Population and activities of curculionids beetle in snake fruit
(Salacca zalacca)

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Abstract. Snake fruit (Salacca zalacca), an Indonesian native palm, has high economic value. This plant has a dioecious inflorescence. At the present time, pollination of snake fruit plants was still conducted by a human. Until now, some insect visitors as a pollinator of the plants were reported, such as stingless bees (Apidae) and curculionid beetles (Curculionidae). In this study, we study the population and activities of curculionid beetles in snake fruit plantations. Three plantations of snake fruit in Sumatera were used to observe beetle populations, i.e., Gunung Leuser National Park (Aceh), Padang Sidempuan (Medan), and Riak Siabun (Bengkulu). The sampling method was used to measure beetle populations by observed directly beetle population on the panicle (flowers). Observation of beetle activities was done by purposive sampling method in 08.00-12.00 am. Results showed that the highest beetle population (23096 individuals) occurred in Riak Siabun, Bengkulu. The highest visiting activity of beetle occurred in the morning.

1. Introduction

The beetle is one of the important native pollinators for the environment. It is supported by the character and shape of a small body that so hard to find the beetle but has a good ability to pollinate. In addition, this group generally makes the right host plant as a breed at every stage of life (life stage). The beetle is a dominant pollinator group in a palm, even some species of beetle which are specific pollinator [1].

Pollination by insects is a symbiosis that occurred during the 60 million years ago, where flowering plants and insects evolve each other. While some other plants have an unspecialized form that only a specific pollinator that able to access the nutrients contained [2]. Some of the factors that insect interest for the shape, color, and aromatic of flowers. Similarly, the quality and quantity of nectar and pollen which is owned by flowers [3]. The symbiotic relationship between insect and plant gave more benefits. Insect gets hold of nutrients (food), such as nectar and pollen [4].

Snake fruit is a native palm in Indonesia that has high economic value. The fruits are oval with a slightly tapered tip, scaly skin of fruit generally arranged like tiles and brown. Snake fruit has several varieties that have been known community is pondoh, bali or gula pasir, swaru, and Sidempuan. There are some animals that have been known as a snake fruit pollinator that are Curculionid beetles and Trygona [5].
Botanist explains that the beetle from subfamily curculioninae as flower beetle because most members of this group put eggs and larvae into reproductive organs of the plant. Moreover, the eggs and larvae will be developed in the reproductive organs of host plants such as flowers, fruits and seeds [6]. For example, the number of beetle population is more prevalent in the male flowers of oil palm. In addition, they also proliferate and perform to own life stages in the male flowers.

The pollinator is one of the key elements to distribution and persevering existence of plant. The small number of pollinators will have an impact on the low fruit produced in a plantation [7]. The results of observation from anthropogenic activities showed excessive exploitation of natural resources (illegal logging, poaching and the utilization of non-timber forest products) resulting in deforestation, fragmentation, and an increase in predators that threaten the population of pollinators [8]. Yet, basic information on beetle pollinator in snake fruit. Therefore, the aim of this research is to investigate and examine the relationship between beetle pollinator and their habitat in Sumatra Island, Indonesia

2. Methods

2.1. Time and lace
Observation of the activity and collection of beetle samples conducted in May 2017-April 2018 in Gunung Leusner National Park (Aceh), Persalakan Padang Sidempuan (Medan), and Riak Siabun (Bengkulu). Observation of beetle morphology is done in the Laboratory of Biosystematics and Animal Ecology, Department of Biology, Bogor Agricultural University.

2.2. Tools and materials
The tools used in this observation are Petri dishes, microtube, dropper drops, brushes, glass objects, tweezers, cameras, plastic bags, gauze, counters, cutter/ scissors, thermohygrometer, anemometer, luxmeter and stereo microscope installed with optilab. While the materials used in the observations are aquadest, and 70% alcohol.

2.3. Methodology Population Studies
Measurement of the beetle population is done by taking beetle samples at 3-6 panicles (depending on the number of panicle hump) in the anthesis snake fruit flower. Panicles took at the top, middle and bottom. Male flower of snake fruit is then put into plastic bags and then counted the number of beetles. The number of bucket beetles is obtained from the average number of panicles taken. The number of beetles per tuber is calculated from the number of beetle probes then multiplied by many panicles in a male snake fruit flower bunch. At the location of the study were taken 9 trees in each hectare and considered as a repeat.

2.4. Observation of Beetle Activity
Observation of beetle visitation activity was done by purposive sampling method [9], which was done for 5-10 minutes every hour starting at 08.00-12.00. Observations included the number of individual beetles who visited the female flowers of snake fruit plants.

2.5. Data analysis
The beetle population data and beetle activity are shown in bar graphs. The association between beetle populations and environmental factors was analyzed using Pearson correlation and was shown in biplot that based on Principle Component Analysis (PCA) with R.

2.6. Observation Of Beetle Population
The results of the study of Curculionidae beetle population showed that the highest population was + 23095.9 individuals at the research location of Riak Siabun Village, Bengkulu. While the lowest population number is + 1572,083 at the research location of Gunung Leuser National Park, Kutacane,
Aceh. There are differences in the number of beetle populations in each study location. The low number of beetle populations in TNG. Leuser because snake fruit which grows is a wild salacca that is not cultivated. Furthermore, the snake fruit trees found at the location are quite far apart. Conditions like this are enough to affect the ability of foraging beetles to find food.

**Figure 1.** The number of beetle population in the sampling area. Barr in graph show error standard.

Measurement of environmental parameters in three study locations (TNG, Leuser, Padang Sidempuan, and Riak Siabun) respectively, namely light intensity ranging from 6,000 - 940,000 lux, air temperature ranging from 24 - 31 °C, and humidity ranging from 71 - 95%. While wind speeds range from 0.4 - 18 Knots.

**Table 1.** Pearson correlation (r) between the number of beetles per hectare and environmental parameters.

| Environmental Parameters | Sampling Location (Sidempuan, Leuser dan Riak Siabun) | Pearson Correlation(r) | r² | P-Value |
|--------------------------|------------------------------------------------------|------------------------|----|---------|
| Temperature              |                                                      | 0.5660125              | 0.3203701 | 0.6170 |
| Light Intensity          |                                                      | 0.5517938              | 0.3044763 | 0.6279 |
| Humidity                 |                                                      | -0.831561              | 0.6914936 | 0.3749 |
| Windspeed                |                                                      | -0.0779829             | 0.0060813 | 0.9503 |
Figure 2. Biplot results of Principle Component Analysis (PCA) analysis between the number of beetles per hectare with environmental parameters in the salak plantations in Padang Sidempuan, Leuser National Park, and Riak Siabun Village (a) and Simatorkis Village, Sibangkua Village, Leuser National Park, and Riak Siabun Village (b). IC: light intensity, Suhu: air temperature, RH: air humidity, KA: Windspeed.

2.7. Observation of Beetle Activity

Based on measurements, the highest frequency of beetle visits in receptive mats seen in the morning ranged from 40.75 individuals (per 10 minutes) and the lowest was found during the day ranged from 16.3 individuals (per 10 minutes).

| Time            | Sibangkua | Simatorkis | Leuser | Riak Siabun | Average |
|-----------------|-----------|------------|--------|-------------|---------|
| Morning (7 – 10 am) | 59        | 47         | 30     | 27          | 40.75   |
| Daytime (10 am – 1 pm) | 44        | 21         | 22     | 18          | 26.3    |
| Afternoon (1 – 4 pm) | 28        | 11         | 14     | 12          | 16.3    |

3. Discussion

The results of the statistical analysis of environmental parameters at the sampling location of snake beetle were known that the light intensity, rainfall, humidity, and air temperature did not have a significant direct effect on the beetle population (table 1 and figure 2). Broadly speaking, the beetle population tends to be influenced by reproductive abilities (potential reproductives) which determine the high and low of a population. Besides that, the speed of reproduction and sex ratio also determines the increase in population. But food factors and environmental parameters become supporters of a population.

In some cases, it was found that food sources and availability affected the size of the body. Food is a source of energy for insects to live and thrive. If food is available with suitable quality and sufficient quality, the insect population will rise quickly. Measuring ecological restoration success is not simple, because the structure and composition of communities are very variable due to considerable fluctuations regarding soil nutrient levels, hydrology, and landscape, among others. Pollination is a process related to system sustainability and may be independent of the structural variation. Therefore, a failure to manage and promote pollinators could lead to a decline or collapse in ecological restoration. Under any type of
perturbation, plant-pollinator interactions disruption will depend on the level of specialization between a plant and its pollinators, on their abundance, and their sensitivity to land-use change. The proximity to natural landscapes can serve as an important support to pollinator communities in restoration activities [10]. The influence of the type of food, water content, and the number of material granules also affect the development of a type of insect. In relation to food, each type of insect has a range of food (hosts) from one to many hosts.

Based on observations it is known that beetles are diurnal animals that have activities in the daytime. Like the other insects, beetles searching food during the day in the form of nectar and pollen. This foraging activity indirectly helps the pollination process. Pollination is an essential process that greatly affects the formation of fruit or seeds. Pollination agents help the fruit or seed production process [8]. Effective pollination significantly increases crop yields.

Flowers represent the reproductive organ of flowering plants and are very important in identification because they typically provide characters that are consistently expressed within a taxon (either at the family, genus, or species level). Characteristics of the flower include size, the position of reproductive organs, open access/ accessibility of nectar, flower shape and flowering period. These factors influence the interaction between plants as a source of food, host-plant and pollinator [11]. Some pollinators show specific characters such as body size, sensory ability, ability to find food and energy sources needed. Thus, there is a relationship between flowering form and structure with the pollinator [12]. Some species of beetles have a vital role as flower and fruit eaters while acting as pollinators [13].

The frequency of visiting curculionid beetles in zalacca plants is relatively less when compared to Elaedobius beetles, which are often pollinating oil palm plants. The frequency of E. camerunikus who visited the highest was around 5438 individuals per hectare and the lowest was 768 individuals per hectare [14]. One of the influencing factors is the way the pollination of zalacca plants is still assisted by farmers. So that when pollinating farmers tend to break the stalks of male flowers and put them on the female flower bulbs. This activity indirectly suppresses population numbers and visits of beetles to female flowers.

4. Conclusion
Curculionid beetle plays a role in the process of pollination of snake fruit plants. The success of pollination is strongly influenced by the number of populations and the frequency of beetles that visit the female flower plants. The highest beetle population (23096 individuals) occurred in Riak Siabun, Bengkulu and lowest occurred in Leuser National Park. The frequency of beetle visit is quite low when viewed from the specific role of beetle and snake fruit is a foodplant from the beetle. Environmental parameters do not correlate significantly in beetle populations. Suggestion, Further research is needed on cruising range and mobility of curculionid beetles in the pollination process. A more specific study of the beetle life cycle and the presence of natural enemies capable of affecting beetle populations.

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