INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
ISSN Print: 1560–8530; ISSN Online: 1814–9596
24–0522/2025/34:340204
http://www.fspublishers.org

Full Length Article

Diversity of Bees Visiting Cashew (*Anacardium occidentale*) Inflorescences and their Daily Dynamics in Northern in Cote d'Ivoire

Traoré Soumaila[1*], Tuo Yalamoussa[1], Soro Nangounon[1], Coulibaly Zanga Lacina[1] and Koua Kouakou Herve[2]
[1]*Department of Animal Biology, U.F.R. Biological Sciences, Péléforo Gon Coulibaly University of Korhogo, Ivory Coast, BP 1328 Korhogo, Ivory Coast*
[2]*Department of Zoology, Animal Biology and Ecology, U.F.R Biosciences Felix Houphouët- Boigny University, Abidjan, 22 BP 1611 Abidjan 22, Ivory Coast*
[*]For correspondence: traoretraore105@gmail.com
Received 19 October 2024; Accepted 29 November 2024; Published 18 May 2025

Editor: Zafar Iqbal

Abstract

Since 2010, cashew nuts have become Côte d'Ivoire's third-largest agricultural export. However, the yield of 300 to 500 kg/ha recorded is still low, compared with the 2000 to 60,000 kg/ha recorded in India. The aim of this study was to identify the bee species visiting cashew inflorescences and likely to be involved in pollination. The study was carried out in the Bagoué region of northern Côte d'Ivoire. Bees were collected from 15 orchards of the same age in the Bagoué region in northern Côte d'Ivoire. The presence of bees on the flowers (daily activity) was measured from 5 h to 19 h per hour for 10 min. Fifteen bee species belonging to three families, Apidae, Halictidae and Megachilidae, were recorded. With an average of 703.20 ± 45 individuals, *Apis mellifera* was the main visitor to cashew inflorescences. Major bee activity was recorded between 8 am and 11 am for Apidae and between 10 am and 12 noon for Halictidae and Megachilidae. To conclude, bees visiting cashew flowers in the Bagoue are highly diversified and dominated by *A. mellifera.*

Keywords: Apidae; Halictidae; Megachilidae; Cashew and inflorescence

Introduction

Cashew production represents a socio-economic development opportunity for producers and their countries. Global cashew demand is growing year on year (Belem 2013). In Africa, between 2011 and 2018, raw nut production rose from 1 million to 1.8 million tonnes, with annual growth of 5.8%, half of which is produced by Côte d'Ivoire, according to Planetoscope (2019) cited by Ndiaye *et al.* (2020). In 2010, cashew became Côte d'Ivoire's third-largest agricultural export after cocoa and rubber (Koné 2010). This performance ranked the country first among the world's cashew nut producing and exporting countries (Diop 2016). Despite the gains recorded, the current annual yield of Ivorian orchards, estimated at between 350 kg and 500 kg ha^{-1}, is still low as, it should reach 1.6 ha^{-1} (Djaha *et al.* 2017).

Several studies explain cashew's low productivity, by under-pollination (Reddi 1987; Freitas *et al.* 2014). According to work carried out by Reddi (1987) in India, 25 to 72% of the pistil, was not pollinated due to the lack of pollinating insects. Insects are therefore essential for cashew pollination. According to work carried out by Bhattacharya (2004), in India, cashew pollination is due to the action of bees, which considerably increase fruiting. Studies carried out by Vanitha and Raviprasad (2019) reveal the presence of 40 insect species belonging to 13 families of three orders. According to these results, Hymenoptera were the main floral visitors, comprising bees, ants and wasps, followed by Diptera. Of the 40 species recorded as flower visitors, only 13 are considered cashew pollinators, eight of which belong to the Apidae and five to the Halictidae. Of these two bee families, the Apidae were the most abundant, contributing 75.6% of bee abundance. Within the Apidae, the highest species abundance was recorded for *Braunsapis picitarsus* (20%), followed by *A. cerana indica* (16.7%). Halictidae bees contributed 24.4% of bee abundance, of which *Pseudapis oxybeloides* was the most abundant (17.6%). Peak bee activity was recorded between 11 am and 1 pm for most bees.

In Brazil, where cashew is native, direct observations of insects visiting the flowers have shown that the *A. mellifera*, although non-native, is the most efficient pollinator of cashew (Freitas *et al.* 2014). However, very little has been known about the bees that visit cashew

To cite this paper: Soumaila T, T Yalamoussa, S Nangounon, CZ Lacina, KK Herve (2025). Diversity of bees visiting cashew (*Anacardium occidentale*) inflorescences and their daily dynamics in Northern in Cote d'Ivoire. *Intl J Agric Biol* 34:340204. https://doi.org/10.17957/IJAB/15.2352

flowers in Côte d'Ivoire, despite its leading position. It was therefore to make up for these data deficit that the present study was carried out. The general objective was to improve cashew production by managing the pollinating entomofauna. Specifically, it consisted in studying the diversity of bees and their daily dynamics in Bagoué, one of the major production areas in Côte d'Ivoire.

Materials and Methods

Study area and sampling stations

The study was carried out in the Bagoué region of northern Côte d'Ivoire. This region is located in the savannah district, which is highly suitable for cashew nut production. The bees were collected in 5 orchards in each of the region's three departments (Boundiali, Kouto and Tengrela). The work was carried out during the cashew nut flowering period, corresponding to the dry season. The Bagoué region belongs to the dry tropical climate regime of the Sudan-Sahel type, whose seasonal rhythm is regulated by the movement of the Intertropical Front (Jourda *et al.* 2005). The climate is characterized by a rainy season from May to October, with maximum rainfall in September, and a dry season from November to April, characterized by the harmattan from December to February. The average annual temperature varies between 25°C and 35°C (Kouakou *et al.* 2014).

Taxonomy of bees

The bees were identified in the laboratory of the Péléforo Gon Coulibaly University in Korhogo. Bees collected from cashew inflorescences were preserved in 70% alcohol and transported to the laboratory. They were then sorted and separated from the other insects. Small bee specimens were dried and mounted on cardboard straws, while large ones were pinned directly from the thorax. Finally, the mounted specimens were identified under Motic brand binocular magnifier using a reference collection of bees previously identified by Dr. Tuo Yalamoussa and confirmed in Belgium by Alain Pauly in 2017. Atlas Hymenoptera bee identification keys were used by Pauly (1979, 1984, 1998) and Pauly *et al.* (2009).

Data collection

In the Bagoué region, 15 cashew orchards of the same age were selected for data collection. To record the diversity of visiting bees, observations were made daily on thirty cashew trees in bloom, selected at random and at regular intervals. Bee species visiting cashew flowers regularly and repeatedly were recorded from January to March 2022. Insects were collected three times a week from the open inflorescences of 30 feet of the same diameter throughout the flowering period. To assess daily insect dynamics, 13 fully opened inflorescences were randomly selected each week in the different plots and observed on two successive days over a three-month period. Observations were made on the inflorescences at 10-min intervals between 5 am and 7 pm. During each time slot, the number and type of bees were recorded.

Data analysis

All data were processed using Excel 2013 and Statistica version 7.1 software. In this study, single-factor analyses of variance (ANOVA; $P < 0.05$) were performed, followed by grouping of homogeneous means using Newman-Keuls tests. These were used to determine separately.

Results

Taxonomic composition of bees visiting cashew flowers in Bagoué

The bees collected from cashew inflorescences in Bagoué belong to three families: Apidae, Halictidae and Megachilidae. The Apidae family was the richest, with 8 species: *A. mellifera*, *Dactylurina staudingeri*, *Meliponula bocandei*, *Meliponula togoensis*, *Xylocopa olivacea*, *Meliponula ferrufinea*, *Amegilla* sp. and *Xylocopa* sp. The Apidae family was followed by the Halictidae family, with four species: *Pseudapis* sp. *Stictonomia schubotzi*, *Lasioglossum* sp., *Halictus* sp. and the Megachilidae family recorded 3 species: *Anthidiini* sp., *Megachile* sp. and *Heriades* sp. (Table 1).

Bee abundance

In terms of bees visiting cashew inflorescences in Bagoué, the Apidae family was most abundant with 892.53 ± 48.41, followed by the Halictidae family with an average abundance of 125.40 ± 1.86. The Megachilidae family was less abundant at 34 ± 1.86. The ANOVA test showed a significant difference between the mean abundance of the three bee families (F = 255.74, ddl= 42, $P = 0.00005$). The Newman-Keuls test grouped them into three homogeneous groups (Fig. 1).

In terms of species, *A. mellifera* recorded the highest mean abundance (703.20 ± 45), followed by *M. bocandei* (107.93 ± 4.06), *Halictus* sp. (68.267 ± 12.02) *M. togoensis* (31.33 ± 4.04), *Pseudapis* sp. (22.47 ± 3.52), *S. schubotzi* (22.07 ± 2.45). Low abundances were observed in *Megachile* sp. (16.40 ± 1.96), *Heriades* sp. (15 ± 1.30), *M. ferrufinea* (14.13 ± 2.03), *Lasioglossum* sp. (12.60 ± 1.15), *Xylocopa* sp. (12.06 ± 2.9), *D. staudingeri* (10.93 ± 3.02), *X. olivacea* (6.93 ± 1.08), *Amegilla* sp. (6 ±1.41) and *Anthidiini* sp. (2.60 ± 0.9). ANOVA and the Newman-Keuls test showed that there was a significant (F = 209.33, $P = 0.00005$) difference between species averages and enabled us to group these species into four homogeneous groups (Fig. 2).

Table 1: Taxonomic richness of bees in Bagoué

Families	Taxa
Apidae	*Apis mellifera*
	Dactylurina staudingeri
	Xylocopa olivacea
	Xylocopa sp.
	Amegella sp.
	Meliponula ferrufinea
	Meliponula bocandei
	Meliponula togoensis
Megachilidae	*Anthidiini* sp.
	Megachile sp.
	Heriades sp.
Halictidae	*Pseudapis* sp.
	Stictonomia schubotzi
	Lasioglossum sp.
	Halictus sp.

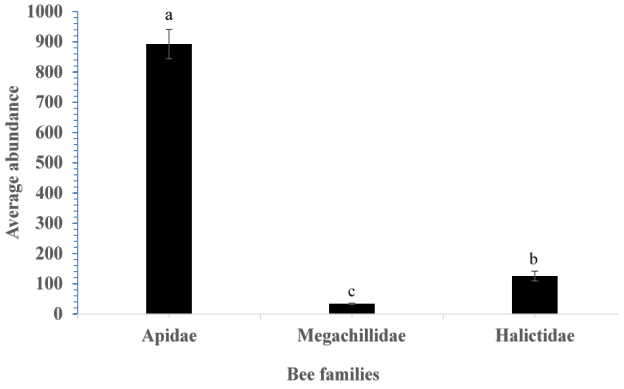

Fig. 1: Average abundance of bee families

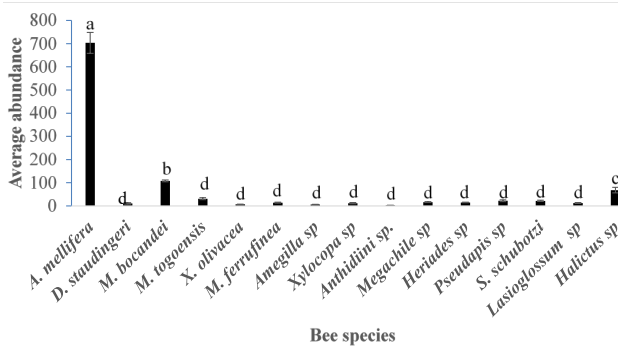

Fig. 2: Average abundance of bee species

Daily activity of bee families visiting cashew inflorescences

The three bee families varied in their activity during the day, as they did not enter into activity at the same time. The Apidae family was more active in the morning than the other families (Halictidae and Megachillidae). Activity began between 6 and 7 am and quickly intensified, peaking between 8 and 9 am with 8580 individuals. After this time, Apidae activity progressively decreased, ending around 12 am. In the afternoon, between 3 and 4 pm, activity picked up again, but was lower, with a second peak between 5 and 6 pm of 2040 individuals (Fig. 3).

As for the two families Halictidae and Megachilidae, they began their activity 3 h after that of the Apidae, in other words between 8 and 9 am for the Halictidae and 9 and 10 am for the Megachilidae. The activity of both families increased progressively, while that of the Apidae decreased appropriately. They reached their maximum peak at the same time, between 10 and 11 am, with 1630 individuals for Halictidae and 349 for Megachilidae. In the afternoon, their second peaks are observed before that of the Apidae, and activity subsides before the Apidae becomes numerous (Fig. 3).

Daily activity of bee species visiting cashew inflorescences by families

Apidae: For the species in this family, overall foraging activity on cashew flowers is continuous throughout the day. It starts at 6 am, intensifies at 9 am and drops off around 11 am. Specifically, the activity of honeybees (*A. mellifera*) and *M. bocandei* species varied throughout the day. It was null between 5 and 6 am for *A. melifera* and between 5 and 7 am for *M. bocandei*, and quickly intensified to reach its maximum peak between 8 and 9 am (6360 individuals) for the honeybee and between 9 and 10 am (1080 individuals) for *M. bocandei*. Beyond this time slot, *A. mellifera* activity gradually declined and cancels at 12 am Activity picked up again towards the end of the afternoon, between 3 and 4 pm, with a second peak between 5 and 6 pm (1320 individuals). As for *M. bocandei* (720 individuals), its activity gradually diminished and ended by 3 pm, with a resumption of activity between 4 and 5 pm and a second peak between 5 and 6 pm (Fig. 4).

The activity of the two species, *M. togoensis* and *M. ferrugenea*, varied throughout the day. Activity began between 6 and 7 am, increasing rapidly to reach its peak between 8 and 9 am for both species, with 980 and 420 individuals respectively. Beyond this time slot, the activity of *M. togoensis* and *M. ferrugenea* gradually weakened to nill between 1 and 2 pm for *M. togoensis* and between 11 am and 12 noon for *M. ferrugenea*. No resumption of activity was observed after the fall (Fig. 4). As for *D. standingeri*, activity was nulled between 5 and 7 am, then began between 7 and 8 am, reaching its only peak between 9 and 10 am (300 individuals). After 9 and 10 am, the activity gradually declined to zero at 12 pm and remained at zero until 7 pm (Fig. 3). The species *Xylocopa* sp. and *X. olivacea* were most active between 7 and 8 am and reached 154 and 89 individuals respectively during this period.

All these Apidae species were very active in the morning and less so in the afternoon. *Amagilla* sp. was active between 11 am and 12 noon with 208 insects.

Halictidae: In the Halictidae family, four bee species visited cashew inflorescences. The *S. schubotzi* species visited cashew inflorescences during the day from 9 am to 5 pm,

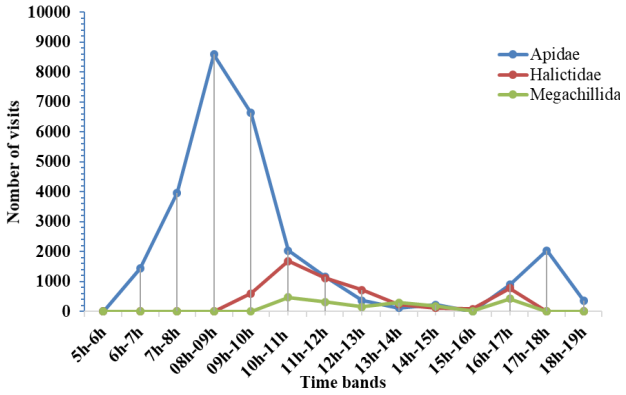

Fig. 3: Intraspecific relations between foraging bees on cashew inflorescences

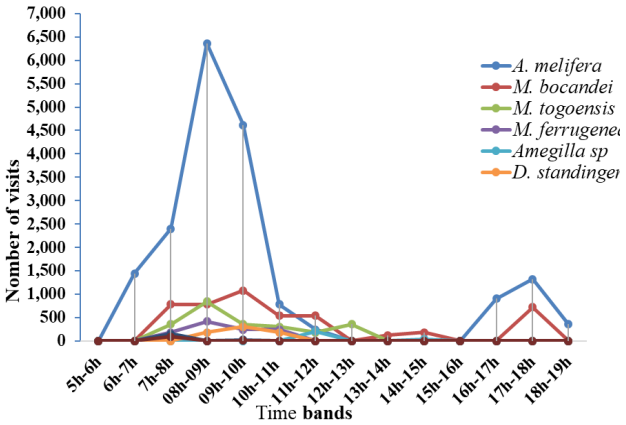

Fig. 4: Daily activity of Apidae species

with three peaks. Activity began at 9 am and intensified rapidly, reaching its peak between 10 and 11 am (840 individuals). From 11 am onwards, activity drops down, then rises again to reach a second peak, lower than the first, between 12 noon and 1 pm (420 individuals). The third and weakest peak was between 3 and 4 pm (80 individuals), and from 5 pm onwards the species' activity levelled off. *Pseudapis sp* was intensely active between 9 and 10 am, peaking at the same time as *S. schubotzi* between 10 and 11 am with 425 individuals, before dropping sharply to zero at 12 noon. A slight resumption of activity was observed between 2 pm and 4 pm, with a second peak of 120 individuals (Fig. 5).

Halictus sp activity began between 9 and 10 am, with a rapid increase to its first peak between 11 and 12 am (660 individuals). From 12 noon onwards, activity fell sharply and was annulled at 2 pm. Activity picked up significantly at 4 pm, reaching its second peak between 4 and 5 pm (780 individuals), which was higher than the first, before dropping off again very quickly at 6 pm (Fig. 5). *Lasioglossum* sp. was the least active species on cashew flowers, it became active between 10 and 11 am with a peak of 180 individuals and reached zero at 6 pm.

Megachilidae: Within the Megachilidae family, three species *Heriades* sp., *Megachile* sp. and *Anthidiini* sp. mainly visited cashew inflorescences. The daily activity of these three bee species evolved differently during the day. Activity began between 9 and 10 am for all three species. After the onset of activity, that of the *Heriades* sp. increased progressively, forming a sire-tooth pattern. There were three peaks, the first and lowest between 11 and 12 am (240 individuals), the second and highest between 1 and 2 pm (300) and the third and highest between 4 and 5 pm (421 individuals).

On the other hand, *Megachile* sp. rapidly increased its activity, reaching a peak of 240 individuals between 10 and 11 am and rapidly increased to zero by 1 pm. No resumption of activity was observed until 7 pm (Fig. 6). *Anthidiini* sp. was the least active species on inflorescences. Its activity progressed very slowly after 9 and 10 am, reaching its peak between 10 and 11 am (49 individuals) and gradually diminishing until it ceased at 2 pm. At 4 pm, the activity resumed but was very low (Fig. 6).

Discussion

Three bee families were identified visiting cashew flowers in the Bagoué region: Apidae, Megachilidae and Halictidae. The Apidae family was the richest in species on inflorescences. This could be explained by the fact that this family groups together most insect species visit cashew flowers. Cashew is a flowering plant, and its inflorescences constitute a food reservoir for visiting insects. In this context, Silué *et al.* (2022) showed that the Apidae, Halictidae and Megachilidae family species were the most diverse on cashew flowers in the cashew-growing regions of Côte d'Ivoire.

Lower species richness of Halictidae and Megachilidae families indicated that these insects visited cashew flowers less frequently or had an alternative food source other than cashew nectar and pollen. Silué *et al.* (2022) showed that Halictidae and Megachilidae were less rich species than the Apidae family. Freitas and Paxton (1996) reported that insects belonging to the orders Neuroptera and Coleoptera do not distinguish young flowers with fresh pollen or receptive pistils from those that are too old. They visit flowers only when they find non-viable pollen or are non-consistent in visiting cashew flowers. Bhattacharya (2004) showed that these insects visit flowers, but less frequently, irregularly and without touching the pistil.

In terms of bee families, our results showed that the Apidae were the most abundant in terms of number of specimens. This could be explained by the fact that the Apidae family is made up of several bee taxa that visit cashew inflorescences in large numbers. In India and Northern Côte d'Ivoire, it is reported that *A. mellifera* is more active on mango inflorescences, a plant belonging to the same family (Anacardiaceae) as cashew, which is

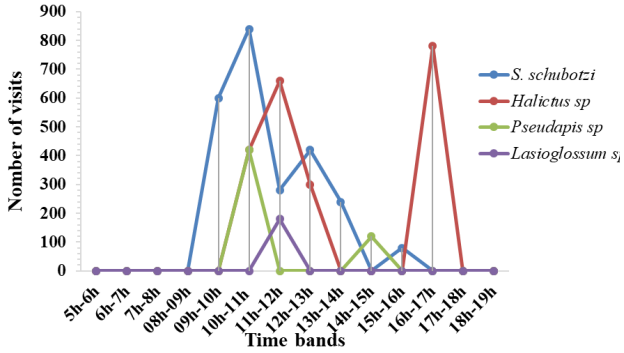

Fig. 5: Daily activity of Halictidae species

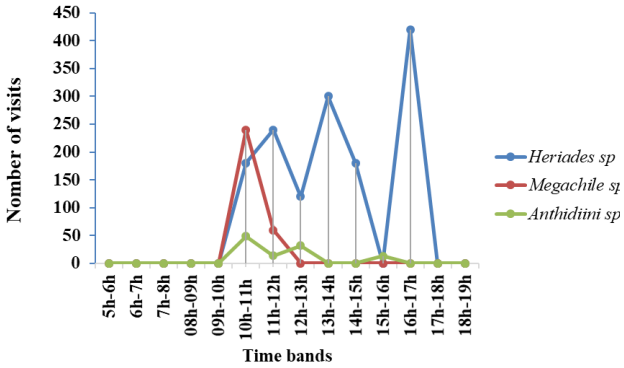

Fig. 6: Daily activity of Megachilidae species

similar to the findings of Silué *et al.* (2022) and Tuo *et al.* (2021) on cashew inflorescences in Côte d'Ivoire. These authors found that the Apidae family comprised a wide variety of species visiting cashew flowers, which would explain the high abundance of this family on the flowers.

In terms of species abundance, *A. mellifera* was found to be the most abundant, as revealed from its constant visit to inflorescences, which are very attractive to honeybees. At the start of cashew flowering in the north of the coast, food resources are scarce, so the *A. mellifera* is attracted by the food available (cashew inflorescences). Studies carried out on cashew trees in Côte d'Ivoire and India have shown that *A. mellifera* is highly attracted to cashew flowers (Tuo *et al*. 2021; Freitas *et al*. 2014). Sung *et al*. (2006) and Fajardo *et al.* (2008) reported that of all the insects visiting mango flowers, *A. mellifera* was the most active. Indeed, *A. mellifera* bee can form colonies of up to 25,000 individuals (Walters and Taylor 2006). This number may directly affect the number of individuals visiting cashew inflorescences (Silué *et al.* 2022).

Concerning the daily activity of Megachilidae and Halictidae, their species began to visit cashew inflorescences when Apidae numbers decreased. It is highly probable that there is antagonism between Apidae species and Megachilidae and Halictidae species, which corroborates the results *Pisum sativum* flowers for the activity of two Hymenoptera. *A. mellifera* (Apidae) and *Lasioglossum* sp. (Halictidae), began to visit at around 8 am and ended at around 3 pm. Peak visits were between 8 and 9 am for *A. mellifera*, and between 10 and 11 am for *Lasioglossum* sp., staggering the daily activity peaks of these two Hymenoptera, which would enable them to limit interspecific competition for pollen and/or nectar from this Fabaceae. When collecting booty from *P. sativum* flowers, both *A. mellifera* and *Lasioglossum* sp. bees were disturbed in their foraging activity by other insects competing for nectar and/or pollen. Among 22 *A. mellifera* visits, 2 (9.10%) were interrupted by *Lasioglossum* sp. and 1 (4.54%) by *Synagris* sp. Of 25 *Lasioglossum* sp. visits recorded, 2 (8%) were interrupted by a species of the Hesperiidae family. These interruptions resulted in a reduction in the duration of some visits, forcing the victim to visit a greater number of flowers during a foraging trip to obtain its optimal load of nectar and/or pollen.

In terms of Apidae activity, all species visited flowers most frequently in the morning between 8 and 11 am, and between 4 and 6 pm for *A. mellifera* and *M. bocandei*. The presence of bees on inflorescences seems to depend on the intensity of the aroma they emit. Insect pollinators seek nectar as a food resource. Nectar production and quality vary according to time of day, flower age, plant species and weather conditions (Pouvreau 1984). The daily activity of bees on flowers depends on whether they produce pollen (Stone *et al.* 1998) or nectar (Suzo *et al*. 2001) during the day. According to (Tuo 2013), most insect activity on oil palm inflorescences was observed between 9 am and 1 pm, with a peak at 11 am on the first and second day of anthesis. This time slot certainly coincided with the period when the aniseed fragrance released by the flower was strong. High bee activity in the morning is synchronized with maximum nectar secretion (Cervancia and Bergonia 1990).

As for the Megachilidae and Halictidae families, the species belonging to these families were most active in the morning (9 am – 12 noon) and afternoon (1 – 4 pm). However, they returned to intense activity when Apidae activity droped (10 am – 12 noon). The presence of bees on inflorescences depends on the intensity of nectar and pollen scents they emit. These insects are in search of nectar, which constitutes their food resource. Nectar production and quality vary according to time of day, flower age, plant species and weather conditions (Pouvreau 1984). The daily activity of bees on flowers depends on whether they produce pollen (Stone *et al.* 1998) or nectar (Suzo *et al*. 2001) during the day.

Conclusion

Bees visiting cashew inflorescences belonged to three families, Apidae, Halictidae and Megachilidae, dominated by Apidae. In terms of species taxonomy, *A. mellifera* far outstripped all the species collected from the flowers in terms of abundance. The activity of species from these families varied throughout the day. Apidae foraging activity

on cashew flowers was continuous throughout the day. It started at 6 am and intensified at 9 am. Halictidae and Megachilidae were active at 9 am, intensified at 11 am. Megachilidae and Halictidae activity was influenced by the effective presence of Apidae.

Acknowledgements

We would like to thank the people of Bagoué for their cooperation, without which this study would have been difficult to carry out. We would also like to thank the various readers of the manuscript for their contributions, which enhanced the quality of the article.

Author Contributions

Data collection and writing of the article were carried out by TS and the statistical analysis by SN. TY and CZL contributed to the writing. A final revision was carried out by KKH.

Conflicts of Interest

All authors declare no conflicts of interest.

Data Availability

Data presented in this study will be available on a fair request to the corresponding author.

Ethics Approval

Not applicable in this paper.

References

Belem BCD (2013). Analyse des déterminants de l'adoption des bonnes pratiques de production de l'anacarde au Burkina Faso. *M.Sc. Thesis*. Université Laval, Québec, Canada

Bhattacharya A (2004). Flowers visitors and fruit set of *Anacardium occidentale*. *Ann Bot Fenn* 41:385–392

Cervancia CR, EA Bergonia (1990). Insect pollination of cucumber (*Cucumis sativus* L.) in the Philippines. *Acta Hortic* 288:278–282

Diop M (2016). *Côte d'Ivoire: Premier producteur mondial de noix de cajou*, p:1

Djaha AJB, AA N'Da, M Dosso, CK Kouakou, AH Djidji, MY Minhibo, H Kpokpa, Bambio ZK, J Bambara (2017). Bien produire des plants greffés d'anacardier en Côte d'Ivoire, *Fiche anacardier n 2, CNRA*, p:2. Available at: https://cnra.ci/download/bien-produire-des-plants-greffes-danacardier-en-cote-divoire/

Fajardo AC, JR Medina, OS Oscar, CR Cervancia (2008). Insect pollinators and floral visitors of mango (Mangifera indica L. cv. Carabao). *Phil Agric Sci* 91:372–382

Freitas BM, RJ Paxton (1996). The role of wind and insects in cashew (*Anacardium occidentale*) pollination in NE Brazil. *J Agric Sci* 126:319–326

Freitas BM, JS Alípio, P Filho, PB Andrade, CQ Lemos, EEM Rocha, NO Pereira, ADM Bezerra, DS Nogueira, RL Alencar, RF Rocha, KS Mendonça (2014). Forest remnants enhance wild pollinator visits to cashew flowers and mitigate pollination deficit in NE Brazil. *J Pollin Ecol* 12:22–30

Jourda JP, BM Saley, EV Djagoua, KJ Kouamé, J Biémi, M Razack (2005). Utilisation des données ETM + de Landsat et d'un SIG pour l'évaluation du potentiel en eau souterraine dans le milieu fissuré précambrien de la région de Korhogo (Nord de la Côte d'Ivoire): Approche par analyse multicritère et test de validation. *Télédétection* 5:339–357

Koné M (2010). *Analyse de la chaîne de valeur du secteur anacarde de la Côte d'Ivoire. Initiative du Cajou Africain*, p:76. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), GmbH, Germany

Kouakou E, B Koné, AN'Go, G Cissé, CI Speranza, I Savané (2014). Ground water sensitivity to climate variability in the white Bandama basin, Ivory Coast. *SpringerPlus* 3:226-236

Ndiaye S, M Charahabil, M Diatta (2020). Evaluation de la qualité des Noix Brutes D'anacarde en Casamance (Sénégal). *Eur Sci J* 16:375–394

Pauly A (1998). Hymenoptera Apoidea du Gabon. *Ann Sci Zool Musee Roy Afr Cent Tervuren* 282:1–121

Pauly A (1984). Mission entomologique en Afrique occidentale (1979–1980). Renseignements ecobiologiques concernant les Hymenopteres. *Notes Fauniq Gembl* 11:1–43

Pauly A (1979). Mission entomologique en *Afrique occidentale*: Renseignements ecobiologiques concernant les hymenopteres. *Fac Sci Agron l'Etat Zool Gen Faunist* 58:41–43

Pauly A, Y Braet, S Tchibozo, C Aikpe, JL Boeve (2009). Hymenoptera Apoidea et Braconidae de quelques forets sacrees du Sud-Benin. *Bull Soc Roy Belge Entomol* 145:121–129

Planetoscope (2019). Planetoscope-Statistiques: Production de noix de cajou dans le monde.*https://www.planetoscope.com/*Epices/1253-production-de-noix-de-cajou-dansle-monde.html

Pouvreau A (1984). Cultures tropicales oléagineuses. In: *Pollinisation et Production Végétale (Coordonné PAR Pesson p., Louveaux j)*, pp:331–347. INRA, Paris

Reddi EUB (1987). Under-pollination: A major constraint of cashew nut production. *Proc Ind Natl Sci Acad B* 53:249–252

Silué D, K Yéo, Na Soro, W Dekoninck, Lmm Kouakou, K Ouattara, S Tiho, S Konaté (2022). Assessing the influences of bee's (Hymnoptera: Apidae) floral preference on cashew (Anacardiacae) agronomics performances in Côte d'Ivoire. *J Anim Plant Sci* 52:9474–9494

Stone GN, P Willmer, JA Rowe (1998). Partitioning of pollinators during flowering in an *African acacia* community. *Ecology* 79:2808–2827

Sung HI, L Ming-Ying, C Chin-Hsing, C Ann-Shiou, C Wen-Shyong (2006). Pollinators and their behaviors on mango flowers in Southern Taiwan. *Formos Entomol* 26:161–170

Suzo MJ, J Pierre, MT Moreno, R Esnault, JL Guen (2001). Variation in out crossing levels in faba bean cultivars: role of ecological factors. *J Agric Sci* 136:399–405

Tuo Y (2013). *Etat de l'entomofaune des inflorescences du palmier à huile en côte d'ivoire: Cas de la station CNRA de La Me, Thèse de doctorat de l'Université Felix Houphouët-Boigny, spécialité entomologie agricole*, p:204. Laboratoire de Zoology Biology Animale et Ecology

Tuo Y, D Coulibaly, M Koné, S Traoré, K Koné, HK Kouakou (2021). Diversity of insects on four cashew nut varieties inflorescences "*Anacardium occidentale* L." in Niofoin "Côte d'Ivoire". *Entomol Appl Sci Lett* 9:31–38

Vanitha K, TN Raviprasad (2019). Diversity, species richness and foraging behavior of pollinators in cashew. *Agric Res* 8:197–206

Walters SA, BH Taylor (2006). Effect of honey bee pollination on pumpkin fruit and seed yield. *Hortscience* 41:370–73