Preferences of fruit-feeding butterfly on bait trap in Soraya Research Station, Leuser Ecosystem, Aceh, Indonesia

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Abstract. Butterflies are insects that live cosmopolitan. Some butterflies in tropical forests look for food sources from sucking the juice of ripe fruits that have fallen on the forest floor. Fruit-feeding butterflies can adapt in finding food sources, selecting and sucking food effectively. Fruit contains varying concentrations of sugar and nitrogen. The existence of fruit-feeding butterflies in tropical rain forests is influenced by the availability and quality of food sources as well as other supporting factors such as temperature, humidity, and light intensity. The purpose of this study was to identify fruit-feeding butterflies and their preferences for banana and pineapple baits in the Soraya Research Station Area, Leuser Ecosystem, Aceh, Indonesia from September to November 2020. Six forest trail locations were selected as trap locations. A total of 360 cylindrical gauze baited traps (80 cm high and 35 cm diameter) were installed on six trails/line transects. Baited traps were set at three different heights, that is at the understory level (± 0-2 m), midstorey level (± 5-6 m), and overstorey level (± 10-11 m) with a distance of ± 5-10 m. The distance between location points is ± 250 m. The fruit baits used in this trap were ripe bananas and pineapples. The results obtained were 37 species with 176 individuals trapped on banana bait and 50 species with 183 individuals on pineapple bait. However, the results of the t-test using the Man-Whitney test showed no significant difference between the banana and pineapple bait used.

Keywords: Fruit-feeding butterflies, Tropical rain forest, Soraya Research Station, Leuser Ecosystem

INTRODUCTION

Soraya Research Station is located in Sultan Daulat District, Subulussalam, Aceh, Indonesia. The area is included in one of the Leuser Ecosystem Areas which has a good environmental carrying capacity and very varied biodiversity, one of which is butterflies [1]. This area has a natural forest that is suitable for the habitat of organisms to adapt, especially fruit-feeding butterflies. The existence of fruit-feeding butterflies in tropical rain forests is closely related to the availability of food sources from rotting or ripe fruit that falls on the forest floor [2].

The tropical butterflies obtain nutrition from flower nectar and some other products that contain sugars such as fruits, as well as the necessary mineral components. The sugar content most favored by butterflies is sucrose, and then fructose, glucose, and maltose [3, 4]. Based on the method of obtaining nutrition at the adult stage (adult feeding habits) butterflies in tropical rainforest areas are divided into three groups, nectar-feeders, fruit-feeders, and omnifeeders [5].

The composition of fruits is similar to the composition of nectar which contains carbohydrates and amino acids. Fruit also provides an additional source of nutrients such as vitamins and minerals. Overripe and rotting fruit produces a lot of metabolite products such as alcohol and organic acids, the substances are very useful as an attractant for fruit-feeding butterflies [2, 6].

Most fruit-feeding butterflies are included in the Nymphalidae family [7], especially from the Charaxinae, Satyrinae, and Nymphalinae subfamilies [8, 9]. The fruit-feeding butterfly group is a species that is attracted to fruit juices, but this does not mean that fruit is the main food source. Fruit as a food source for butterflies in forest areas comes from overripe or rotting fruit that has fallen on the forest floor and has the

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Received: September 2021 | Revised: October 2021 | Accepted: October 2021
smell or smell of decaying fermentation [2, 6, 10, 11].

Many types of tropical fruit can be used as bait in cylindrical gauze traps such as bananas and pineapples. Several studies have used baits [1, 4, 11, 12]. Reported as many as 40 species of fruit-feeding butterflies trapped using banana bait in the tropical forest area of Borneo, 31 species were caught at the understory level, while 23 species were caught at the overstorey level (the canopy) [13]. Furthermore, using pineapple bait got 11 species at the understory level and 2 species were caught around the tree canopy [14]. In addition, pineapple bait also obtained 22 species of fruit-feeding butterflies at the understory and 12 species at the overstorey level [15]. A lot of butterfly species that are often found around the understory level area are caused by the factor of sufficient light intensity compared to around the canopy. In addition, rotting fruit is often found on the forest floor. Until now, there is no information about bait preferences for fruit-feeding butterflies, especially in the tropical forests of the Leuser Ecosystem. Therefore, this study aimed to identify the types of fruit-feeding butterflies and their preferences for banana and pineapple baits in the Soraya Research Station, Leuser Ecosystem, Aceh, Indonesia.

**METHODOLOGY**

**Study site**

The study was conducted at the Soraya Research Station, Subulussalam, Aceh Province (Figure 1). The area has high biodiversity and is part of the Leuser Ecosystem. The forest condition of the area is still in the regeneration stage or succession stage. Geographically, this station is located at coordinates between 2°55’25” South Latitude and 97°55’43” East Longitude with a topography of 75-350 m above sea level.

![Map of Soraya Research Station](image_url)

**Figure 1.** The location and placement of cylindrical gauze baited traps, in Soraya Research Station, Sultan Daulat, Subulussalam, Aceh, Indonesia
**Data collection**

This research was conducted experimentally using 60 traps baited with cylindrical gauze (80 cm high and 35 cm diameter) with a gap of ± 4 cm at the bottom where butterflies enter. Two types of bait were used, bananas and ripe pineapples [16]. Experiments were carried out at different stratification, at the understorey level (± 1-2 m), midstorey level (± 5-6 m), and overstorey level (± 10-11 m) above the ground. Next, traps were placed on 6 transect lines/trails with each line consisting of 10 sampling points. Totally 360 samples were used (6 transect lines x 10 sampling points x 3 levels stratification x 2 types of bait). The distance between of sampling points and the next sampling point was ± 250 m, while the range between the traps in each sampling point was 5-10 meters. Observations were carried out for 3 months, September - November 2020 from 8.00 am to 5.00 pm. The data collection of trapped butterflies is carried out every 2x24 hours [13, 17].

**Baiting traps**

The bait was placed on each trap containing overripe bananas and pineapples. Next, the banana was split into 2 parts and placed in each trap, while the pineapple was cut horizontally with a thickness of ± 2 cm. Bait traps were laid from September to November 2020 with different heights of trapping (understorey ± 1-2 meters, midstorey level ± 5-6 meters, and overstorey level ± 10-11 meters) [17]

**Collection of samples**

Bait checks and sampling were carried out every 2 x 24 hours. The trapped fruit-feeding butterflies were taken carefully and stunned by pressing the thorax and inserted into papilot paper, labeled with data on the location of collection, type of bait, and height of the trap. Species identification of fruit-feeding butterflies refer to books of butterfly [18, 19, 20] and related journals [12, 15].

**Parameter**

The parameters observed included the number of species and the number of individual butterflies that entered the baited trap at three different heights.

**Analysis of data**

Data on the number of species and the number of individual fruit-feeding butterflies at three different heights were statistically analyzed using a non-parametric test (Mann-Whitney test) [21]

**RESULTS AND DISCUSSION**

The results showed that there were 55 species and 359 individuals of fruit-feeding butterflies. A total of 37 species with 176 individuals caught on banana bait and 50 species with 183 individuals on pineapple bait. All of these species belong to five subfamilies of Nymphalidae (Charaxinae, Danainae, Nymphalinae, Morphinae, and Satyrinae (Table 1). The highest number of species was found in the subfamilies Nymphalinae and Satyrinae, while the least in the subfamilies Danainae. This is due to the availability of feed and host plants as well as environmental factors and suitable vegetation conditions. The dominant vegetation in the study area is from the family Dipterocarpaceae and several other species such as Mangifera sp., Barringtonia scortechinii, Anacardium sp., Garcinia sp. and Melastoma malabatricum. The Nymphalidae family is a family that has the highest number of species in the order Lepidoptera and is polyphagous, allowing this family to still be able to meet its needs for host plants even though the main host plant is not available [22]. In addition, the Nymphalidae family is often found in animal waste and sucking rotten fruit [14].

Based on Table 1 shows that the number of species and the number of individuals caught on pineapple bait is more than on banana bait. This happens because the overripe fruit used has differences in terms of chemical composition, fruit size, and fermented sugar content [23]. The aroma possessed by the fruit usually has a different appeal depending on the maturity of the fruit. The pungent fruit aroma is most likely to be detected from a distance in a forest environment that can be used to find food. Fruits contain varying concentrations of sugar and nitrogen which are used by fruit-feeding...
butterflies in tropical forest areas. In addition, the aroma of fermentation from the fruit can be used as a clue to find the location of the presence of food for fruit-feeding butterflies [2].

**Table 1.** The species of fruit-feeding butterflies trapped in banana, pineapple, and understory, midstorey, and overstorey at Soraya Research Station

| Family/Sub Family | Species                        | Based on | B | P | U | M | O |
|-------------------|--------------------------------|----------|---|---|---|---|---|
| Nymphalinae       |                                |          |   |   |   |   |   |
| Charaxinae        |                                |          |   |   |   |   |   |
|                   | Charaxes calyxoides            |          |   |   |   |   |   |
|                   | Charaxes bernardus             |          |   |   |   |   |   |
|                   | Charaxes dunnfordi             |          |   |   |   |   |   |
|                   | Polyura athamas               |          |   |   |   |   |   |
|                   | Prothoe franck                |          |   |   |   |   |   |
| Danainae          |                                |          |   |   |   |   |   |
|                   | Euploea cyndihovii            |          |   |   |   |   |   |
| Nymphalinae       |                                |          |   |   |   |   |   |
|                   | Bassarona recta               |          |   |   |   |   |   |
|                   | Cynitia gondattii             |          |   |   |   |   |   |
|                   | Dichorragia nesimachus        |          |   |   |   |   |   |
|                   | Dophla evelina                |          |   |   |   |   |   |
|                   | Euthalia aconthea             |          |   |   |   |   |   |
|                   | Euthalia ipona                |          |   |   |   |   |   |
|                   | Euthalia kanda                |          |   |   |   |   |   |
|                   | Euthalia merta                |          |   |   |   |   |   |
|                   | Euthalia montina              |          |   |   |   |   |   |
|                   | Herona sumatranana            |          |   |   |   |   |   |
|                   | Kallima limborgii             |          |   |   |   |   |   |
|                   | Lebadea martha                |          |   |   |   |   |   |
|                   | Lexias cynipardus             |          |   |   |   |   |   |
|                   | Lexias pardalis               |          |   |   |   |   |   |
|                   | Neptis sedata                 |          |   |   |   |   |   |
|                   | Rhinopalpa polynice           |          |   |   |   |   |   |
|                   | Sephsia chandra               |          |   |   |   |   |   |
|                   | Stibochiona coreisia          |          |   |   |   |   |   |
|                   | Sumalia agneya                |          |   |   |   |   |   |
|                   | Tanaecia aruna                |          |   |   |   |   |   |
|                   | Tanaecia clathrata            |          |   |   |   |   |   |
|                   | Tanaecia gondartii            |          |   |   |   |   |   |
|                   | Tanaecia iapis                |          |   |   |   |   |   |
|                   | Tanaecia munda                |          |   |   |   |   |   |
|                   | Tanaecia palguna              |          |   |   |   |   |   |
|                   | Tanaecia pelea                |          |   |   |   |   |   |
| Morphinae         |                                |          |   |   |   |   |   |
|                   | Amathuxidia amythaon          |          |   |   |   |   |   |
|                   | Amathusia masina              |          |   |   |   |   |   |
|                   | Amathusia philippus           |          |   |   |   |   |   |
|                   | Amathusia schoenberghi        |          |   |   |   |   |   |
|                   | Discophora necho             |          |   |   |   |   |   |
|                   | Discophora timora             |          |   |   |   |   |   |
|                   | Zeuxidia aurelius            |          |   |   |   |   |   |
|                   | Zeuxidia amethystus           |          |   |   |   |   |   |
| Satyrinae         |                                |          |   |   |   |   |   |
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| Family/Sub Family | Species               | Based on                      |
|-------------------|-----------------------|-------------------------------|
|                   |                       | B    | P    | U    | M    | O    |
|                   | Coelites euptchioides | -    | ✓    | ✓    | ✓    | -    |
|                   | Elymnias casiphona    | -    | ✓    | ✓    | -    | -    |
|                   | Elymnias nasaea       | -    | ✓    | -    | -    | ✓    |
|                   | Elymnias penangia     | ✓    | ✓    | ✓    | ✓    | ✓    |
|                   | Erites argentina      | ✓    | ✓    | -    | -    | -    |
|                   | Melanitis leda        | ✓    | ✓    | ✓    | ✓    | ✓    |
|                   | Mycalesis dohertyi    | ✓    | ✓    | ✓    | -    | -    |
|                   | Mycalesis fusca       | -    | ✓    | ✓    | ✓    | ✓    |
|                   | Mycalesis horsfieldi  | ✓    | ✓    | ✓    | ✓    | ✓    |
|                   | Mycalesis intermedii  | ✓    | ✓    | ✓    | -    | -    |
|                   | Mycalesis musicles    | -    | ✓    | ✓    | -    | -    |
|                   | Mycalesis orseis      | ✓    | ✓    | ✓    | ✓    | ✓    |
|                   | Mycalesis perseus     | ✓    | ✓    | -    | -    | ✓    |
|                   | Neorina lowii         | ✓    | ✓    | ✓    | ✓    | ✓    |
|                   | Ragadia makuta       |   | ✓    | ✓    | -    | -    |

Information: B = Banana; P = Pineapple; U = Understorey (±0-2 meters); M = Midstorey (±5-6 meters) O = Overstorey (±10-11 meters)

Number of species: 37, 50, 39, 30, 31
Number of individuals: 176, 183, 200, 74, 85

**Figure 3.** (a) Percentage of 37 species (b) Percentage of 176 individuals fruit-feeding butterflies trapped in banana bait at Soraya Research Station, Leuser Ecosystem
Different heights banana and pineapple bait preferences at three different heights had no significant effect (Man-Whitney test, n = 60, p > 0.05). This is in accordance with previous studies that differences in fruit aroma preferences result in an abundance of species and individuals at the subfamily level [2, 24, 25].

The number of species and the number of individual fruit-feeding butterflies based on the height of the cylindrical gauze trap using banana and pineapple bait, obtained the most fruit-feeding butterflies at the understorey level (55.7% of 200 individuals and 39 species) compared to the midstorey level (20.6% of 74 individuals and 33 species) and overstorey level (23.6% of 85 individuals and 31 species). This is consistent with several studies showing that the level of diversity of fruit-feeding butterflies is higher in the soil surface or understorey parts than in the canopy [12, 13, 15, 24, 25, 26, 27]. Most of the sub-family Charaxinae, Nymphalinae are found in the canopy, while Satyrinae and Morphinae are more commonly found in understorey in neotropical forests [28]. However, the highest species diversity in the middle strata of the forest was caused by the overlap between the understorey and organisms in the canopy. This pattern is found in the vertical strata of tropical rain forests in Kalimantan [29].

The abundance of ripe or rotting fruit falling to the forest floor can attract fruit-feeding butterflies to find food locations. This allows the high diversity of species in the understorey. While in the canopy, there are generally fruits that are still ripe or unripe and do not have an aroma that attracts the attention of butterflies, especially fruit-feeding butterflies. The fruit that the butterfly lands on to eat, is usually a fruit that has fallen to the forest floor, is too ripe or is rotting fruit that produces a fermented aroma [9]. Fruits that produce a fermented aroma have different concentrations of sucrose, where the variation of sucrose in the fruit depends on the level of maturity or stage of fruit spoilage. When the fruit is ripe, the sugar concentration can increase but will decrease when fermentation occurs [30].

**CONCLUSION**

Butterfly preferences for banana and pineapple baits did not show a significant difference (39 species of bananas and 52 species of pineapples...
Kunte, K. 2006. Fruit-feeding butterflies were more commonly found in the understory (39 species), compared to the midstorey (30 species) and overstorey (31 species). The most subfamily or species is Nymphalinae (26 species), while the least is found in the Danainae subfamily (1 species).

ACKNOWLEDGMENT

The authors would like to thank the Department of Environment and Forestry of Aceh Province and Leuser Conservation Forum for their permission to research at The Soraya Research Station in Subulussalam, Aceh, Indonesia. This research funded by the Institute for research and community service of Syiah Kuala University Contract Number 170/UN11/SPK/PNBP/2021.

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