10.7251/AGSY1203196K
UDK 638.1

WHAT ARE THE BEES COLLECTING?: CASE STUDY OF STINGLESS BEES IN THE CENTRAL REGION OF GHANA

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Abstract

Bees provide pollination service which is very important for the reproduction of most seed producing plants as well as food crops. The Pollination services are also crucial for biodiversity conservation. *Apis mellifera* bee species have been known and kept all over the world for pollination services. In recent times it has become critical to explore and enhance the prospects of other bee species as alternatives to *A. mellifera* due to diseases and pests such as the varroa mites. Some tropical countries such as Australia have benefited immensely from stingless beekeeping but this practice is non-existent in Ghana due to lack of knowledge about the bees even though some species are found. By means of Direct Visual Observation Method in a randomized complete block design, the foraging resources of stingless bees in a forest and coastal savannah ecologies were investigated, using coconut as test crop to form a baseline for stingless beekeeping in Ghana. The stingless bees in the two ecosystems visited only the floral parts of the coconut, collecting pollen and nectar. The bees collected more pollen than nectar from the coconut and the probability of the two sample t-test showed a highly significant difference ($P< 0.001$). Also the two species of *Meliponula* stingless bees, identified were found in either of the two ecosystems.

Keywords: *Pollination, biodiversity conservation, stingless bees, food crops, ecosystems*

Introduction

The Meliponines or stingless bees are the only social bees other than the true honeybees, *A. mellifera* (Michener, 2000). These bees have so many characteristics that enhance their potential as pollinators of crops. They are polylectic or generalist flower visitors, visiting a broad range of plant species. Heard (1999) reviewed the crop pollination of stingless bees and reports that *Hypotrigona ponthieri* visited 54 species in 28 families, *Melipona marginata* visited 173 species in 38 families and *Melipona favosa* visited 38 species in 26 families. In the tropics and subtropics stingless bees have been found to visit most flowering plants (O'toole and Raw, 1991) and are therefore considered to be important pollinators of crops in these parts of the world (Free, 1993).

Pollination service of bees is very important for the reproduction of most food crops and seed producing plants as well as biodiversity conservation. In Ghana *Apis mellifera* bee species (common honeybees) are the only bee species that have been kept, especially for hive products. However with the diseases and varroa mites havoc that is threatening honey beekeeping all over the word in recent times, it has become critical to explore and enhance the prospects of other bee species in Ghana as alternatives to *A. mellifera.*

Knowledge about the forage resources of insects is key to effective and successful rearing of insects or beekeeping. Stingless bees are found to collect a lot of food resources on

coconut from various parts of the world. For instance in Surinam and Costa Rica, stingless bees are reported to be the dominating visitors of coconut (Engel Dingemans-Bakels, 1980; Hedström, 1986). In Trinidad, four species of stingless bees occasionally collected coconut pollen (Someijer *et al*., 1983). Both the male and female flowers of coconut are visited by the bees (Hedström, 1986) but previous studies give different accounts about which forage resource is collected more by the bees. For example, Heard (1999) reports that about 83% of individual stingless bees visiting pistillate flowers in search of nectar, carried loads of coconut pollen from previously visited staminate flowers. Kleinert-Giovannini and Imperatriz-Fonseca (1987) also reports that coconut species are mostly visited for nectar rather than pollen.

The study sought to investigate the foraging resources of stingless bees in a forest and coastal savannah ecologies using coconut as test crop to form a baseline for stingless beekeeping in Ghana.

The following hypotheses were tested during the study:

Ho 1: Generally, stingless bees do not collect more pollen than nectar on coconut

Ho 2: Stingless bees in forest ecosystems do not collect more pollen than nectar on coconut plants.

Ho 3: Stingless bees in coastal savannah ecosystems do not collect more pollen than nectar on coconut plants.

Materials and methods

The studies were carried out in two ecological areas also in the Central region of Ghana. These ecological areas are Agyirikrom (elevation 172ft 05^{o} 06.207' N and 001^{o} 27.627' W) in the Lower – Denkyira district of the Central region representing the forest zone and Ayensudo (elevation 204ft, 05^{o} 13.893' N and 001^{o} 12.079' W) in the Komenda Edna-Eguafo Abirem (KEEA) district of the Central region representing the coastal savannah zone.

Both the forest and coastal savannah zones are generally hot and there is a comparatively dry period from November to February when the North-East Trade Winds sets in, bringing in harmattan conditions. In the KEEA district the original vegetation was dense scrub, which was supported by rainfall. This has given way to grassland and scrubs of about 1.5m high grass and a few scattered trees in the coastal areas. In the Lower –Denkyira district, the predominant vegetation is secondary forest.

The studies were conducted through direct visual observation also known as sampling at flowers (Silveira, 2004) in a randomized complete block design. Within each coconut farm five trees of the crop were randomly selected. Each selected tree within a coconut farm was observed for 10 minutes and the various stingless bee species visiting the plants were identified. However, unidentified bees were collected using insect net, for further studies and identification in the laboratory by a bee Taxonomist. The foraging materials collected by the bees were also noted. Data was collected twice per month from the period October 2006 – March 2007. The diversity of the bees within the two ecosystems was computed using the Simpson's Diversity Index D (http://www.countrysideinfo.co.uk/simpsons.htm).

Results and discussion

Stingless Bee Species Found on the Coconut Plants

A total of four stingless bee species were recorded on coconut flowers from the forest and coastal savanna zones within the six, months' research period. The four species are *Dactylurina staudingeri* (Gribodo), *Meliponula bocandei* (Spinola) *Meliponula ferruginea* (Lepeletier) and *Liotrigona parvula* Darchen. *M. ferruginea* occurred only in the coastal savannah zone, whereas *M. bocandei* occurred only in the forest zone.

Diversity of Stingless Bees on Coconut Plants

The diversity of stingless bees was taken as a measure of species richness (the number of different kinds of stingless bee species present in a particular ecosystem) and evenness (the relative abundance of the different species making up the richness of an ecosystem). According to the Simpson's diversity index, an area is more diverse when its D- value is more towards zero (0) and less diverse when it approaches one (1). The D-values indicate that the forest is more diverse than the coastal savannah ecosystem in terms of stingless bees as it is more towards zero (0). Even though the two ecosystems had the same stingless bee richness, the relative abundance of the various species was different in both ecosystems (Table 1). *D. staudingeri* dominated all the other stingless bee species in terms of abundance.

Table 1. Diversity of the stingless bees on coconut plants within the two ecosystems

Species	**Forest n (relative abundance)**	**Coastal savannah n (relative abundance)**
D. staudingeri	104	53
M. bocandei	30	0
M. ferruginea	0	5
Liotrigona parvula	14	3
D (diversity index)	**0.54**	**0.76**

Foraging resources collected by the stingless bees on the coconut plants

The stingless bees were found visiting only the floral parts of the coconut plants within the two ecosystems (Plates 1 & 2). They collected resources from both the male and female inflorescences of the plants confirming Heard's earlier observation (Heard, 1999). The probability (under null hypothesis of equal variances) of the two sample t-test showed a highly significant difference ($P < 0.001$), thus Ho1 is rejected in support of Ha1. Thus the bees generally collected more pollen than nectar from the coconut. Nonetheless, at the 95% Confidence Interval (C.I.), the T-test value of 0.23 with a P-value 0.826 within 10 degrees of freedom, shows that the difference between the frequency of pollen and nectar collection by the three stingless bee species in the forest ecosystem is not significant thus failure to reject Ho2. This implies that within the forest ecosystem, the stingless bees did not frequently collect more pollen than nectar. In the coastal savannah ecosystem on the other hand, at the 95% C.I., the T-test value of 2.79 with a P-value of 0.019 within 10 degrees of freedom shows that the difference between the frequency of pollen and nectar collection by the three stingless bee species is significant. Therefore we reject Ho3 in favour of the alternate hypothesis. In other words, within the coastal savannah ecosystem, the stingless bees frequently collected more pollen than nectar.

Figure 1. *D. staundingeri* collecting nectar on female inflorescence

Figure 2. *M. bocandei* collecting pollen on the male inflorescence

Conclusion

The study showed that generally stingless bees frequently visit coconut to collect pollen than nectar. This confirms the observation that stingless bees prefer pollen to nectar as food and therefore collect mainly pollen during visits (Amano, 2002) probably for brood provisioning.

The bees were found to be more diverse in the forest than in the coastal savannah and *M. bocandei* and *M. ferruginea* occurred separately in the forest ecosystem and coastal savannah respectively. Further work needs to be undertaken to comprehend the separate occurrence of the two meliponula species.

Acknowledgement

The authors are grateful to the Marlin Foundation and the CS-Funds for the financial support.

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