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Diversity and relative Distribution of Honeybees Foraging Plants in some selected Reserves in Mubi Region, Sudan Savannah Ecological zone of Nigeria

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ABSTRACT

Surveys were conducted from August 2009 to June 2011 in some selected grazing and forest reserves of Mubi to study the diversity and distribution of honeybees foraging plant species. The survey was conducted through monthly visit to the selected sites located in some reserves in two randomly selected local government areas of Mubi region. One each of grazing and forest reserves was purposefully selected in every selected local government area to serve as study site. Four (4) transects of 1,000m in length were selected and stationed on two separate points on each site at every study visit. The start and end of each transect were marked with flags made from white or red clothes to enhance visibility. Moving on the transects, flowering plants found at about 50m radius were visited and observed for the presence and foraging activities of honeybees within a predetermined period of 10 minutes. Plants were scored as bee foraging species when at least three (3) honeybees had visited and foraged on the flowers within the observation period. The result indicated that 103 species of plants were promising as potential forages for honeybees. Though, the plants were not found to be evenly distributed over the entire surveyed locations, all the sites had some reasonable population of bee foraging species. The implications of these findings to prospective beekeepers are discussed. It was concluded that any of the studied locations can be profitably utilized for beekeeping.

Keywords: Diversity, relative distribution, honeybees, foraging plants, reserves, sudan savannah.

INTRODUCTION

Honeybees have been described as the most useful of all insects known to man, because, it provides man as well as other forms of life with basic services to their survival (Adjare, 1990). They are well distributed over the globe except in the severe cold areas of the Polar Regions (Adjare, 1990). They produce honey which is man's sweetest food (Adjare, 1990) and a balanced nutritious food having medicinal value (Rahman, 2006). Apart from honey, honeybees also produce beewax, propolis, pollen, royal jelly and bee venom (used as desensitizer for those allergic to bee stings and in the treatment of arthritis) which are also products vital to man

(Adjare, 1990 and Rahman, 2006). Similarly, they are known to play a vital role in the pollination of plant (Adjare, 1990; Rahman, 2006 and Burkle and Irwin, 2009).

Pollination of fruit crops is about the most important service the honeybee renders to mankind (Rathcke, 1992). The fact that honeybees are important in pollination of many species of plant is not new, but the fact that honeybee are becoming indispensable in our agricultural economy may be considered new (Adjare, 1990). The value of bees in pollination exceeds by ten to twenty times their value in the production of honey and beewax (Rathcke, 1992; Gomez *et al.*, 2007).The species of bees responsible for all the benefits to man are varied. However, the predominant honeybee species in Africa is the African honeybee *Apis mellifera adonsonii* and it is well adapted to the African ecological conditions and produces several honey crops a year. It gathers its own food freely throughout the year and there is little need to feed it (Adjare, 1990) especially in the savannah regions.

The savannah and the semi-arid regions occupy over 50% of African total land area (Areola, 1983; Adebayo, 2004 and Yonnana, 2004). The savannah regions can ideally support large scale commercial beekeeping because, its climatic conditions favour the honeybees and almost every plant found in the region produces flowers (Adjare, 1990). Many of such plants are good for bees pasture. Since the African bees work all year round, when there are large plantations of such bees pasture plants, the beekeeper can take advantage by sitting his apiary within or close to areas with concentration of the bee floral species. Good apiary location is one with nectar and pollen producing plants (Rahman, 2006) at all times across the year. Savannah regions are also endowed with abundant species of grasses which though are wind pollinated; it is common to find bees visiting them. These may also be vital source for foraging to bees alongside the trees and shrubs.

Mubi region being situated in a typical sudan savannah region can therefore be a potential site for commercial beekeeping enterprise. However, there is dearth of information in literature on plant species that could serve as bee foraging plants in this particular region as bee floral species are known to be specific to different areas and have definite micro-regional habitats (Rahman, 2006). The objective of this particular paper therefore, is to document plants that could serve as bee foraging floral species and their relative distribution in the region. This knowledge will be vital to prospective commercial beekeepers and policy makers willing to incorporate beekeeping in programmes aimed at reducing unemployment and poverty.

MATERIALS AND METHODS

The Study area

Mubi region lies between 9^0 30' and 11^0 north of the equator and longitude 13^0 and $13^0$45' east of the Greenwich meridian. It is bounded in the north by Borno State, in the west by Hong and Song local government areas and in the south and east by the Republic of Cameroon. It has a land area of 4728.77 km^2 (Adebayo, 2004)

Mubi region falls within the Sudan savannah belt of Nigeria's vegetation zones (Yonnana, 2004). The regions vegetation types is best described as Combretaceous woodland savannah (Areola, 1983) made up of grasses, aquatic weeds in river valley and dryland weeds interspaced by shrubs and woody plants (Yonnana, 2004). Forest reserve, grazing reserves and plantations also forms part of the regions vegetative resources (Yonnana, 2004) and it is made up of five (5) local government areas.

Site selection

Two of the five local government areas namely Mubi south and Michika were randomly selected for the study. In each of the selected local government areas, one each of grazing reserve (Mujara and Moda grazing reserves in Mubi south and Michika local government areas respectively) and forest reserves (Vi and Nduku in Michika and Mubi south local government areas respectively) and their immediate environs were also selected.

Sampling Protocols

Stratified random sampling procedures were used for the study in which every grazing and forest reserve purposefully selected based on accessibility formed a stratum. In each selected grazing or forest reserve, sampling was carried out on randomly chosen transect of 1,000 m in length.. The start and end of each transect was marked with a flag made from red or white clothes. On each study visit, observation for bee foraging plants were done on four transects chosen at two different locations within the sites to form sampling units. Every two of these transects crossed the other at the centre (500 m) perpendicularly. Plants seen with flowers within a 50 m radius of each transect were visited and observed for the presence of honeybees.

Whenever bees were found on the flowers of such plants, their foraging behaviour was observed for a period of 10 minutes. If the success of any foraging attempt was ascertained, the plant was scored as bee foraging species after at least three (3) honeybees have visited the flowers simultaneously within the observation period (10 minutes). Such plants were identified immediately using the key to plants by Hawtorne, 1990; Keller, 1996; Akubundu and Agyakwa, 1998 and Arbonnier,2004 in situ. If a plant was recorded as bee foraging species at a particular site and later encountered in subsequent surveys on other sites, it is only scored for presence (observations for bee foraging attempt were not repeated on them). Sample of plants that could not be identified in the field were collected using a sharp penknife; where a small twig or portion of a branch of the plant with the full complement of its leaves and flowers were cut, placed and pressed in-between the pages of old newspaper (Adeoti, 2006; personal communication), packaged in a properly labelled brown envelopes and placed horizontally in specimen box, and we return to the transect to finish observations to its end mark. All collected samples were later sent to Ahmadu Bello University, Zaria-Nigeria herbarium for proper identification by a taxonomist.

If the success of foraging attempts were not certain (i.e. when it was apparent that bees flew off from flowers to continue the search for suitable ones), the plant was regarded as a non-honeybee foraging species, we then return to transect to complete observations to the end.

Observations in each site were repeated every months ensuring as much as possible that previously surveyed areas were avoided. Each study visit served as pseudo replicates for the site and all observations were done between 0700-0930hours and 1530-1730hours on every study visit.

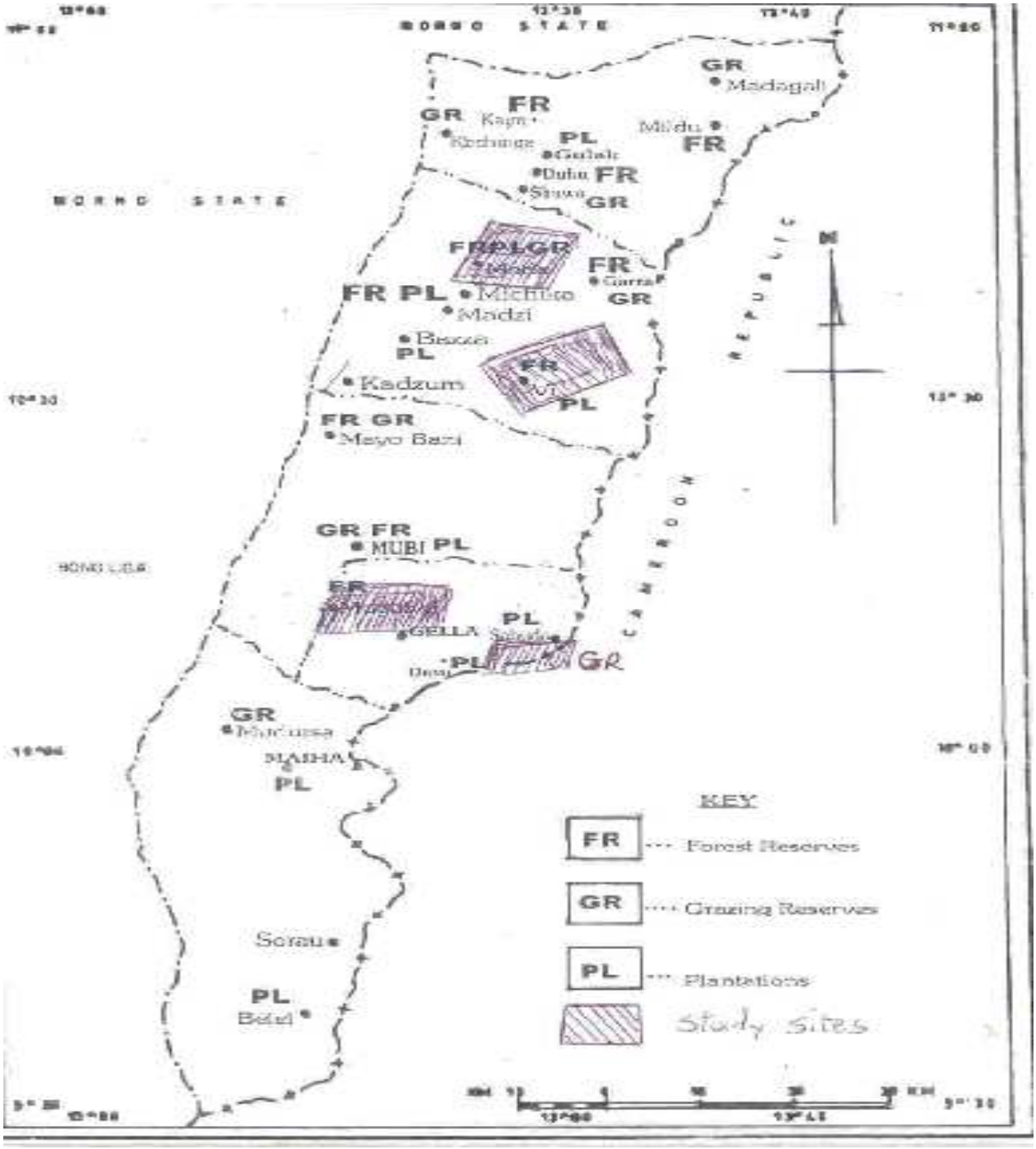

Fig 1: Map of Mubi region (Yonnana, 2004) showing the Study sites

RESULTS

The result showed that about 103 species of plant were found to be foraged upon by honeybee and all the studied locations had reasonable number of the bee foraging floral species. The highest numbers of species were recorded from Vi forest reserve (n = 81) and the least being at Moda grazing reserves (n = 71), both locations being in Michika local government area (Table 1). This shows that the species were not equally found in all the sampled locations, however, it was evident from the result that slightly more than half of the species (n= 52) were found in all the locations and about 73 species occurred in at least three (3) of the sampled sites.

Table 1: Bee foraging plants species of Mubi Region and their relative distribution across the sampled locations

Plant species	Sampling Locations			
	Mubi South L. G. A		Michika L. G. A	
	Nduku GR	Mujara FR	Moda GR	Vi FR
Abutilon mauritianum (Jacq.) Medic.	*	*	*	*
Acacia ataxacantha DC	*	*	-	*
Acacia dudgeon Craib ex Hall.	*	*	*	*
Acacia Erythrocalyx Brenan	-	*	-	-
Acacia Gerrandii Benth.	*	-	-	*
Acacia gourmaensis A.Chev.	*	-	-	*
Acacia hockii De Wild	-	-	-	*
Acacia leata R. Br. ExBent	*	*	*	*
Acacia mellifera (Vahl) Benth	*	*	*	*
Acacia sayel Del.	*	*	*	*
Acacia senegal (L.) Willd	*	*	*	*
Acacia Sieberiana DC	-	-	*	-
Acacia Tortilis (Sari) Brenan	-	-	-	*
Acanthus montanus (Nees) T. Anders	*	*	*	*
Adansonia digitata L.	*	*	*	*
Ageratum conyzoides Linn.	*	*	*	*
Albizia adianthifolia (Schummach.) W.F. Wight	*	*	*	*
Albizia Zygia (DC) J. F. Marcbr.	*	*	*	*
Amaranthus spinosus Linn.	*	*	*	*
Anacardium occidentale L.	-	-	*	*
Annona senegalensis Pers.	*	*	*	*
Anthocleista procera Lepr. Ex Bureau	-	-	*	-
Aspilia Africana (Pers.) C. D. Adam	*	*	*	*
Azadiracchta indica A. Juss	-	*	-	*
Balanites eagyptiaca (L.) Del.	*	*	*	*
Carica papaya L.	-	-	-	*
Carissa edulis Vahl	*	*	-	-
Ceiba pentandra (L.) Gaertn.	*	*	*	*
Chamaecristis mimosoides (L.) Greene	*	*	*	*
Chrysanthellum indicum (Linn.) Vatke var.	-	*	-	-
Citrus aurantifolia (Christm.) Swingle	-	-	-	*
Citrus grandis (L.) Osbeek	*	-	-	-
Citrus limon (L.) Burm. F.	-	-	-	*
Citrus reticulata Blanco	-	*	-	*
Cleome viscose L.	*	*	*	*
Cochlospermum planchoni Hook. F	*	*	*	*
Crotalaria retusa Linn	*	*	*	*
Dialium guineense willd	*	*	*	*
Diospyros mespiliformis Hochst. Ex.A.Rich	*	*	*	*
Entada abyssinica Steud. Ex A. Ric	*	*	*	*
Entada Africana Guill. & Perr.	*	*	*	*
Faidherbia albida (Del.) Chev.	*	*	*	*
Gardenia aqualla Staff and Hutch.	-	*	-	-
Heamatostaphis barteri Hook. F.	*	-	-	-
Heterotis rotudifolia (Sm.) jac-fel	*	*	*	-
Luduvigia decurrens Walt.	*	-	*	*
Hibiscus asper Hook F.	*	*	*	*
Hoslundia opposite Vahl.	*	*	*	*
Ipomoea involucrate P. Beakvi	*	*	*	*
Ipomoea Vagans Bak.	*	*	*	*
IpomoeaMauritiana Jacq.	*	*	-	-
Isoberlinia tomentosa (Harms) Craib and Stapf.	-	*	*	*

Jasminum dichotomum Vahl	*	-	-	-
Jathropa Curcas L.	-	-	-	*
Jathropa gossypiifolia L.	-	-	-	*
Justicia flava (Forsk) Vahl	*	-	-	-
Khaya senegalensis (Ders.) A. Juss	*	*	*	*
Launaea taraxacifolia (Willd) Amin. Ms ex	-	*	*	*
Leonotis nepetifolia (L.) Ait. F.	-	-	-	*
Lophira lanceolata Van tiegh	*	-	-	*
Mangifera indica L.	-	-	-	*
Melanthera scandens (Schum and Thonn.)	*	*	*	*
Mitragyna inermis (Willd) Kuntze	-	*	-	-
Momordica chorantia Linn.	*	*	-	-
Neptunia olerace Lour.	*	*	*	*
Oryza longistanus A. Chev & Roehr.	-	-	-	*
Parkia biglobosa (Jacq.) R. Br.	*	*	*	*
Paullinia pinnata L.	*	-	*	*
Pennisetum violaceum L. Rich.	*	*	*	*
Phyllanthus muellerianus (O. ktze) Exell	*	-	-	*
Physalis angulata Linn	*	-	*	*
Piliostigma reticulatum (DC) Hochst.	*	*	*	*
Piliostigma thonningii (Schum.) Milne-Readhead	*	*	*	-
Pithecellobium dulce (Roxb.) Benth	-	-	*	-
Prosopis Africana (Guill & Perr.) Taub.	*	*	-	*
Prosopis julifora (SW) DC	*	*	*	-
Protea madiensis Oliv.	*	*	-	-
Psidium guajava L	-	-	-	*
Punica granatum L.	*	*	*	*
Ricinus communis L.	*	*	*	*
Sarcocephallus latifolius (Smith) Bruce	-	*	*	*
Sclerocarpus africanus Jacq.& Murr.	*	*	*	*
Sclerocarya birrea (A.Rich) Hochst.	*	*	*	*
Senna obtusfolia (L.) Irwin and Barneby	*	*	*	*
Sesamun indicum Linn.	*	*	*	*
Sida acuta Burm. F.	-	-	*	-
Solanum torvum Swartz	*	*	*	*
Spilanthes filicaulis (Schum and Thonn.)	*	*	*	*
Steganotaenia aralicea Hochst.	*	*	*	*
Syzgium guineense (Engl.) F. White	*	*	*	-
Talinum Triangulare (Jacq.) Willd	*	*	*	*
Tamarindus indica L.	*	*	*	*
Tephrosia bracteolate Guill and Perr.	*	*	*	*
Tithonia diversifolia (Hemsl.) A. Gray	*	-	-	*
Tridax procumbens Linn.	*	*	*	*
Urena lobata Linn.	*	-	*	-
Uvaria chamae P. Beauv.	*	*	*	-
Vitellaria paradoxa Gaertn. F.	*	*	*	*
Vitex doniana	*	-	*	*
Ximenia Americana L.	-	-	-	*
Ziziphus absysinica Hochst.	*	*	*	*
Ziziphus mauritiana Lam.	*	*	*	*
Ziziphus mucronata Willd	*	*	*	*
Total number of species/location (n)	78	72	71	81

**= presence of plant species at site, - = absence of plant species at site, GR= Grazing reserve, FR= Forest reserve, L.G.A. = Local government area.*

DISCUSSION

In this particular study, 103 species of plant were found to be foraged upon by honeybees. This is an indication that areas covered by the study and by extension other similar areas found in Mubi region and elsewhere could be a very good site for beekeeping. This is because the availability and quality of forage has a profound influence on the abundance, survival, reproduction, activity and even species interaction of bees and herbivores in general (Bukovinszky et al., 2008). Similarly, it has been established that forage sources for honey bees are an important consideration for beekeepers (Greenleaf et al., 2007; Burkle and Irwin, 2009) and a good apiary location is the one with abundant pollen and nectar source throughout the year (Rahman, 2006). The result further suggests that honeybees will easily obtain quality pollen and nectar in all the localities surveyed due an all year round availability of flowers seen on the bee foraging plant found here. An all year round supply of cheap quality nectar and pollen is vital for bee keeping especially in poor resourced countries where prospective beekeepers may lack extra finances that may be needed for supplemental bee feeding; and bees cannot produce without harvesting pollen and nectar to feed themselves and their offspring (Michener, 2007). Furthermore, preference and performance of adult pollinators like honeybee may be affected by the quality and quantity of floral resources they receive in their larval stages (Williams and Kremen, 2003). Bees also vary in growth and reproduction based on resources availability (Burkle and Irwin, 2009) and production of bee products and services can equally vary with floral nectar and pollen resources (Kim and Thorp, 2001).

Judging from the bee activity observed from this present study, it could be expected that farmers have been benefiting tremendously from the ample presence of bee foraging plants in the vicinity of their farms. The foraging activities of plant pollinators like honey bees is known to enhance the performance of a cross pollinated crop in a kind of mutualistic relationships (Gomez et al., 2007; Sahli and Cornner, 2007) and bees are the most important pollinator taxon (Greenleaf et al., 2007).

As a general rule, the performance of plant herbivores is dependent on the quality and quantity of plant resource at their reach (Awmack and Leather, 2002.). And since the surveyed areas are naturally endowed with bee floral resources, enhanced honeybee performance can be expected to occur here. Although, the result clearly shows that, the bee forages were not found evenly distributed over the study sites, slight variations in nectar resources across the landscape is common (Ratchcke,1992) . And this may not pose a serious challenge to profitable apiculture here since bees can detect nectar-rewarding flowers within their foraging range (9 km from beehive) based on visual and olfactory cues (Howel and Alarcon, 2007).

The positive relationship between bees activities and floral densities as observed here have been reported to mean that bees have higher recruitment, reproduction and survival rates in areas with more flowers (Westphal et al., 2006). However, the above relationship can be influenced by other limiting factors such as rate of parasitism, predation and nest site availability (Elliot, 2009). Therefore, unless there is high rate of predation, parasitism and to lesser extent dearth of suitable nesting site (which can of course can be overcomed easily by provision of modern bee hive) within these areas, profitable apiaries could be easily established, maintained and sustained favourably here. There is therefore, the need to study honeybees predators, parasitoids and parasites that may be found in the study area with a view to coming up with the site-specific functional relationships to establish how these interactions may constrain bee keeping here. There is also the need to mobilise farmers in these areas through properly articulated extension programme to embrace beekeeping as means of diversification of ventures to boost their earnings

for enhanced standard of living. In conclusion, the result clearly indicated that the area is rich in bee foraging plant species. The result can equally serve as a guide for deciding plantations by different agencies based on the multiple use principle and their value as bee forage as one of the uses.

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