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Original Research Article

Palm weevils, *Rhynchophorus* sp. (Coleoptera: Dryophthoridae): species inventory and population dynamics in the Kisangani region of DR Congo

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ABSTRACT

The palm weevils, *Rhynchophorus*, have last stage larvae that are highly appreciated by the population of the Democratic Republic of Congo. The population has a poor knowledge of the adult of this insect. We initiated this work to contribute to a better knowledge of the species of *Rhynchophorus* in the region and, to know their population dynamics. Three sites (Tshopo, Lubunga and Bangboka) on three different axes, 12 km from the city center were chosen. We used erect type traps, mounted on Wild Palms for two years (2012 and 2013). This work revealed the existence of three species of *Rhynchophorus* in this region: *R. phoenicis*, *R. ferrugineus* and *R. quadrangulus*. *R. phoenicis* is the most abundant species in the three study sites; *R. ferrugineus* is a rare species, while *R. quadrangulus* is relatively absent. The Tshopo and Lubunga sites each have three species, while the Bangboka site has only one (*R. phoenicis*). The insects are more frequent during the rainy period (March to May). The sex ratio was 0.5 in 2012, while in 2013 it reached 0.6, characterizing a growing population.

Keywords: sites, species of *Rhynchophorus*, population dynamics, trap upright type, sex-ratio.

Les charançons du palmier, *Rhynchophorus* sp. (Coleoptera : Dryophthoridae) : inventaire des espèces et dynamique de population dans la région de Kisangani en RD Congo

Les charançons du palmier, *Rhynchophorus* ont des larves de dernier stade très appréciées par la population de la République Démocratique du Congo. La population a une mauvaise connaissance de l'adulte de cet insecte. Nous avons initié ce travail afin de contribuer à une meilleure connaissance des espèces de *Rhynchophorus* dans la région et connaitre leur dynamique des populations. Trois sites (Tshopo, Lubunga et Bangboka) sur trois axes différents, à 12 km du centre-ville ont été choisis. Nous avons utilisé les pièges de type dressé, montés sur palmiers sauvages pendant deux ans (2012 et 2013). Ce travail a révélé dans cette région, l'existence de trois espèces de *Rhynchophorus* : *R. phoenicis*, *R. ferrugineus* et *R. quadrangulus*. Le *R. phoenicis* est l'espèce la plus abondante dans les trois sites de l'étude ; le *R. ferrugineus* est une espèce rare, tandis que le *R. quadrangulus* est relativement absente. Les sites de Tshopo et de Lubunga comptent chacun trois espèces, tandis que le site de Bangboka n'en compte qu'une seule (*R. phoenicis*). Les insectes sont plus fréquents pendant la période des pluies (mi-mars à mai). Le sexe ratio était de 0,5 en 2012, alors qu'en 2013 il a atteint 0,6, caractérisant une population en pleine expansion.

Mots-clés : sites, espèce, *Rhynchophorus*, dynamique des populations, piège de type dressé, sex-ratio.

INTRODUCTION

The entomophagy (consumption of insects) is increasingly considered as an opportunity to solve the problems of dietary deficiencies or malnutrition. Indeed, insects provide many nutritional benefits (van Huis and Tomberlin, 2017; Jaynie and Yao, 2018). In Central Africa and particularly in DR Congo, the consumption of insects is a component of the food habits, but it is mainly based on the harvesting of insects in the natural environment. However, Lenga et al. (2012) showed that the excessive collection of individuals of a species in the nature may have a great impact on the economy and the ecology and in extreme cases, may also lead to the erosion of this species. The conservation of a resource can be possible only if the local population

is assured of the security of its means of existence (Ranaivomanana, 2006).

In a poor country, the best way to conserve a resource is to supply the population with a livestock. To conserve a resource, you first have to know its demography. Demographic studies of insects are especially influenced by climatic factors, in general insect populations decrease during the dry season and increase during the rainy season (Gilles, 2001). Strong relative humidities of the air generally have a negative influence on the abundance of insects. Before our work in the region of Kisangani, the number of species of *Rhynchophorus* present in the environment was not known. People consume the larvae of *Rhynchophorus* and the majority do not know anything about its biology, and that they come from the eggs laid by adults or do not recognize these adults (personal investigation). They do not include more than the excessive levies can do that these insects become scarce and at what time of the year they are abundant.

The work of Wattanapongsri (1966) concluded that there are two species of *Rhynchophorus* in Africa (*R. phoenicis* and *R. quadrangulus*); Mayné and Donis (1962) in their book show that there is only one species of *Rhynchophorus* in DR Congo (*R. phoenicis*). The objective of this study was to inventory the species of *Rhynchophorus* present in the region of Kisangani and to know at what time of the year they are abundant. Contrary to what has been found in previous work by (Buyckx, 1962; Mayné et Donis, 1962), we believe to find more than one *Rhynchophorus* species in the Kisangani region.

MATERIALS AND METHODS

Sites of trapping

Three sites in the Kisangani region (Fig.1) have been selected to do the trapping: (i) Tshopo site located at 00, 34° north latitude and the 025, 08° east longitude and at 450 m of altitude; (ii) Bangboka site at 00, 50° north latitude and 025, 29° east longitude and at an altitude of 413 m; (iii) Lubunga site located at 00, 41° north latitude and 025, 15° east longitude and at an altitude of 438 m. Two years of trapping were carried out: for nearly 3 months, from 19th March to 11th May 2012 and nearly four months, from 6th February to 26th May 2013. The Kisangani region has an equatorial climate characterized by the absence of totally dry months and is thus classified as an equatorial African climate (Af) in Koppen's classification (Mate, 2001). The average annual temperature is 25,6°C. The relative humidity is very high, with an average of 88.96%. The sites were fallows of about 4 years.

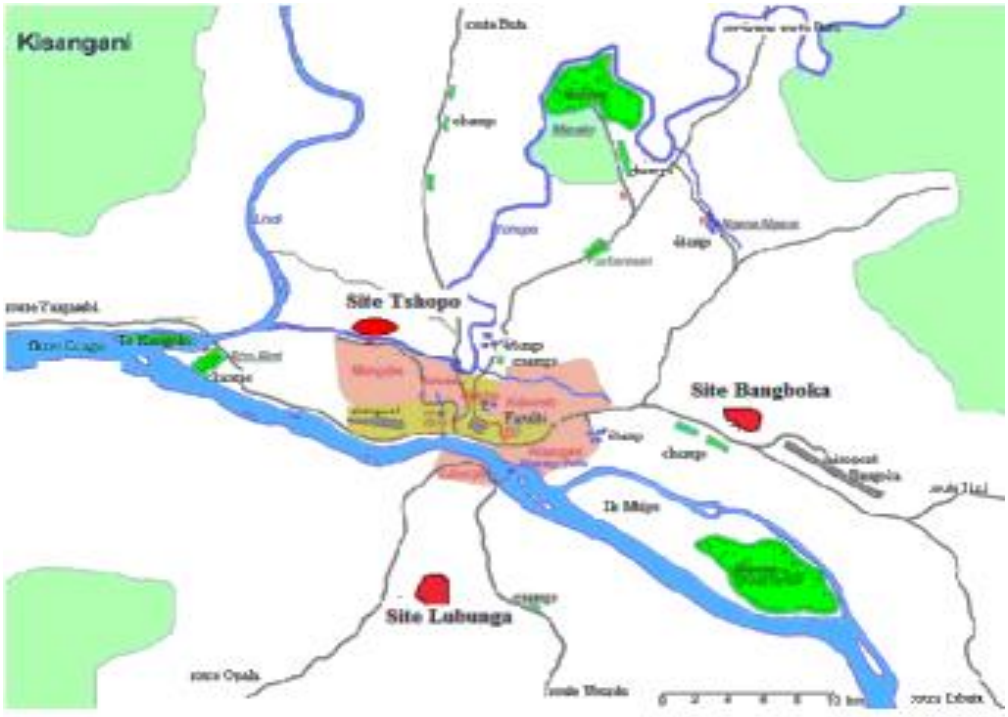

Fig. 1. Map of Kisangani and its hinterlands (Google Earth, 2004 modified). In blue, the Congo River, in purple, the city of Kisangani, in green the forest reserves, in red, different sites, and the lines are the different roads.

Trapping of adults

We used the trap not classic (ten by site by week) the more efficient (the upright type) as described by Monzenga et al. (2017).

Counting and identification of insects harvested

The identification of insects trapped until the species-specific level has been carried out using the keys for the determination of *Rhynchophorus* spp developed by Wattanapongsrii (1966), by comparison with specimens of reference (collection of the Museum of Central Africa in Tervuren) and the available literature (Martinez, 1981). One of the criteria was the sexual dimorphism from the rostrum. The rostrum of the female is long, curved, and glabrous, that of the male is shorter, a little cylindrical, straight and carries at its end dorsal a tuft of bristles. The sex ratio has also been calculated for each species, site and statement of trap with the following formula:
I = number of males / (number of females+number of males). I stand for sex-ratio

Statistical analysis

GLM (with poisson distribution link function) was performed with R version R 3.5.3. software to determine the effect of the factors (sites, sex and year) on the number of collected individuals.

RESULTS

We catched 2296 individuals and according to the determination key used, three species of *Rhynchophorus* have been identified during the whole study : *R. phoenicis*, recognizable with its black color, reddish streaks on the pronotum, Back and end of the Abdomen almost rounded (dorsal view) (Figure 2); *R. ferrugineus*, which was recognized by its reddish coloration, blackish streaks on the elytra and its end of the Abdomen pointed (dorsal view) (Figure 4); *R. quadrangulus*, visible by its pronotum almost square (Figure 3). In 2012, three species of *Rhynchophorus* were harvested: *R. phoenicis*, *R. ferrugineus* and *R. quadrangulus*. The Tshopo site has given the three species, Lubunga two species and Bangboka has had only a single species. The most abundant species was the *R. phoenicis* with 576 individuals.

Fig. 2. *Rhynchophorus phoenicis* © Jean Claude Monzenga, 2013.

Fig. 3. *Rhynchophorus quadrangulis* © Jean Claude Monzenga, 2013.

Fig. 4. *Rhynchophorus ferrugineus* © Jean Claude Monzenga, 2013.

The *R. ferrugineus* was a rare species with 9 individuals, whereas *R. quadrangulus* remained the species most rare with 2 individuals. In 2012, the three species was still present. The Bangboka site arrived at the head in terms of the number of individuals collected (698), but still poor in species, only one (*R. phoenicis*). The site Lubunga arrived in second position with 579 individuals caught, but in head for the specific richness (three species) and Tshopo occupied the last position with 438 individuals and two species, *R. phoenicis* and *R. ferrugineus*. We observed a significant difference between males and females (df = 177; χ^2 = 848.72 and p = 0.001). We harvested more individuals in 2013 than in 2012 (df = 180; χ^2 = 929.98 and p = 0.001) as illustrated in figure 5.

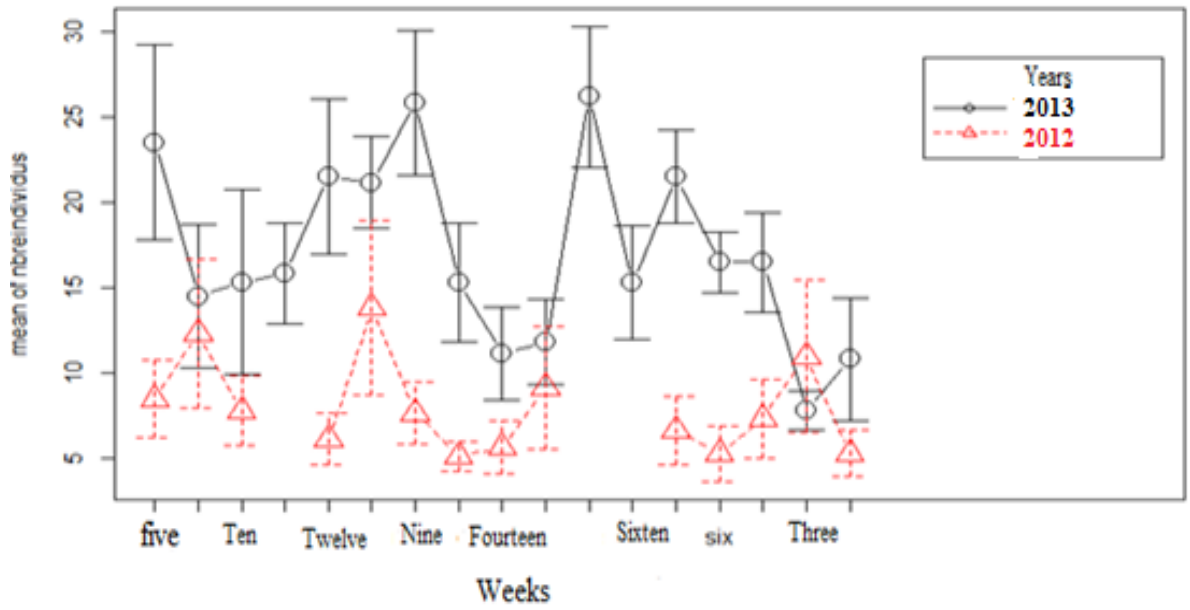

Fig. 5. Average number of individuals collected/week/month/year for the three species combined

This figure also showed that the *Rhynchophorus* are more frequent during rainy periods, which corresponds to the peaks of crops as well, observed on the figure and the low crops to dry periods (December to February and June to July). We observed a significant difference between sites (df = 178; χ^2 = 882.48 and p = 0.001); an interaction between year and site (df = 175; χ^2 = 662.01 and p = 0.001); between year and sex (df = 174; χ^2 = 651.50 and P = 0.01). The sex-ratio General was 0.5 in 2012 and 0.6 in 2013, the symbol of a growing population. However, the sex-ratio by species was 0.6 for *R. phoenicis* and *R. ferrugineus* (second consecutive year); which shows that these two species were in expansion compared to *R. quadrangulus* which remained static.

DISCUSSION

The results highlighted that this insect is found in large numbers in the Kisangani area. Three species are present, two of which had not been reported in the region *R. ferrugineus* and *R. quadrangulus*. On the three harvested species only one, *R. phoenicis* is very

abundant. The Bangboka site might be hostile to the rare species (*R. ferrugineus* and *R. quadrangulus*). The present research complements the studies of Wattanapongsri (1966) who have described only two species of *Rhynchophorus* in Africa: *R. phoenicis* and *R. quadrangulus*; also, Mayné and Donis (1962) who reported one specie in DR Congo (*R. phoenicis*).

It was also observed that there was a real bias in favor of females in 2013 with a sex ratio of 0.6, proximate to the observations of Monzenga (2015) on the production of adults in the laboratory by female, who had given a sex ratio of 0.5. The catches started well in the sites of trapping with high staff except the Lubunga site which has had a workforce low at departure due to a Belated recovery of rain on this side of the river. This is a clear proof that these insects are more frequent during the rainy period (March to May and September to November) because it is in the month of March where there is a recovery of the rains. The dominance of females was since they remain long for laying eggs, while males are at any time on the lookout for new mate.

The sex ratio of 2013 omen a good development of the population of these insects, because with more females, more eggs will be laid and the likelihood of having an increase of the population is high regardless of the presence of predators. From the point of view of the specific richness, we can say that the latter represents 30% compared to 10 species in the genus *Rhynchophorus* (Wattanapongsri, 1966). Among the three harvested species, only one is remarkable, *R. phoenicis*, because during the two years of study and in all sites, it gave 2269 individuals which represent 95% of the catch individuals.

CONCLUSION

The objective of this study was to inventory the species of Rhynchophorus present in the region of Kisangani and know at what time of the year they abundant. We have done the trapping during 2 years in the three targeted areas. The keys for the determination of *Rhynchophorus* and comparison with specimens of reference (collection of the Museum) were used. The results have shown that in the Kisangani region three species of *Rhynchophorus: R. phoenicis, R. ferrugineus* and the *R. quadrangulus* were available. The *R. phoenicis* was the most abundant species in all the study sites, the *R. ferrugineus* was a rare species, while the *R. quadrangulus* was the rarest species. In the terms of specific richness, the Tshopo sites and Lubunga have three species and the Bangboka site has only a single (*R. phoenicis*). These insects are more frequent during the rainy period. These results indicated that the population of *Rhynchophorus* in the Kisangani region is in full expansion.

Conflicts of Interest

The authors declare no conflict of interest.

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