THE ECOLOGY OF HONEY PRODUCTION IN SRI LANKA

by E. F. W. FERNANDO
(Department of Zoology, Vidyalankara Campus,
University of Sri Lanka, Kelaniya, Sri Lanka)

Original Contribution

Introduction

Recently much interest has been directed towards the development and expansion of apiculture and honey production in Sri Lanka, and studies on various aspects of the biology and ecology of the indigenous honeybee Apis cerana under local conditions have therefore been needed.

A study of the foraging activity of honeybees and the availability of honeybee forage in different climatic regions and in various forest communities in the country is of importance in determining the suitability. of a particular region for apicultural practices, since a honey crop is dependent on the availability of nectar and on the number of honeybees present to collect it. The number of honeybees flying from a colony at any given period is regulated by several variable factors both extrinsic and intrinsic many of which are difficult to assess. However, quantitative estimation of flight activity at the hive entrance can provide a useful index on the foraging activities in the field and the stimuli contributing to the regulation of such activities. (Todd & Bishop, 1940: Gray 1967).

Meteorological conditions have been shown to be a major factor influencing plant growth, flowering periodicity and availability of pollen and nectar. They also influence the flight activity of honeybees. Butler (1941), Synge (1947) and Percival (1950, 1955) have shown that the pollen gathering behaviour of Apis mellifera is influenced by the time of day at which pollen is available while Wafa and Ibrahim (195o) found that such activities were also correlated with temperature. Bight and Pant (1968) have shown that in Delhi, India, there is a negative correlation between temperature and pollen gathering activity and a positive correlation with relative humidity for A. cerana Jay (1973) has reported that in Jamaica A. mellifera visits mainly male coconut flowers in the morning but gather nectar from both male and female flowers in the afternoon.

Interest has recently been expressed in the possibility of using flight activity as an index of the foraging potential of honeybee colonies that are to be used for the pollination of agricultural crops.

Most of these studies are based on the activities of Apis mellifera in temperate countries. However, the ecology of the floral sources important as honeybee forage could vary from one region to another. Apart from the observations of Kannangara (1940) and Baptist (1956; 1976) there is very little information available on honeybee forage in Sri Lanka. Further, the flight

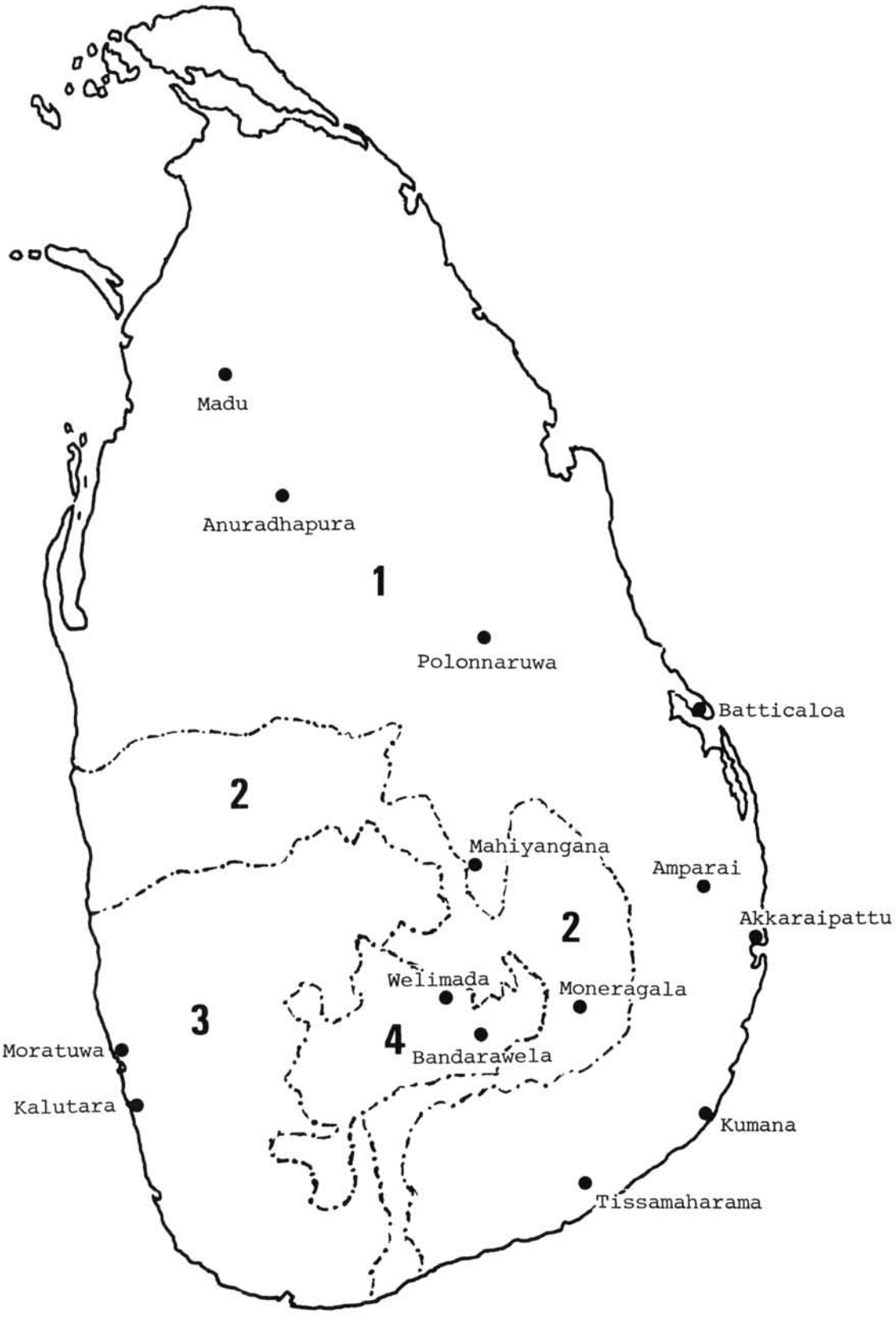

Fig. 1. The distribution of the generalized major ecosystems of Sri Lanka. (1) Dry zone (2) Intermediate zone (3) Lowland wet forest (4) Montane zone. The names indicate places from which data were obtained.

activity of Apis cerana under conditions prevailing in this country is not well understood either.

Therefore, the primary objective of this study was to collect information (a) on the flowering periodicities of some of the more important bee forage plants occurring in natural and man-made forests with a view to establishing their significance in honey production, and (b) for postulating tentative norms in foraging activity for a normal colony of A. cerana in a wet-zone region of Sri Lanka where the floral sources are predominantly coconut (Cocos mucifera).

Methods

A. Floral Sources

Observations on the flowering periods of the more important honeybee forage plants were made during surveys on the exploitation of forests for wild honey by peasants in different regions of the island. These honey hunters were also interviewed. However, time for these surveys was too limited to obtain enough information to formulate a detailed floral calendar.

Fig. 1 shows the localities where the observations were made for the present study. The phyto-geographical regions were mainly based on studies made by Fernando (1968) and Brink et al,(1971).

B. Foraging Activity

Observations were made at Moratuwa during the dry months, January to May 1974, when the colonies are most populous and flight activity was very high.

Foraging activity was studied by recording the numbers of incoming honeybees in a normal 'domesticated' colony in a movable-frame hive consisting of a brood chamber and a honey chamber, each with six frames, internal dimensions of which are shown in Table 1.

TABLE 1

Component	*Length*	*Height*	*Width (cm)*
Brood chamber	32	19	17.5
Brood frame	28	14.5	2.0
Honey chamber	32	9.0	17.5
Honey frame	28	6.0	2.0

The brood chamber rested on the floor board and had a rectangular entrance at the bottom 17.5 x 2.0 cm. A well ventilated roof covered the honey chamber. All incoming bees were counted at the entrance during 10-minute periods at hourly intervals between 06.00 h. and 18.00 h. This procedure was repeated every seventh day, from the first week of January 1974. The temperature and humidity of the environment were recorded during each observation period.

Results and Discussions

Ecology

The island can be divided very broadly into four major ecosystems (Fig. 1): (1) dry zone, (2) intermediate zone, (3) lowland wet forest, (4) montane zone. Several different habitats are found in them, including those resulting from the exploitation and conversion of natural forests for diverse agricultural practices. The general ecological and phenological features in each habitat of any one zone are characteristic of that habitat.

The dry zone vegetation is dominated mainly by tall or medium-sized trees like Manilkara hexandra, Chloroxylon swietenia, Schleichera cleosa, in addition to dense spinous scrub or dry grassland. This region experiences drought from April to September, and during the north-east monsoon rains are operative and dominant. This dry season coincides with the heavy south-west monsoon rains which dominate the wet lowland and montane ecosystems. The lowland wet forests cover the south-western part of the island to about 900 m above sea level, and are mainly dominated by Dipterocarpus spp., Mesus ferrea, Doona spp.

Rubber (Hevea brasiliensis) has been extensively cultivated in this region.

The intermediate zone ecosystem occupies the peripheral parts of the dry zone and of the wet lowland and upland regions. Some of the dominant flora are Dipterocarpus zeylanicus, Euphoria longana, and Artocarpus nobilis. Much of this region is cultivated, and is covered by coconut (Cocos nucifera) plantations and other food crops. The montane zone extends from 900 m to about 2700 m above sea level, the dominant trees being Rhododendron arboreum, Syzygium spp., and Doona spp. Characteristic features of this zone are large expanses of grasslands known as "patanas" and vast tracts of land planted with several species of pine and Eucalyptus.

This rich forest flora, particularly in the dry zone (Fig. 1), sustains many natural colonies of the honeybee Apis cerana, and of the large rock bee A. dorsata, and the dwarf bee A. florea. During the main honey flow season, which usually extends from June to September, these wild colonies, especially those of A. cerana, are exploited for honey by village honey hunters. (Fig 2). During the operation, the bees are often driven away from their colonies through a hole made in the upper region of the tree cavity which harbours the colony, by letting in smoke through the flight entrance, which is widened with an axe to facilitate the removal of the combs. Honey is extracted by squeezing out the combs into a container, which is often the dried, thick rind of a large bottle-gourd, Lagenaria siceraria (Cucurbitaceae), a commonly cultivated vegetable in the dry zone regions (fig 3).

The flowering periods of some important honeybee forage plants, occurring mainly in the dry zone districts, are shown in Table 2. This is based on preliminary observations and is in no way complete. There must be still a large number of other important floral sources which are yet to be evaluated. It appears that most of these species bloom between March and the end of September. Table 3 shows that wild colonies of A.cerana yield sufficient honey, thanks to the continuous availability of

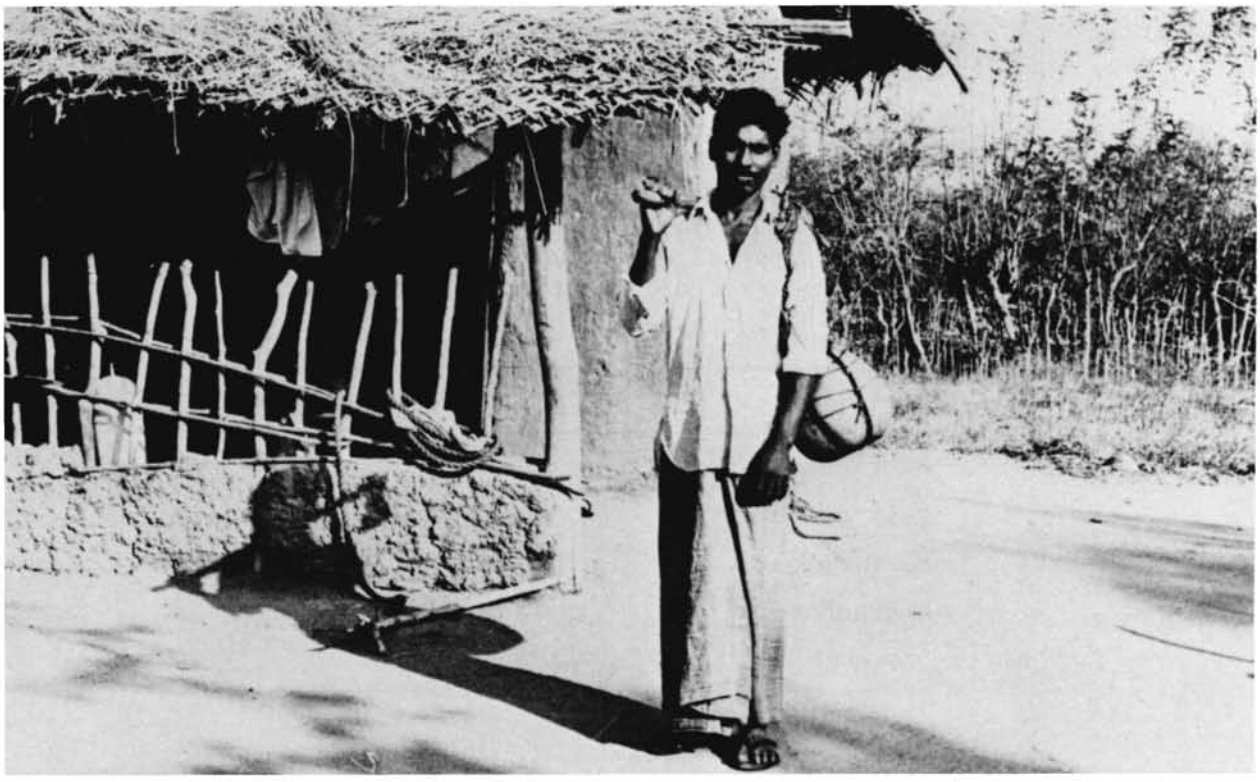

Fig. 2. A typical village honey-hunter near his dwelling.

Fig. 3. The axe and gourd used by a village honey-hunter.

during this dry season. The number of colonies hunted is not known.

TABLE 3

Amounts (kg) of wild honey collected by village honey hunters from some dry-zone regions in 1974

District	Village	Month	Honey
Batticaloa	Kallichchai	June	99.0
Batticaloa	Kallichchai	August	11.7
Batticaloa	Vahanery	August	5.4
Anuradhapura	(several)	June - August	297.0

During the monsoon period in the dry zone, there appears to be very little flowering between October and February, and plants in bloom (like Tectona grandis, a useful nectar source) will be of significance to bees only during the intermittent dry spells. It is evident from these observations that the forest resources which yield wild honey could also be exploited by colonies kept in apiaries.

Planted forests are also important sources of bee forage; some planted mainly with Eucalyptus spp. (Table 2) are common in Bandarawela and Welimade, where they provide a major source of honey for the successful honey harvests (Table 4) from domesticated colonies.

TABLE 4

Honey yields from domesticated honeybee colonies in Bandarawela and Welimade district. Each colony was provided with 6-12 frames for honey storage

Year	No. Colonies	Total yield (kg)	Yield per colony (kg) Average	Lowest	Highest
1968	35	79	2.2	0.4	9.5
1969	30	169	3.5	0.7	6.0
1970	71	221	3.1	0.7	7.8
1971	91	178	1.8	0.3	6.4
1972	133	322	2.4	0.3	7.7
1973	164	403	2.4	0.3	6.3

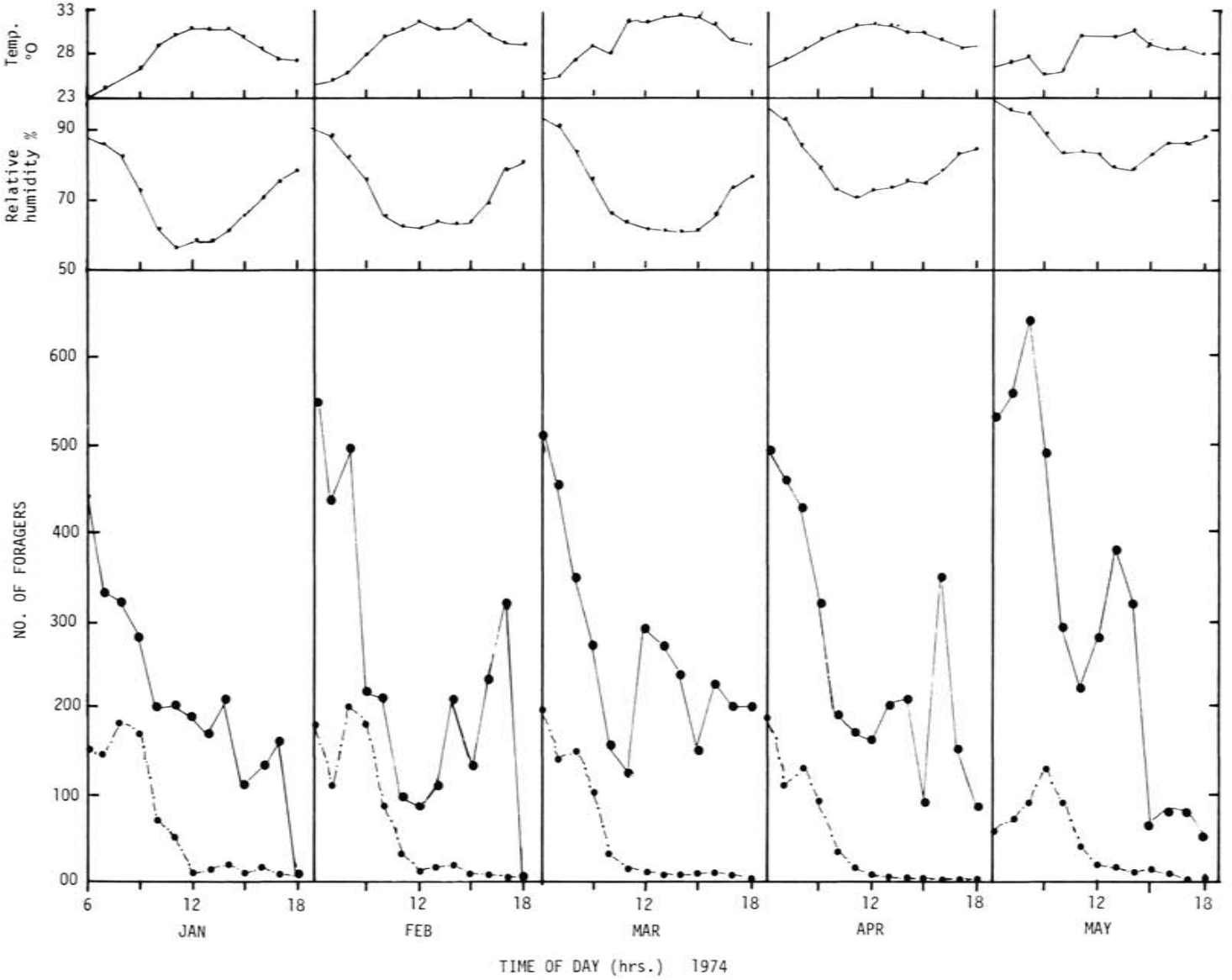

Fig. 4. Foraging activity of a colony of Apis cerona throughout the day, in each month from January to May, in an area dominated by coconut palms.

(●—● nectar gatherers; ●·-·● pollen gatherers.)

The young extra-floral nectaries on the petioles of rubber leaves (Hevea brasiliensis) secrete nectar from February to April, and provide a very important source for A. cerana (Fernando, 1978). Several beekeepers with colonies on coconut plantations (esp-cially in the Kalutara district, in the lowland wet zone) transfer them to nearby rubber plantations during this period.

Foraging Activity

The daily foraging activity in a colony of Apis cerana in an area where the dominant flora is coconut is shown in Fig 4. Of the total foraging population only about 25% were gathering pollen, mainly in the early part of the day and decreasing sharply after about 10.00h.

There was a major peak of nectar foraging in the early morning, and a smaller afternoon peak. This regular daily pattern from January to May may well be due to a heavy flow of nectar in the early morning which drops off towards midday,when temperature is high and relative humidity low.

Although the male coconut flowers remain open throughout the day, the availability of pollen for honeybees appears to be confined to the early hours, as has been observed in Jamaica (Jay, 1973). In Jamaica, however, nectar foraging was not so much confined to the morning.

The bees also visit unopened male inflorescences that have been injured by tapping to collect material for the preparation of "toddy" (a fermented liquor from the sugary exudates of injured blossoms, collected in earthenware pots). Kannangara (1940) stated that bees drink the fermented liquor and drown in it, due to intoxication. Counts were therefore made on insect populations in the liquid in randomly selected pots that had been suspended for 24 h on injured florescences (Table 5). Members of the Orders Orthoptera, Lepidoptera, Hymenoptera and Diptera were found while the resident fauna were mainly non-flying insects (Dermaptera and Formicidae (Hymemoptera)). About 77% of the visiting insects were A. cerana foragers where-as there were very few A. dorsata and A.florea. The relatively high proportion of A.cerana could be due to the presence of domesticated colonies nearby.

The exudate collected contains a high percentage of sugars; syrup prepared by boiling and concentrating this liquor, before any fermentation occurs, can contain as much as 75-80% sucrose (Pulle, 1975). The reason why A. cerana is attracted to the exudates is due to their high sugar concentration, and the bees drown accidentally while feeding, not as a result of intoxication as stated by Kannangara (1940).

Conclusions

Good potential thus exists for the planned harvesting of honey from wild colonies which are found in abundance in various forests in the different zones of the island. The establish-ment of apiaries of hives of A. cerana in coconut plantations (especially where the inflorescences of palms are tapped for collection of the sugary exudates) could be very productive, particularly in the lowland wet zone where migration of the colonies to nearby rubber plantations is economically feasible. The honey from the coconut exudates would not be high quality honey.

TABLE 5

Insects collected from earthenware pots containing fresh sap from tapped coconut flowers

Pot No.	Visitors (flying insects) Honeybees (Apis)			Other Insects	Resident (non-flying insects)	A.cerana as percentage of total visitors
	cerana	dorsata	florea			
1	73	10	5	-	26	83%
2	22	1	1	1	63	88%
3	19	4	2	5	68	63%
4	6	-	-	3	52	67%
5	11	3	-	1	27	73%
6	14	-	-	2	17	88%

More information about the distribution and flowering of bee forage plants, and about the foraging behaviour of honeybees in different ecological regions under diverse environmental conditions, will make it possible to select sites best suited for colonies of A.cerana throughout the island, particularly for establishing a cottage industry.

Both physical characteristics and chemical composition of honey obtained from colonies in coconut and rubber plantations may vary from those of honeys from colonies situated in and near the forests. Analysis of such honeys will be necessary to establish suitable standards for grading.

Acknowledgements

Mr. K. H. Dayaratne, Department of Agriculture, kindly provided the information on honey yields in the Bandarawela-Welimada districts. Thanks are also due to Dr.I.V.S. Fernando, Vidyalankara Campus University of Sri Lanka, for the critical reading of the manuscript. This project was partly supported by a research grant from the Vidyalankara Campus, University of Sri Lanka.

References

Baptist, B.A. (1956) - Beekeeping with special reference to its development in Ceylon. Proc. Ceylon Ass. Advmt Sci 12: 99 - 118

Baptist, B.A. -(1976) - Beekeeping development programme in Sri Lanka. pp. 135-142 from Apiculture in tropical climates ed. E. Crane. International Bee Research Assoc.

Bisht, D.A.; Pant, N.C. (1968) - Studies on pollen gathering activity of the Indian honeybee Apis indica F. under Delhi conditions. Indian J. Ent. 30: 163-168

Brink, P.; Anderson H.; Cederholm,L. (1971) - Lund University Ceylon Expedition in 1962. Ent. scand. Suppl.1:4-36

Butler, C.G. (1941) - A study of the frequency with which honey bees visit red clover (Trifolium pratense) together with an examination of the environmental conditions. Ann, appl. Biol. 28: 125-134.

Fernando, E.F.W. (1978) - Studies of apiculture in Sri Lanka. I. Characteristics of some honeys. J. apic. Res. 17 (1): 44-46.

Fernando, S.N.W.(1968) - The natural vegetation of Ceylon. Colombo: Swabhasha Printers 85 pp.

Gray, N.E. (1967) - Diurnal variations in the intensity of flight activity from honeybee colonies. J.apic. Res 6: 65-68.

Jay, S.C. (1974) - Nectar and pollen collection by honeybees from coconut flowers. Bee Wld 55: 105-111.

Kannangara, A.W. (1940) - Some bee plants of Ceylon. Bee Wld 21 : 94-96.

Parker, R.L. (1926) - The collection and utilization of pollen by the honeybee. Mem. Cornell Univ. agric. Exp. Stn. No. 98: 1-55.

Percival, M.S. (1950) - Pollen presentation and pollen collection. New Phytol. 49: 40-63.

Percival, M.S. (1955) - The presentation of pollen in certain angiosperms and its collection by Apis mellifera. New Phytol. 54: 353-368

Pulle, M (1975) - Quality characteristics of sugar substitutes. Proc. Sri Lanka Ass. Advmt Sci. 31.

Synge, A.F. (1947) - Pollen collection by honeybees (Apis mellifera). J. Amin. Ecol. 16: 122-138.

Todd, F.E.; Bishop, R.K. (1940) - Trapping honeybee gathered pollen and factors affecting yield. J.econ.Ent.33: 866-870.

Wafa, A.K.; Ibrahim, S.H. (1950) - Temperature as a factor in pollen gathering activity by the honeybee in Egypt. Bull. Fac. Agric. Cairo Univ. No. 163 10pp.