Nesting habitat and honey production of asiatic honey bees (*Apis cerana*) in the protected forest in Enrekang Regency, Indonesia

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Abstract. This study aims to determine the characteristics of nesting habitat, harvesting techniques, and honey production of Asiatic honey bee (*Apis cerana*) in the protected forest in Enrekang Regency, Indonesia. Data was collected in the form of primary and secondary data. Data is collected by observation, survey, and literature study then analyzed by descriptive statistical methods. The results showed that the Asiatic honey bee hunting technique by local communities in the protected forest in Enrekang Regency was carried out traditionally during the flowering season, especially in September and October. Asiatic honey bees nest in stone cavities or cracked stones around flowering plants in elevation 976.9-1,085.1 masl. Depth of stone cavities nest ranges between 40-70 cm, height ranges between 20-60 cm, width ranges between 60-100 m, temperature and humidity in stone cavities nest vary between 23-26.9 °C and 70-87%, respectively. The average weight of honeycomb is 1.137.5 g produces an average honey 250.58 g, beeswax 250.58 g, bee bread 169.17 g, and bee brood (eggs, larvae, pupa) 105.42 g. Honey bee yields average is 17.20%, bee wax 60.05%, bee bread 13.97%, and bee brood (larvae, eggs, and pupae) 8.78%.

1. Introduction

Indonesia is a tropical country that has abundant natural wealth in the form of flora and fauna. One of the beneficial fauna for humans is the honey bee. Honey bee cultivation has long been known by rural communities and communities around the forest. Indonesia's fertile natural conditions allow the growth of various types of plants. The community is well acquainted with honey produced from honey bee culture, especially the Asiatic honey bee (*Apis cerana*). The total area of agriculture, plantation, and forestry in Indonesia has the potential to cultivate honey bees because honey bee feed can be obtained from flowers produced by agriculture, plantation and forestry areas. The Asiatic honey bee has become increasingly important in beekeeping, as this species provides honey products and helps pollinate plants that are important in the ecosystem [1–5]. Beekeeping is very important for global agricultural production [6–9]. In several areas in Asia, honey is a major commodity that contributes to improving communities’ economies [10–13]. Honeybee supply several products, such as honey, royal jelly, propolis, pollen, wax, and venom, for food and medicine [14–17].

Honey is also a part of a communities’ cultural identity. Many indigenous communities preserve their forests for sustainable honey production [18]. The honeybee exhibits complex social behaviors such as nesting [19]. Asiatic honey bees exhibit a variety of nesting habits, including in bare ground, cavities, deadwood, trees, and rocks [20]. The Asiatic honey bee is found in Sulawesi and surrounding
islands and, to date, has not been successfully cultivated or managed well by communities around the forest area. The Asiatic honey bee is nested with holes in the rock, which is the main honey producer in the Sulawesi Islands. Honey produced from the Asiatic honey bee (Apis cerana) which is only found in stone pits, has its special features because this honey is produced from habitats that are not contaminated by human activities. *Apis cerana* has vulnerabilities and requires relatively large cavities for nesting [20].

South Sulawesi is one of the producers of Asiatic honey bees, which is quite potent in addition to Central Sulawesi and Southeast Sulawesi. One of the areas in South Sulawesi Asiatic that producing honey from the Asiatic honey bee is the Enrekang Regency, where around 85% of this area is mountainous. This area is an agricultural area surrounded by forest. Bee hunting has always been carried out in the community to obtain additional income in addition to their consumption. The characteristics of the habitat (stone hole) where to nest and the potential of Asiatic honey bee products around the forest area are not yet known. Therefore, this study to know the harvesting techniques, habitat characteristics (stone holes) of nesting sites, and the potential of Asiatic honey bee products around the forest in Enrekang Regency, South Sulawesi Province Indonesia.

2. Methods

2.1. Tools and material

The tools used in this study were digital scales, gloves, buckets, ropes, machetes, flashlights, hygrometers, compasses, GPS, calculators, and writing instruments. The material used in this study was 12 nests of the Asiatic honey bee.

2.2. Methods

Data was collected in the form of primary and secondary data. Data is collected by observation, survey, and literature study then analyzed by descriptive statistical methods.

2.3. Data analysis

The data collected is then analyzed descriptively, quantitatively with an analysis unit based on primary data and secondary data.

3. Result and discussion

3.1. Hunting technique of asiatic honey bee

The Asiatic honey bee hunting technique in the forest of Enrekang Regency is done traditionally. Local bee hunting is carried out during the day by searching for stone holes which are usually occupied by local bees nesting in their gardens or forest areas. The stone pit containing local bees is then marked by tying raffia or grass around the beehive to make it easier when monitoring the hive and harvesting the Asiatic honey bee later. The determination of beehive ownership is based on the ownership of the land where the stone pit is where the beehives are nesting. If the stone pit is in an area that is not owned by the community, for example, in the forest area the ownership is based on who first discovered the stone pit where the beehives.

3.2. Harvesting technique of asiatic honey bee

Harvesting preparation is done by preparing harvesting tools and materials. Tools and materials prepared at the time of harvest include: Flashlight as a lighting tool to facilitate the journey to the beehive and facilitate the process of taking Asiatic honey bee; the machete is used to slice the Asiatic honey bee hive in a stone pit and after slicing is finished letting the hive under the stone hole 2 minutes so that the Asiatic honey bee dwellers move from the beehive, buckets are used as a gathering place or beehive when collecting Asiatic honey bee in a stone pit, Sarong is used as a mask as a face shield so that not too many worker bees attack when slicing Asiatic honey bee and banana leaves are used as a place to put a beehive that is stored under a honeycomb stone hole or parallel to where the Asiatic honey bee bees are hung so that the hive will not be mixed with dirt in the honeycomb hole.
Harvesting of honey is usually carried out in September-October and January-February in the flowering season of crops, plantations, and forest plants. The results of monitoring from the stone pit where the Asiatic honey bee nest is indicated by the signs of the hive has been filled with honey to be the basis in determining the time of harvest. The age of colonies at the time of harvest varies between 2-24 weeks depending on the results of the examination at night, usually, people use a machete to prick a beehive if there is honey, which means that the hive has honey and is ready to be harvested. Another way, by blowing the hive, so that the bees move and the hive is visible, the nest containing honey is usually brownish, if white means the nest is very new and does not yet have honey if the dark color is usually the honey has less honey but has a lot of candles and bee brood (larvae).

Harvesting is usually done in groups of 3 people. Each group member has a different task. One person is in charge of carrying buckets to transport the harvest, one person is in charge of carrying a flashlight and unloading stone holes, and one person is in charge of slicing the Asiatic honey bee beehives. Harvesting is done by slicing the hive and separating a little (the circumcision system) so that the bee can return to the rock hole again. The age of the colonies at the time of harvest varies between 3-24 weeks. Harvesting is usually done in September-October with a high honey yield because it is the flowering season of coffee (Coffea sp.) And mango (Mangifera indica). Mundan Village is a coffee-producing center area so that during the flowering season, the potential for nectar producing coffee flowers is very large. In addition to coffee, in September-October, there is also pollen-producing corn as local bee food. In addition, local bee harvesting is usually carried out in January-February during the flowering season of fruit plants such as calliandra red (Calliandra calothyrsus), advocate (Parsia americana), as well as several plants such as red dadap (Erythrina cristagalli), gamal (Gliricidia sepium), teak (Tectona grandis) and pecan (Melochia umbellate) and agricultural crops such as tomatoes (Solanum lycopersicum) and large chili (Capsicum annuum).

Honey bee food is nectar and pollen found in plant flowers and water [21]. Honey bees harvest pollen and nectar from the flowers and help in the pollination process [22]. In many intensive plantations, to ensure pollination of the crop, domesticated bees are usually applied as pollinator agents [23]. All flowering plants are almost a food source for honey bees [24], and therefore, the efforts of beekeeping must be close to locations or places that produce a considerable amount of nectar, pollen, and water. Some types of plant sources of honey bee feed are; orchids, frangipani, rubber, kedondong, hibiscus, sunflowers, bananas, grapes, apples, star fruit, duku, durian, oranges, coconut, guava, chocolate, mango, rambutan, rice, corn, sugar palm, cotton, cotton, acacia, and coffee. Honey bee food in the form of nectar, pollen, and water is reduced in the dry season. Honey bees raised at that time should be given additional food in the form of artificial honey made from sugar and water. How to make it is quite easy, namely by mixing water and sugar with a ratio of 1 part sugar and 1 part water. The two ingredients are dissolved into one and placed around a beehive. A few minutes after that, the worker bees will transport the artificial food into the hive for consumption with other bees. Apiculture can be practiced in orchards, home gardens, plantations, and many agroforestry systems, including coffee and others. Beekeeping is also a relatively low-impact activity that can increase local people's income from native forests or conservation areas [25].

3.3. Habitat characteristics of asiatic honey bee

Based on the results of the study showed that the stone pit where the Asiatic honey bee nest generally leaning towards the south or north and tend to avoid east or west. This is thought to avoid the intensity of direct sunlight entering the nest hole. Elevation of the hole from the surface of the sea ranges from 976.9-1,085.1 masl. The depth of the bee nesting stone ranges between 40-70 cm, the height of the bee nesting stone ranges between 20-60 cm, the width of the bee nesting stone ranges between 60-100 m. This stone hole has a small entrance hole that is usually composed of small stones that are naturally arranged or arranged by the community to attract bees into the nest hole. Location temperature on the outside face of the nest in the morning (06.00-07.00 am) around 23-26.9 °C, during the day (12.00-13.00 WITA) around 26-27.1°C, and in the afternoon (05.00-06.00 pm) around 23-26.9 °C. The location humidity in the outer face of the nest in the morning (06.00-07.00 am) is around 72-87%, in the afternoon
(00.00-01.00 pm) around 61-71%, and the afternoon (05.00-06.00 pm) around 70-87%. Measurement of temperature and humidity in the suggestion can only be measured at the time of harvest when dismantling small stones in the mouth of the nest and carried out at night. The temperature and humidity in this honeycomb stone hole at night (08.00-11.00 pm) each varied between 23-26.9 °C and 70-87%.

Honey bee production is closely related to ideal habitats such as suitable places or seasons, water availability, and the availability of flowering plants as a food source. The life activity of bees is also greatly influenced by the temperature of the air in the natural surroundings because temperatures that are too cold or too hot can kill all members of the bee colony. Areas that have temperatures between 26-37 °C and have many plantation areas are very suitable for raising bees. The life of bees in these areas will be more active, fast-growing, and produce satisfactory production when compared to areas that have temperatures below 26 °C. Bee wing veins will weaken at temperatures below 26 °C. Bee wing veins will weaken at temperatures below 26 °C so that the bees become lazy to fly and the resulting product will also be less.

3.4. Production of bee products

The production of bee products is an average nest weight of 1.137.5 g/nest, which produces an average honey weight of 250.58 g/nest, beeswax 250.58 g/nest, bee bread weight 169.17 g/nest and Weight of bee brood (eggs, larvae, pupa) 105.42 g/nest. Honey bee yields average of the Asiatic honey bee is 17.20%, bee wax 60.05%, bee bread 13.97%, and bee brood (larvae, eggs, and pupae) 8.78%. Processing honeycomb wax (dirty wax) into beeswax (clean wax) produces a yield of around 48.83% and the rest is dirt. In the research location, the community did not process honeycomb wax into beeswax but used honeycomb wax directly as traditional medicine, itching, and substitute incense.

Asian honey bee (Apis cerana) is a native Asian honey bee that spreads from Afghanistan, China, Japan to Indonesia. The method of cultivation is still largely traditional, which is in the fields. Modern cultivation is in a movable box. Asiatic honey bee (Apis cerana) can produce 5-10 nest combs in one colony, and honey production can reach 2-5 kg at one harvest. Production of Asiatic honey bee (Apis cerana) maintained in modern nests is an average of 1.7 kg of comb nest weight, 0.7 kg of honeycomb weight, and 0.6 kg of honey weight, while honey bee production, which is maintained in traditional nests are 1.2 kg weight of comb nest, 0.5 kg honey weight and 0.4 kg honey weight. Honey bees produce maximum production after being kept in a nest for 1 to 2 months. This is caused by the insufficient nectar collected by bees and only a small amount of honey that is stored in the honeycomb until the honey is produced to a maximum. A lot of honey production is highly dependent on the amount of nectar collected. The average yield of bee products (Apis cerana) for honey is 17.20%, bee wax 60.05%, Bee Bread 13.97%, and Breed Brood (Larvae, eggs, and pupae) 8.78%.

4. Conclusions

The Asiatic honey bee (Apis cerana) hunting technique in the Enrekang District regency was carried out traditionally using the circumcision system. Characteristics of Asiatic honey bee (Apis cerana) nesting sites are elevation 976.9-1.085.1 masl, depth of stone nest ranges between 40-70 cm, height ranges between 20-60 cm, width ranges from 60-100 m, location temperature on the outer face nests range from 23-27.1 °C, humidity between 61-87% while temperature and humidity in stone hole vary between 23-26.9 °C and 70-87%, respectively. The production of bee products is an average nest weight of 1.137.5 g/nest, which produces an average honey weight of 250.58 g/nest, beeswax 250.58 g/nest, bee bread weight 169.17 g/nest and Weight of bee brood (eggs, larvae, and pupae) 105.42 g/nest. Honey bee yields average of the Asiatic honey bee is 17.20%, bee wax 60.05%, bee bread 13.97%, and bee brood (larvae, eggs, and pupae) 8.78%.

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