Melliferous Resources for Bee Forage

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Abstract

The efficiency of the beekeeping industry largely depends on productive colony management, beehive location, climatic factors, and availability, richness, and proper utilization of the melliferous resources around the apiary. The present investigation identified the diversity of melliferous resources in the three selected study sites in the Second Congressional District in Cagayan Valley from March 2014 to April 2015 using a descriptive survey method of research. It likewise documented a bee floral calendar based on the pollen and nectar availability in the province. The study employed a frequency count in analyzing and discussing the gathered data. In the vegetations sampled, 54 plant species are useful to honeybees, 27 of which are forest trees, 25 are agricultural crops, and one each is a shrub and a weed. The study ascertained 18 flowering plants as extremely indispensable bee floras since these blossom throughout the year. March to May was the honey flow period in the study sites. July to September (dry season) and October to December (monsoon season) were the critical periods for honeybees. The floral calendar was developed in relation to the time and duration of bloom of the important honey and pollen plants. Northwestern Cagayan is suitable to sustain bee colonies.

Keywords: Ecology, melliferous resources, bee forage, nectar, pollen, floral calendar, descriptive survey, Cagayan Valley, Philippines

1.0 Introduction

The demand of beekeeping has been increasing tremendously in the world (Bhalchandra&Baviskar, 2015).It offers direct and indirect benefits to the rural people. Directly, beekeeping substantiates household income from hive product sales to food, safe medicines and raw materials for industries (Manyi-Loh, et al., 2011). Indirectly, beekeeping contributes to forest conservation and crop pollination (Lietaer, 2009).Many of the world's crops are pollinated by bees and they are often assumed to be the most important pollinators (Berenbaum, 2016).The extra-remarkable aspect of beekeeping is that it ensures the continuation of natural assets: by the pollination of wild and cultivated plants (Fadare, et al., 2008). Bees are not only a fantastic world resource; they are essential for sustaining our environment (Badbear, 2009).

Bees collect nectar, pollen or both to ensure their survival (Somerville, 2000; Harugade & Chaphalkar, 2013). They harvest where they can. Subsequently, wild cultivated wasteland and even land-mined areas have value for beekeeping. Bees have no competition with other animals (Javi International Consulting PLC, 2015, Heaf & Heaf, 2010). In their absence, the primary products like honey, pollen, beeswax, propolis and other bee products would not be harvested. However, the amount of pollen a colony eats largely depends on the availability of pollen to foraging honeybees (Somerville, 2001; Harugade & Chaphalkar, 2013).

Consequently, the abundance and occurrence of pollen and nectar sources within the surrounding area of an apiary from which the bees forage (Balchandra, et al., 2014) regarding both quality and quantity is a prerequisite for successful beekeeping (Al-Ghamdi, et al., 2016). These would enable beekeepers to utilize them at the maximum level, so that they can harvest a good yield of honey and other bee products in addition to efficient pollination, which enhances crop yields (Balchandra, et al., 2014; Harugade & Chaphalkar, 2013).

With the rapid increase of population, Bista and Shivakoti (2011) recounted that the supply of honey and other bee products become limited. In other words, there is a wide gap between supply and demand of the products which necessitates the increase in the production of bee products. Given these, the present study was carried out to develop a floral calendar on the blooming schedules of bee pasture/forage plants in Northwestern Cagayan. Specifically, it aimed to identify the melliferous plant species and their density in each study site; describe the main characteristics of each plant species; determine the peak and scarcity periods of honey foraging activities; and develop a beekeeping floral calendar on the existing honey plants in the selected study sites. The results of the study will serve as a guide for the beekeepers to migrate their colonies during honey flow to obtain higher honey production. These will also be a useful reference for substantial recommendations to strengthen the programs of the Department of Agriculture and the Department of Environment and Natural Resources along the areas of land use or vegetative cover. By these means, the attainment of the national goals along sustainable food production and reduction of food shortage and malnutrition through bee products will be achieved.

Theoretical Framework

The presence of honey plants that provide pollen and nectar for foraging bees is indispensable for the existence, strength, production, and productivity of the honeybee colony. Thus, identification and registration of bee floral species in various agro-ecological zones, the value of different honey plants as sources of nectar and pollen or both, their life form, possible ways of propagation and the potential of these plants for honey production is of paramount importance (Wubie, et al. 2014). Moreover, beekeepers must have a working knowledge of appropriate sites that have enough supply of bee forage for successful yield of honey and for them to determine when to carry out various management practices with their colonies.

Bees forage mainly on pollen and nectar (Teklay, 2011). Pollen grains are essential to the production of brood. Today, it is well known that its availability directly influences the brood rearing capability of the honeybee colony. Correspondingly, the amount of honey a colony can produce depends on, to a large extent, the abundance of nectar secreting plants in the vicinity of an apiary.

Accordingly, this study anchors on the Optimal Foraging Theory. The theory postulates that a successful search for food sources is advantageous to an individual's survival.

When observing animals in the wild, they are most likely to be seen foraging for food. If successful, their foraging efforts culminate in feeding. Animals search, sense, detect and feed. The ultimate reason for foraging arises from the

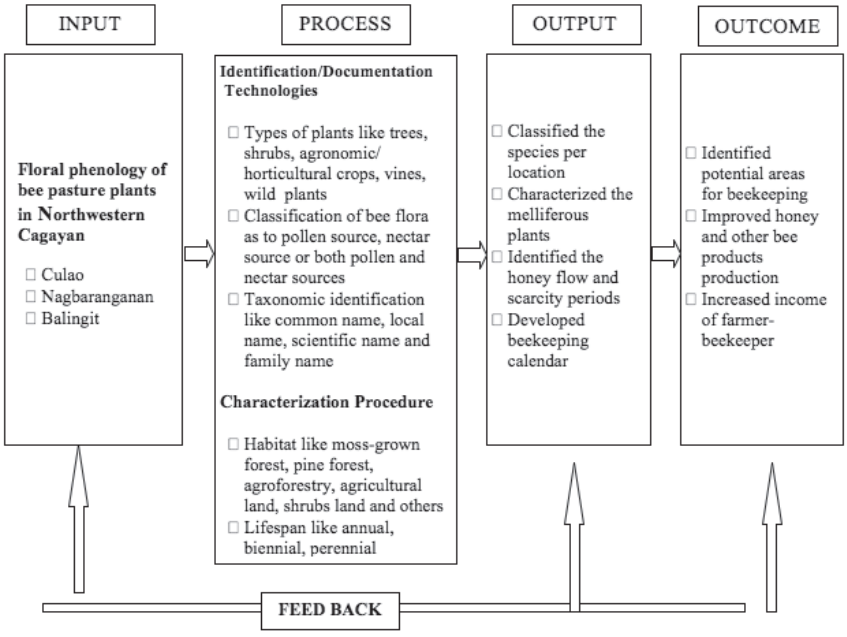
difference between life and death. At some point in an animal's life, it may experience episodes of starvation and prolonged starvation can lead to death. If animals survive and die as a function of variation in their foraging strategies, then, natural selection has run its course. Animals that survive can contribute genes to the next generation, while those with unsuccessful foraging behaviors die (Sinervo, 2006). Understanding the foraging behavior of bees, has significant implications for developing a floral calendar for bee pasture plants (Nicholson, 2012).

Bernd Heinrich was one of the first to test the Foraging Theory using pollinators and has published many papers on the foraging of bees. Optimal Foraging Theory is one of several cost/benefit analysis used to predict or explain the behavior of bees. Optimal Foraging Theory predicts that bees will behave in such a manner as to maximize their energy intake (benefit) with the minimal output of energy (cost). Foraging by bees provides an area to test optimal foraging. When bees forage, they are faced with many stimuli in a short period. Depending on the diversity of flowers in a particular area, the bees are faced with stimuli of color, smell, size, flower complexity and distance between the flowers. If Optimal Foraging Theory holds, bees should choose flowers whose cost of obtaining nectar is less than the energy gain from the nectar. Cost may include energy used in searching for the food source and the time it takes to manipulate a food source ("Differences in honey bee and bumble bee foraging behavior," n.d. para.1).

Bees obtain their principal sources of food from nectar and pollen-producing plants and other resources within their flight range (Kleinert and Giannini, 2012). If foraging bees discover a sufficient source of food, they can communicate this information with other bees when they return to the hive. They are very efficient. They will travel no further than they need to satisfy their needs. As a rule of thumb, the foraging area around a beehive extends for two miles (3 km), although bees forage twice and three times this distance from the hive. Experiments have shown that bee colonies within 4 miles of a food source will gain weight, but beyond that, the energy expended is greater than that stored during the foraging flight. Foraging at extreme distances, wears out the wings of individual bees, reduces the life expectancy of foraging bees and therefore the efficiency of the colony (Krengel, 2006; "Forage (honey bee)," n.d. para. 2).

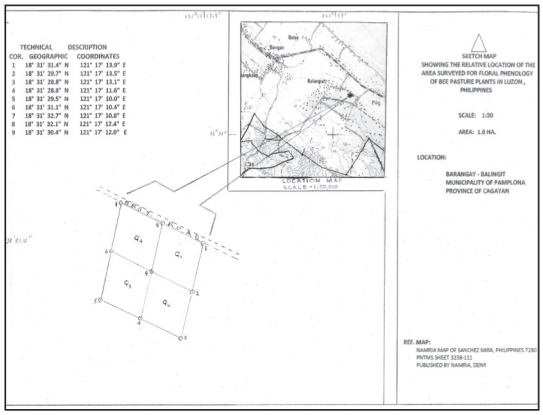
It is, therefore, assumed that a knowledge of the distribution of food sources within the flight range of honeybees, blooming time and duration, and quality of bee flora from which the bees forage for pollen and nectar are important considerations for beekeepers. Beekeepers must also know the ecological factors influencing the blooming season of every major honey plant and the carrying capacity of each site (Gebretsadik, 2016). The assessment of the vegetation cover in each of the study sites will likewise generate salient information/data as a basis for developing a floral calendar. Beekeepers and other stakeholders can make use of the floral calendar to plan a range of beekeeping management operations for them to produce a good yield of bee products and promote beekeeping as a profitable agricultural occupation.

Consequently, the framework that guided the conduct of this study is represented in the paradigm on the next page.



2.0 Methodology

In March 2014 to April 2015, a study on the present status of plant species for bee forage in Northwestern Cagayan was conducted through a descriptive survey method of research to obtain factual, accurate and systematic data. The area lies in the northwestern tip of mainland Luzon, Philippines, making it closest to Taiwan and Japan. The representative beekeeping sites are the barangays Culao in Claveria, Nagbaranganan in Sanchez Mira and Balingit in Pamplona. Before the selection of the study sites, a field reconnaissance survey was carried out purposely to become familiar with the area and to get an insight on the vegetation distribution in the landscape. A one hundred percent inventory of the potential vegetation or plant species in the three study sites was followed using the quadrat method. To facilitate the inventory, a one hundred square meters per plot. Frequency count was used to analyze and discuss the data gathered.



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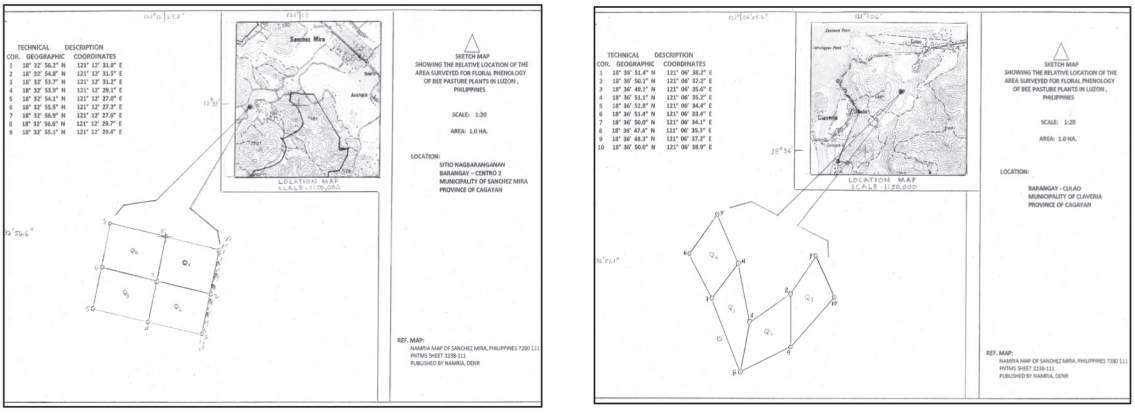

Nagbaranganan ***Culao***

Figure 1. *Sketch map of the locations of the area surveyed.*

Taxonomic identification of melliferous plant species was made at each study site. The local names, official common names, scientific names, and family names of the melliferous plant resources were identified through actual ocular inspection and survey. The other data gathered were as follows: (1) identification of the plants as a forest tree, agricultural crop, shrub and weed; (2) density of present vegetation; (3) characterization of the identified flora in terms of food and non-food producing species, life span, propagation technique and habitat type; (4) flowering season/ blooming schedule; and (5) number of nectar and/ or pollen producing plants;

To further validate the taxonomic identities of the different bee pasture plants, random informal interview of local people was conducted. The flowering season of each of the plant species was recorded every month for one year. During the observation, the peak and critical months of blooming period and frequency of flowering were identified. As soon as the researcher gathered the pertinent data, a floral calendar was developed for Northwestern Cagayan.

Cagayan Valley

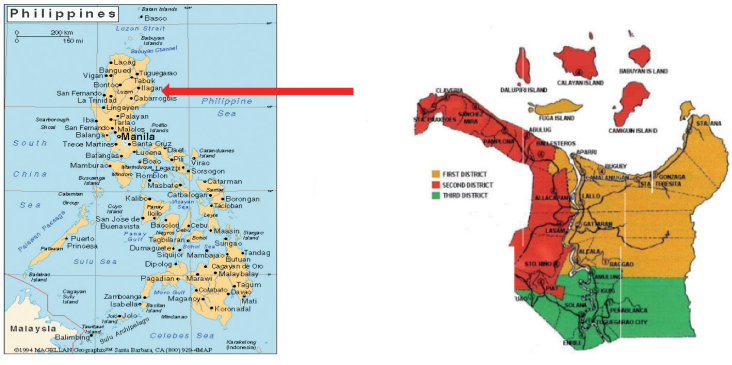

Figure 2. *Location map of Northwestern Cagayan Valley, Luzon, Philippines*

3.0 Results And Discussion

Honey Flora Resource Base

Table 1 presents the essential bee floral species in the study areas with their respective local, common, scientific and family names. These plant species,belonging to 29 families, were identified based on source status as a forest tree, agricultural crop, shrub, and weed. Of the 54 species, 27 are forest trees, 25 are agricultural crops, one is a shrub, and one is a weed. The study areas have varied bee floral species for bee forage; however, forest trees are the key vegetation represented by plant family Arecaceae. The presence of these honey plants is extremely helpful to the honeybees since they depend wholly on plants for food. Honeybee workers make thousands of visits to flowering plants in order to collect nectar and pollen (Dukku, 2013), which they use to feed the larvae (Heaf & Heaf, 2010). Because of the large diversity of flowering plants on which bees forage, Cacatian, et al., (2013) reported that Northwestern Cagayan is a potential area to commence beekeeping activities.

Table 1. *Bee floral species.*

COMMON NAME	LOCAL NAME	SCIENTIFIC NAME	FAMILY NAME
FOREST TREES			
Alim	Alim	Melanolepis multiglandulosa	Euphorbiaceae
Acacia (Japanese)	Auri	Acacia auriculiformis	Fabaceae
Anahaw	Labig	Livistona rotundifolia	Arecaceae
Balete	Baliti	Ficus stipulosa	Moraceae
Banaba	Banaba	Lagerstroemia speciosa	Lythraceae
Bangkal	Bulala	Nauclea orientalis	Rubiaceae
Bani	Bani	Pongamia pinnata	Fabaceae
Betel Nut	Bua	Areca catechu	Palmaceae
Bitaog	Bitaog	Calophyllum inophyllum	Clusiaceae
Dipterocarps	Apitong	Dipterocarpus grandiflorus	Dipterocarpaceae
Dita	Dalipaweng	Alstonia scholaris	Apocynaceae
Flame tree	Bagbag	Delonix regia	Fabaceae
Fishtail palm	Anibong	Caryota urens	Arecaceae
Gmelina	Gmelina	Gmelina arborea	Lamiaceae
Hauili	Raya-raya	Ficus septica	Moraceae
Ipil-ipil	Ipil-ipil	Leucaena glauca	Fabaceae
Kapok	Kapasanglay	Ceiba pentandra	Malvaceae
Madre de Cacao	Kakawate	Gliricidia sepium	Fabaceae
Mahogany	Mahogany	Cedrela mahogani	Meliaceae
Malabago	Marabago	Hibiscus tiliaceus	Malvaceae
Malapapaya	Malapapaya	Polyscias nodosa	Araliaceae

Molave	Sagat	Vitex parviflora	Verbenaceae
Narra	Narra	Pterocarpus indicus	Fabaceae
Tangisang bayawak	Latabak	Ficus variegata	Moraceae
Tibig	Tebbeg	Ficus nota	Moraceae
White lauan	Apnit	Shorea polysperma	Dipterocarpaceae
Ylang-ylang	Ilang-ilang	Cananga odorata	Annonaceae
AGRICULTURAL CROPS			
Avocado	Abokado	Persia americana	Lauraceae
Balimbing	Dalligan	Averrhoa carambola	Oxalidaceae
Banana	Banana	Musa paradisiaca	Musaceae
Bignay	Bugnay	Antidesma bunius	Euphorbiaceae
Breadfruit	Rimas	Artocarpus altilis	Moraceae
Breadnut	Pakak	Artocarpus camansi	Moraceae
Cacao	Cacao	Theobroma cacao	Malvaceae
Calamansi	Kalamansi	Citrus microcarpa	Rutaceae
Chesa	Chesa	Pouteria campechiana	Sapotaceae
Coconut	Niyog	Cocos nucifera	Arecaceae
Guava	Bayabas	Psidium guajava	Myrtaceae
Guayabano	Guayabano	Annona muricata	Annonaceae
Himbabao	Alucon	Allaenthus luzonicum	Moraceae
Kamagong	Mabolo	Diospyros philippinensis	Ebenaceae
Kamias	Pias	Averrhoa bilimbi	Oxalidaceae
Katmon	Palali	Dillenia philippinensis	Dilleniaceae
Langka	Anangka	Artocarpus heterophyllus	Moraceae
Mandarin	Mandarin	Citrus sinensis	Rutaceae
Mango	Mangga	Mangifera indica	Anacardiaceae
Papaya	Papaya	Carica papaya	Caricaceae
Pummelo	Suha	Citrus grandis	Rutaceae
Rambutan	Rambutan	Nepthelium lappaceum	Sapindaceae
Santol	Santol	Sandoricum koetjape	Meliaceae
Star apple	Kaimito	Chrysophyllum cainito	Sapotaceae
Tamarind	Salamagi	Tamarindus indica	Fabaceae
SHRUB			
Alumamani	Alumamani	Leea sambucina	Leeaceae
WEED			
Lantana	Bangbangsit	Lantana camara	Verbenaceae

Honey Plant Species Density

The density of honey source plants constitutes the groundwork of beekeeping. It benefits greatly the beekeepers. In the three study sites, the density of forest trees, shrubs and agricultural crops in a one-hectare area was determined by counting all the potential honey source plants. According to the results of the survey, the richness of plant species was highest in Culao as there are 481 honey source plants in all. Next is Nagbaranganan with a total number of 253 plants, and the least is Balingit with 156 bee plants. It is evident in the data that the density of flowering plants in Northwestern Cagayan varies from the three municipalities. This result is consistent with the study of Wubie, et al. (2014) affirming that the composition and population of honeybee plants vary widely from area to area.

In the three vegetation sampled, there were 890 plant species. Consequently, the size of the honeybee colonies depends immensely from the areas having sufficient number of melliferous plant resource base. However, this does not mean that areas with the highest number of plant diversity are better for bee forage, as plant density and abundance determine more the important bee forage.

Table 2. *Honey plant species density.*

COMMON NAME	LOCAL NAME	SCIENTIFIC NAME	NUMBER OF PLANTS /HECTARE			
			Balingit	Nagbaranganan	Culao	**Total**
FOREST TREES						
Alim	Alim	Melanolepis multiglandulosa			1	**1**
Acacia (Japanese)	Auri	Acacia auriculiformis			1	**1**
Anahaw	Labig	Livistona rotundifolia	24	2	124	**150**
Balete	Baliti	Ficus stipulosa	1	1	1	**3**
Banaba	Banaba	Lagerstroemia speciosa	11	2	16	**29**
Bangkal	Bulala	Nauclea orientalis			2	**2**
Bani	Bani	Pongamia pinnata	1			**1**
Betel Nut	Bua	Areca catechu	10	1	81	**92**
Bitaog	Bitaog	Calophyllum inophyllum	1			**1**
Dipterocarps	Apitong	Dipterocarpus grandiflorus			4	**4**
Dita	Dalipaweng	Alstonia scholaris			2	**2**
Flame tree	Bagbag	Delonix regia			9	**9**
Fishtail palm	Anibong	Caryota urens			2	**2**
Gmelina	Gmelina	Gmelina arborea	3	3	19	**25**
Hauili	Raya-raya	Ficus septica			7	**7**
Ipil-ipil	Ipil-ipil	Leucaena glauca		1		**1**
Kapok	Kapasanglay	Ceiba pentandra			4	**4**
Madre de Cacao	Kakawate	Gliricidia sepium	1		19	**20**
Mahogany	Mahogany	Cedrela mahogani			3	**3**
Malabago	Marabago	Hibiscus tiliaceus		29	2	**31**
Malapapaya	Malapapaya	Polyscias nodosa	1	4	1	**6**
Molave	Sagat	Vitex parviflora	12	1		**13**

Narra	Narra	Pterocarpus indicus	8	7	17	**32**
Tangisang bayawak	Latabak	Ficus variegata		2	4	**6**
Tibig	Tebbeg	Ficus nota	1	8	2	**11**
White lauan	Apnit	Shorea polysperma		1		**1**
Ylang-ylang	Ilang-ilang	Cananga odorata		3		**3**
AGRICULTURAL CROPS						
Avocado	Abokado	Persia americana		6	3	**9**
Balimbing	Dalligan	Averrhoa carambola	3			**3**
Banana	Banana	Musa paradisiaca		5	25	**30**
Bignay	Bugnay	Antidesma bunius	1		2	**3**
Breadfruit	Rimas	Artocarpus altilis	2			**2**
Breadnut	Pakak	Artocarpus camansi	6	3	15	**24**
Cacao	Cacao	Theobroma cacao	1		22	**23**
Calamansi	Kalamansi	Citrus microcarpa		4	7	**11**
Chesa	Chesa	Pouteria campechiana	3			**3**
Coconut	Niyog	Cocos nucifera	41	59	28	**128**
Guava	Bayabas	Psidium guajava	1	1	3	**5**
Guayabano	Guayabano	Annona muricata			3	**3**
Himbabao	Alucon	Allaenthus luzonicum	2		3	**5**
Kamagong	Mabolo	Diospyros philippinensis	1	1	4	**6**
Kamias	Pias	Averrhoa bilimbi	1	1		**2**
Katmon	Palali	Dillenia philippinensis	6		2	**8**
Langka	Anangka	Artocarpus heterophyllus	2		13	**15**
Mandarin	Mandarin	Citrus sinensis			1	**1**
Mango	Mangga	Mangifera indica			1	**1**
Papaya	Papaya	Carica papaya	1			**1**
Pummelo	Suha	Citrus grandis	2	83	3	**87**
Rambutan	Rambutan	Nepthelium lappaceum	1	2	1	**4**
Santol	Santol	Sandoricum koetjape	3	20	3	**26**
Star apple	Kaimito	Chrysophyllum cainito	5	2		**7**
Tamarind	Salamagi	Tamarindus indica		1		**1**
SHRUB						
Alumamani	Alumamani	Leea sambucina			11	**11**
WEED						
Lantana	Bangbangsit	Lantana camara			10	**10**

Honey Plant Characteristics

Among the many parameters of the study, the characteristics of potential flowering plants are the main factors in considering a locality as suitable for raising honeybee colonies. Table 3 presents that 30 or 55.56% are food crops. These food crops are agricultural crops that are grown for human consumption but are beneficial for honeybees since they provide essential products like nectar and pollen in sufficient quantities. Only 24 or 44.44% are non-food crops or non-food use for humans from which the bees obtain their dependable sources of food.

Data, likewise, show that 53 (98.15%) of the flowering plant species are perennial plants. The maximum advantage of the diverse selection of perennial vegetation is that the bee pasture is more or less permanent. Moreover, the multi-year grazing area is versatile as they have varied flowering dates (Delaplane, et al., 2013; "Pollination: establishing a bee pasture," n.d. para. 6).

As to the method of propagation, 50 or 92.59% of the plant species, the highest number of diversity, are propagated by seeds. Since the majority is agricultural and forest crops, propagation by seeds is usually the simplest, the least expensive and often the only means of reproduction in plant species grown in a natural ecosystem. Asexual propagation like layering, marcotting, grafting, and budding are the means of propagating plants in the orchard and other ornamental plants that receive specialized care.

Geographically, Northwestern Cagayan is a tropical province. The site is practically the reason why inventory results show that the majority of the honey plants' (25 or 46.30%) habitat type is agricultural land. Various trees (21 or 38.89%) also thrive in a tropical rainforest. Only a few (6 or 11.11%) survive in agroforestry, and 2 or 3.70% live in shrubland. As a tropical province, it houses the greatest diversity of agricultural and forest plants. Apparently,trees form the major structural and functional basis of the tropical forest ecosystems (Jakumar & Nair, 2013). The favorable local condition determines the richness of the vegetation having a continuous supply of rainfall and sunshine. Richness, therefore, is a positive predictor of a place that is of value for beekeeping.

Table 3. *Honey plant characteristics.*

COMMON NAME	LOCAL NAME	SCIENTIFIC NAME	CLASSIFICATION	LIFE SPAN	METHOD OF PROP	HABITAT TYPE
			Food/ Non Food			
FOREST TREES						
Alim	Alim	Melanolepis multiglandulosa	NF	P	S	●
Acacia (Japanese)	Auri	Acacia auriculiformis	NF	P	S	●
Anahaw	Labig	Livistona rotundifolia	F	P	S	●
Balete	Baliti	Ficus stipulosa	NF	P	C,L	●
Banaba	Banaba	Lagerstroemia speciosa	NF	P	C, S,Su	●
Bangkal	Bulala	Nauclea orientalis	NF	P	S	●
Bani	Bani	Pongamia pinnata	F	P	C, S, Su	●
Betel Nut	Bua	Areca catechu	F	P	S	●
Bitaog	Bitaog	Calophyllum inophyllum	NF	P	C, S	●
Dipterocarps	Apitong	Dipterocarpus grandiflorus	NF	P	S	●
Dita	Dalipaweng	Alstonia scholaris	NF	P	S	▲
Flame tree	Bagbag	Delonix regia	NF	P	C, S	●
Fishtail palm	Anibong	Caryota urens	F		S	●
Gmelina	Gmelina	Gmelina arborea	NF	P	S	▲
Hauili	Raya-raya	Ficus septica	NF	P	C, S	●
Ipil-ipil	Ipil-ipil	Leucaena glauca	NF	P	C, S	●
Kapok	Kapasanglay	Ceiba pentandra	NF	P	B, C, S	●
Madre de Cacao	Kakawate	Gliricidia sepium	NF	P	C	●
Mahogany	Mahogany	Cedrela mahogani	NF	P	C, S	▲

Malabago	Marabago	Hibiscus tiliaceus	NF	P	C, S,	●
Malapapaya	Malapapaya	Polyscias nodosa	NF	P	S	●
Molave	Sagat	Vitex parviflora	NF	P	S	▲
Narra	Narra	Pterocarpus indicus	NF	P	C, S	▲
Tangisang bayawak	Latabak	Ficus variegata	NF	P	C,L	●
Tibig	Tebbeg	Ficus nota	F	P	S	●
White lauan	Apnit	Shorea polysperma	NF	P	S	●
Ylang-ylang	Ilang-ilang	Cananga odorata	NF	P	S	▲
AGRICULTURAL CROPS						
Avocado	Abokado	Persia americana	F	P	G, S	■
Balimbing	Dalligan	Averrhoa carambola	F	P	G, S	■
Banana	Banana	Musa paradisiaca	F	A	Su	■
Bignay	Bugnay	Antidesma bunius	F	P	B,C, G, L, S	■
Breadfruit	Rimas	Artocarpus altilis	F	P	G, L, S	■
Breadnut	Pakak	Artocarpus camansi	F	P	S	■
Cacao	Cacao	Theobroma cacao	F	P	B,C,M, S	■
Calamansi	Kalamansi	Citrus microcarpa	F	P	M, S	■
Chesa	Chesa	Pouteria campechiana	F	P	G,L, S	■
Coconut	Niyog	Cocos nucifera	F	P	S	■
Guava	Bayabas	Psidium guajava	F	P	G, L, S	■
Guayabano	Guayabano	Annona muricata	F	P	G, S	■
Himbabao	Alucon	Allaenthus luzonicum	F	P	C, S	■
Kamagong	Mabolo	Diospyros philippinensis	F	P	B, C, S	■
Kamias	Pias	Averrhoa bilimbi	F	P	L, S	■
Katmon	Palali	Dillenia philippinensis	F	P	S	■
Langka	Anangka	Artocarpus heterophyllus	F	P	C, G, L, S	■
Mandarin	Mandarin	Citrus sinensis	F	P	G, S	■
Mango	Mangga	Mangifera indica	F	P	G, S	■
Papaya	Papaya	Carica papaya	F	P	S	■
Pummelo	Suha	Citrus grandis	F	P	B, L, S	■
Rambutan	Rambutan	Nepthelium lappaceum	F	P	G, L, S	■
Santol	Santol	Sandoricum koetjape	F	P	B,I, L, S	■
Star apple	Kaimito	Chrysophyllum cainito	F	P	B, G, L, S	■
Tamarind	Salamagi	Tamarindus indica	F	P	B, C, G, L, S	■
SHRUB						
Alumamani	Alumamani	Leea sambucina	NF	P	C, L, S	◆
WEED						
Lantana	Bangbangsit	Lantana camara	NF	P	L, S,Su	◆

Legend:

Life Span: A= Annual B= Biennial P= Perennial

Method of Propagation: B = Budding C = Cutting G = Grafting I = Inarching L = Layering M= Marcotting S = Seeds S = Sucker

Habitat Type: ■ = Agricultural ▲ = Agroforestry ◆ = Shrubland ● =Tropical Rainforest

Floral Calendar of Melliferous Resources for Bee Forage in Northwestern Cagayan

The classification, product load, and time and duration when bee plants flowered in the study areas were the bases of the bee floral calendar for Northwestern Cagayan.

Table 4 presents that based on product load, almost all (53 or 98.15%) of the plant species were recognized as nectar and pollen sources. Bees utilize all these plants as foraging sources.

Eighteen of the flowering plant species blossom all year round. These are:*Areca catechu* (Betel nut), *Calophyllum inophyllum* (Bitaog), *Caryota urens* (Fishtail palm), *Ficus septica* (Hauili), *Leucaena glauca* (Ipil-ipil), *Ficus nota* (Tibig), *Cananga odorata* (Ylang-ylang), *Psidium guajava* (Guava), *Lantana camara* (Lantana), *Averrhoa carambola* (Balimbing), *Musa paradisiaca* (Banana), *Artocarpus altilis* (Breadfruit), *Artocarpus camansi* (Breadnut), *Theobroma cacao* (Cacao), *Citrus microcarpa* (Kalamansi), *Cocos nucifera* (Coconut), *Dillenia philippinensis* (Katmon), and *Carica papaya* (Papaya). Honeybees frequently visit these plant species that blossom throughout the season(Teklay, 2011). Obviously, they are highly melliferous. In other words, they are the principal sources of honey and pollen for the honeybees. These plants are, therefore, extremely necessary melliferous resources in Northwestern Cagayan.

March to May have the most number of flowering plants. Those that blossom during these months are: *Melanolepis multiglandulosa* (Alim), *Ficus stipulosa* (Balete), *Dipterocarpus grandiflorus* (Dipterocarps), *Gliricidia sepium* (Madre de Cacao), *Cedrela mahogani* (Mahogany), *Hibiscus tiliaceus* (Malabago), *Polyscias nodosa* (Malapapaya), *Ficus variegate* (Tangisang bayawak), *Shorea polysperma* (White Lauan), *Antidesma bunius* (Bignay), *Annona muricata* (Guayabano), and *Nepthelium lappaceum* (Rambutan). The findings of the study lend support to the study of Liseki & Boniphace (2008) on "Honeybee Colony Development and the Flowering Calendar" that the build-up period in Tanzania is between March and June when the majority of plants are in bloom. The findings are further confirmed by Cacatian, et al. (2013) that March to May are the months when honeybee foraging activity is at its peak.

The source plant species that blossom for at least two months (except for those that bloom all year round) are*Acacia auriculiformis* (Acacia), *Alstonia scholaris* (Dita), *Vitex parviflora* (Molave) and *Artocarpus heterophyllus* (Langka). These are abundant sources of pollen and nectar during the dearth period.

Melanolepis multiglandulosa (Alim), *Acacia auriculiformis* (Acacia), Pongamia pinnata (Bani), *Calophyllum inophyllum* (Bitaog), *Leucaena glauca* (Ipil-ipil), *Shorea polysperma* (White Lauan), *Citrus sinensis* (Mandarin), *Mangifera indica* (Mango), *Carica papaya* (Papaya), and *Tamarindus indica* (Tamarind) are the 10 plant species that are very rare in all the three study areas. However, these are stillgood nectar and pollen sources for honeybees.

Table 4, likewise, shows that in Northwestern Cagayan, March to May is the peak periods for bee foraging activity. During the seasons, abundant bee flora bloom with little or no rainfall. Honeybees could visit these plants extensively for honey production and colony multiplication as reported by this study and by Bista and Shivakoti (2011). They collect and convert into honey more nectar than they consume (Jacobs et al., 2006). Other abundant and rare plants throughout the periods could, likewise, support colony build-up. It is possible, therefore, to identify honey flow seasons

from the analysis of the flowering periods of the bee plants (Belie, 2009; Gebretsadik, 2016).

July to September (dry season) and October to December (rainy season) are the dearth periods for honeybees in Northwestern Cagayan. The reason behind this is that most of the plants are not in bloom and many hives are vacant (Namwata, et al., 2013). These periods have, therefore, been found the worst seasons for honeybee foraging (Neupane & Thapa, 2005). Critical period happens when few plants are flowering because of continuous rain and, thereby, fluctuation in temperature and short daylight (Liseki & Boniphace, 2008; Harugade & Chaphalkar, 2013). Although some honey plants blossomed during the rainy season, they were not sufficient to sustain for the honeybee colonies in that area (Teklay, 2011; Bista and Shivakoti, 2001). The months of the rainy season are reported to be periods of pollen and nectar scarcity (Gebeyehu, et al., 2010; Ejigu, et al., 2009). As a result, honeybees flee or face starvation due to insufficient nectar flows (Belie, 2009). Nectar forms the basis of honey, the energy rich (carbohydrate) food that honeybees need to sustain the life of the colony while pollen provides the protein, vitamins and other nutrients required for the developing larvae. Without sufficient carbohydrate, the colony will die of starvation quite quickly; without pollen, the colony will die out slowly as it will not be able to produce new bees to replace old ones as they die (Teklay, 2011; Heaf and Heaf, 2010).

The success of beekeeping in a certain area depends on the understanding of the floral calendar in different foraging zones. Several plant families are blossoming at different time intervals of the year in every region. Depending upon the soil type, climatic factors and the habitat of the vegetation, the duration, and time of the blooming may change for even the same nectar plants (Balchandra, et al., 2014). The duration of flowering time would provide information to the beekeepers as to where to migrate their colonies during the peak periods for honeybee foraging. Such information will motivate beekeepers and would-be beekeepers to expand their apiaries knowing the conditions of potential beekeeping areas that would redound to increase in the volume of honey and other bee products production.

The floral calendar for Northwestern Cagayan is a document that shows to the beekeepers the accurate date and duration when the important honey and pollen plants are in bloom. It is one of the most valuable tools of the beekeepers. As mentioned by Akratanakul (1990), it provides them information on what to expect in bee-forage availability, and when, so that they can manage their colonies in the most rational manner. He also suggested that the accuracy and practical value of a floral calendar depend solely on the careful recording of the beginning and end of the flowering season of the plants and how they affect the bees. In an interview with the respondents, they stressed that the floral calendar provides them with a list of honey plants that are common in the locality, and they find it very useful for colony management and for migratory beekeeping.

Table 4. *Floral calendar of melliferous resources for bee forage in Northwestern Cagayan.*

COMMON NAME	LOCAL NAME	SCIENTIFIC NAME	FAMILY NAME	MONTH OF FLOWERING												PRODUCT LOAD
				J	F	M	A	M	J	J	A	S	O	N	D	Nectar/ Pollen
FOREST TREES																
Alim	Alim	Melanolepis multiglandulosa	Euphorbiaceae			■	■	■								N/P
Acacia (Japanese)	Auri	Acacia auriculiformis	Fabaceae									■	■	■	■	N/P
Anahaw	Labig	Livistona rotundifolia	Arecaceae	■	■	■										N/P
Balete	Baliti	Ficus stipulosa	Moraceae			■	■	■								N/P
Banaba	Banaba	Lagerstroemia speciosa	Lythraceae.			■	■	■	■	■						N/P
Bangkal	Bulala	Nauclea orientalis	Rubiaceae								■	■	■			N/P
Bani	Bani	Pongamia pinnata	Fabaceae				■	■	■							N/P
Betel Nut	Bua	Areca catechu	Palmaceae	■	■	■	■	■	■	■	■	■	■	■	■	N/P
Bitaog	Bitaog	Calophyllum inophyllum	Clusiaceae	■	■	■	■	■	■	■	■	■	■	■	■	N/P
Dipterocarps	Apitong	Dipterocarpus grandiflorus	Dipterocarpaceae			■	■	■								N/P
Dita	Dalipaweng	Alstonia scholaris	Apocynaceae										■	■	■	N/P
Flame tree	Bagbag	Delonix regia	Fabaceae			■	■	■	■							N/P
Fishtail palm	Anibong	Caryota urens	Arecaceae	■	■	■	■	■	■	■	■	■	■	■	■	N/P
Gmelina	Gmelina	Gmelina arborea	Lamiaceae		■	■	■									N/P
Hauili	Raya-raya	Ficus septica	Moraceae	■	■	■	■	■	■	■	■	■	■	■	■	N/P
Ipil-ipil	Ipil-ipil	Leucaena glauca	Fabaceae	■	■	■	■	■	■	■	■	■	■	■	■	N/P
Kapok	Kapasanglay	Ceiba pentandra	Malvaceae		■	■										N/P
Madre de Cacao	Kakawate	Gliricidia sepium	Fabaceae			■	■	■								N/P
Mahogany	Mahogany	Cedrela mahogani	Meliaceae			■	■	■								N/P
Malabago	Marabago	Hibiscus tiliaceus	Malvaceae			■	■	■								N/P
Malapapaya	Malapapaya	Polyscias nodosa	Araliaceae			■	■	■								N/P
Molave	Sagat	Vitex parviflora	Verbenaceae	■	■									■	■	N/P
Narra	Narra	Pterocarpus indicus	Fabaceae		■	■	■	■								N/P
Tangisang bayawak	Iatabak	Ficus variegata	Moraceae			■	■	■								N/P
Tibig	Tebbeg	Ficus nota	Moraceae	■	■	■	■	■	■	■	■	■	■	■	■	N/P
White lauan	Apnit	Shorea polysperma	Dipterocarpaceae			■	■	■								N/P
Ylang-ylang	Ilang-ilang	Cananga odorata	Annonaceae	■	■	■	■	■	■	■	■	■	■	■	■	N/P
AGRICULTURAL CROPS																
Avocado	Abokado	Persia americana	Lauraceae				■	■								N/P
Balimbing	Dalligan	Averrhoa carambola	Oxalidaceae	■	■	■	■	■	■	■	■	■	■	■	■	N/P
Banana	Banana	Musa paradisiaca	Musaceae	■	■	■	■	■	■	■	■	■	■	■	■	N/P

Bignay	Bugnay	Antidesma bunius	Euphorbiaceae												N/P
Breadfruit	Rimas	Artocarpus altilis	Moraceae												N/P
Breadnut	Pakak	Artocarpus camansi	Moraceae												N/P
Cacao	Cacao	Theobroma cacao	Malvaceae												N/P
Calamansi	Kalamansi	Citrus microcarpa	Rutaceae												N/P
Chesa	Chesa	Pouteria campechiana	Sapotaceae												N/P
Coconut	Niyog	Cocos nucifera	Arecaceae												N/P
Guava	Bayabas	Psidium guajava	Myrtaceae												N/P
Guayabano	Guayabano	Annona muricata	Annonaceae												N/P
Himbabao	Alucon	Allaenthus luzonicum	Moraceae												N/P
Kamagong	Mabolo	Diospyros philippinensis	Ebenaceae												N/P
Kamias	Pias	Averrhoa bilimbi	Oxalidaceae												N/P
Katmon	Palali	Dillenia philippinensis	Dilleniaceae												P
Langka	Anangka	Artocarpus heterophyllus	Moraceae												N/P
Mandarin	Mandarin	Citrus sinensis	Rutaceae												N/P
Mango	Mangga	Mangifera indica	Anacardiaceae												N/P
Papaya	Papaya	Carica papaya	Caricaceae												N/P
Pummelo	Suha	Citrus grandis	Rutaceae												N/P
Rambutan	Rambutan	Nepthelium lappaceum	Sapindaceae												N/P
Santol	Santol	Sandoricum koetjape	Meliaceae												N/P
Star apple	Kaimito	Chrysophyllum cainito	Sapotaceae												N/P
Tamarind	Salamagi	Tamarindus indica	Fabaceae												N/P
SHRUB															
Alumamani	Alumamani	Leea sambucina	Leeaceae												N/P
WEED															
Lantana	Bangbangsit	Lantana camara	Verbenaceae												N/P

4.0 Conclusion

A floral calendar, containing the classification, availability and abundance, flowering time and duration, and other main characteristics as economic value, product load, life span, method of propagation and habitat type of melliferous resources around a bee farming area is essential for beekeeping activity. Northwestern Cagayan, having diversified plant species which support foraging bees, is appropriate to initiate beekeeping.

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Acknowledgment

The author is thankful to the Commission on Higher Education for funding the research study. It is pleasurable to acknowledge the Don Mariano Marcos Memorial State University-National Apiculture Research, Training and Development Institute for the supplies and materials needed in the study and for the support and efforts extended. She is also grateful to Dr. Noemi C. Bayag, Engr. Shirly O. Agcaoili, Foresters Jose A. Mackay and Conrado Toribio, for their earnest assistance during the field survey. Much gratitude is due to Dr. Lina M Garan for her encouragement and administrative support. The same appreciation is extended to Dr. Froilan A. Pacris, Jr. for his salient help during the course of study.