer to be sold the next day.

RESULTS

The figure 3 gives an overview on the monthly number of *Eidolon helvum* bats on sale at the Maele Island market based on the daily data obtained from the hunters and traders.

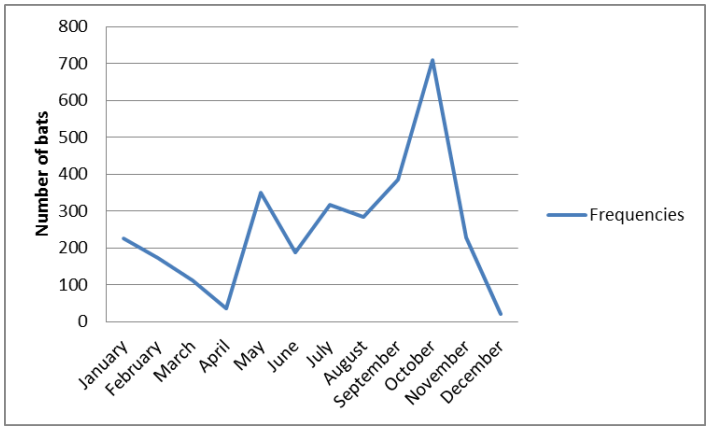

Figure 3: Overview of the monthly number of *Eidolon helvum* bats on sale at the Maele Island market year-round.

The figure shows that there was an extremely large amount of bats available in October (710 specimens), which was building up from August through September (386). This peak coincides with one of the wet seasons. A second, much smaller peak overlaps with end of the second wet season in May (349 bats). Remarkably, however, the number of bats available on the market in both March and April was low.

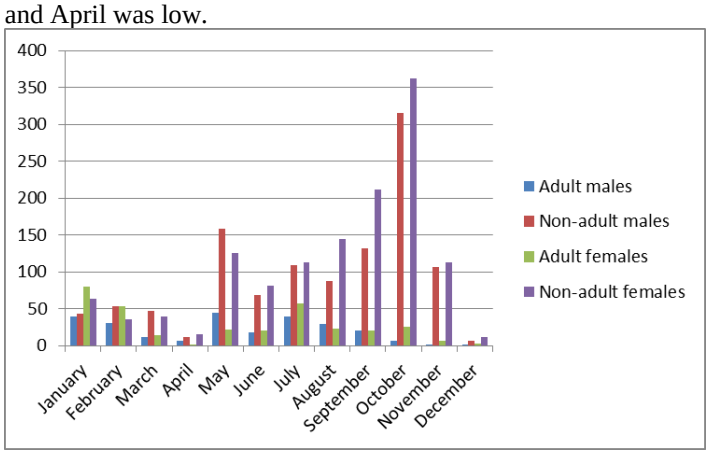

Figure 4: Estimated number of sold bats on the Maele island market, divided by sex and age.

From the figure 4, when the monthly numbers are split up by sex and age, it is clear that an overwhelming number of sold bats were

non-adults, especially during the peak of the wet season (from September to November). Adult bats were only available in relatively high proportions in January and February. Throughout the year, females were generally more available than males, only in May (and to a lesser extend in March) there were more males than females.

The figure 5 gives the distribution of the availability of straw-coloured fruit bats on the market at Maele Island over the different seasons.

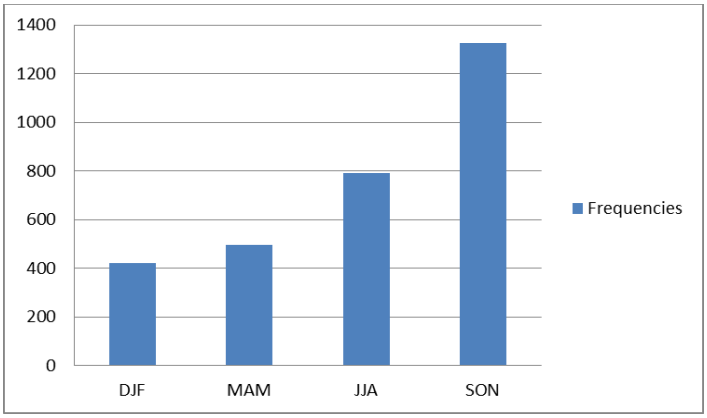

Figure 5: Frequencies according to the seasons (DJF: December - January -February; MAM: March-April-May; JJA: June-July-August; SON: September-October-November).

The graph shows a steady built-up of the number of bats available on the marked from the December to February dry season, over the wet season from March to May and the second dry season from June to August. Most bats were available during the second wet season of the year: from September to November, when 1,318 carcasses were inventoried (43.63 % of all specimens).

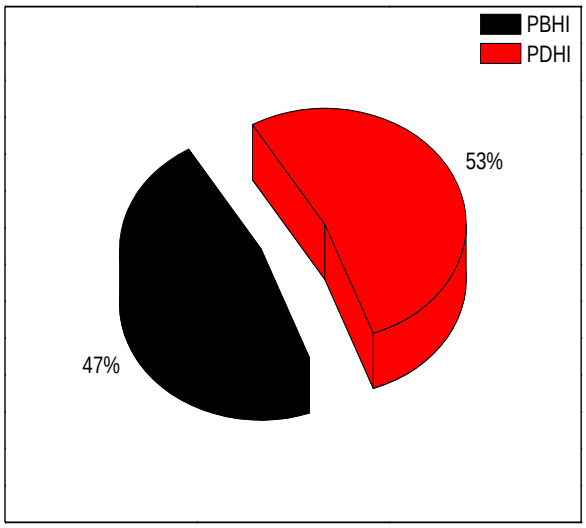

Figure 6: Ratio of the bats on sale during the period that hunting is allowed (PBHI: December through July) or not (PDHI: August through November).

In the Kisangani area, hunting bats is allowed from December through July (PBHI: Period before the hunting interdiction). However, most bat carcasses (53%) were sold during the period that the hunt and the trade in bushmeat was illegal (PDHI: Period during the hunting interdiction) (Figure 6).

DISCUSSION

During our survey period, 3,034 specimens or carcasses of *Eidolon helvum* were inventoried on the market at Maele, where they were sold as bushmeat. The abundance of *E. helvum* among the bats available on the market at Maele is also linked to the species' habits: roosting in trees by the thousands. The genus *Eidolon* is known for the large groups it forms, consisting of thousands or millions of individuals [25-27]. As such, they offer an opportunity for hunters to kill them in large numbers. Furthermore, being of small size, they are easily transportable to the markets. This explains why these bats are found in large numbers on markets.

Additionally, the lack of alternative steady income-generating activities for the majority of the hunters and the consumer's taste for these bats generate an extra pressure to capture *E. helvum* bats. During the current study, besides the 3,034 *E. helvum* specimens, 147 *Hypsignathus monstrosus* H. Allen 1861, 51 *Myonycteris torquata* (Dobson, 1878), 19 *Rousettus aegyptiacus* (E. Geoffroy, 1810), and 15 *Epomops franqueti* (Tomes, 1860) were registered. A study by [28] on the seasonal distribution of fruit bats at Yoko in relation to the various seasons showed that the capture of Pteropodids was only profitable during the season with abundant rains. During this season, 59% of the *Casinycteris argynnis* Thomas, 1910 specimens were captured, as well as 79% of *Epomops franqueti*, 95% of *Hypsignathus monstrosus*, 91% of *Myonycteris torquata* and 69% of all *Scotonycteris zenkeri* Matschie, 1894 [=*Scotonycteris bergmansi* [29]. In the seasons with lower rain intensities, the only species that were more or less profitable to collect were *Megaloglossus woermanni* Pagenstecher, 1885 (71% of all captures) and *Rousettus aegyptiacus* (58% of all captures).

With the exception of [30], all studies covering of bats on the main market at Kisangani mention *Eidolon helvum* to be present. The author [31] attributed the high rank of *E. helvum* in the local food supply to its large size. This makes it a highly valued species for the hunters. Furthermore, [32] found that 43.2% of all the fresh mammals sold on the marked in 1989 were representatives of this bat species: 2,005 out of 4,637 (the second most numerous mammalian order were the Primates).

Bushmeat is an important source of animal protein in the daily diet of populations in the Congo Basin [33], and its contribution to the household economy is significant [18, 34].

Although hunting in the DRC is covered by law (laws 82-002 of 28 May 1982, 014/CAB/MIN/ENV/2004 of 29 April 2004 and 14/003 of 11 February 2014 [35] which closes the hunt during certain periods of the year, it is often condoned by local authorities as is illustrated in Figure 6. The author [36] claimed that the closed hunting season was abided until the early 1970s, after which it watered down. The intense poaching on *E. helvum*, however, might lead to a faster extinction in view of the low reproduction rate of this species [36-38]. In Kisangani, economic profit unfortunately does not care at all about the sustainability of the species, hence the game market is operational year-round, and wildlife is subject to continuous hunting pressure throughout the year.

Jenkins et *al*. [39], who discussed the consumption of bat meat in Madagascar, demonstrated the appreciation of this type of meat by the local population. The preferred species included three fruit bats (*Pteropus rufus* Tiedemann, 1808 [=P. niger Kerr, 1792], *Eidolon dupreanum* (Pollen, 1867), and *Rousettus madagascariensis* G. Grandidier, 1929) and one large-sized insect-eating bat: *Hipposideros commersoni* (E. Geoffroy, 1813). Additionally, they also reported the consumption of small insect-eating bats. As in Kisangani, they also found that the hunting season is generally not respected, as bats were also available during the months that hunting was illegal. In some areas of

Madagascar, this causes a serious threat on bat populations. They also found little data on the socioeconomic or cultural values of bats.

In Yoko, the author [28] found that the majority of specimens captured were adults or subadults, the present study found that an overwhelming part of the specimens presented for sale at the Maele market were non-adult specimens. Unfortunately, we do not have any detailed information concerning their exact age category (juvenile, immature, sub-adult), so they might represent various stages in their development. Nevertheless, given the fact that *E. helvum* only has one young a year and that the number of males and females are more or less equal [27], it remains surprising to see that such a large amount of non-adults were captured. This might possibly be the result of these young (er) bats being less agile or less able to avoid the nets being used to capture them. Or perhaps they might be captured purposely because of the local food taste. The author [27] also mention "At Kampala, rain falls throughout the year but there are peaks in Oct-Nov and Apr-May, and the reproductive chronology is such that both spermatogenesis and lactation coincide with periods of high rainfall, and births during the relatively dry periods are avoided." This is very comparable with the situation in Kisangani and would explain the high peak in the September through November wet season.

CONCLUSION

During the year 2013, 3,034 *Eidolon helvum* carcasses were inventoried on the market at Maele, right across Maele Island, where these animals were captured.

The hunting pressure on Maele Island was highest during the months of October, September and May with respectively 710, 386 and 349 carcasses. Females formed the majority of bats captured during almost the entire year, especially during the months of September and October (wet season). Males were only in the majority in May. Non-adult bats were dominantly present from May to December, but also in lower numbers in March. The only month that adults were in the majority was January, although there were still a large number of non-adult bats available.

Although there is a major fluctuation, hunting occurs during the entire year, implying that the closure of the hunting season from August through November is not respected in the area around Kisangani especially as most of the carcasses were on sale during that period.

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