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The Composition and Important Value Index of Trees for Wildlife Feed in Bacan Island, South Halmahera

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Abstract. Forests provide protection, food, and habitats for wild animals such as monkeys, birds, bats, squirrels, and weasels that depend on the fruits and seeds from the trees. Due to human's activities, the functions of the forest in Bacan Island have decreased significantly in terms of numbers, kinds, and important value index. Local people have converted forests into agricultural lands. As a result, the existence of natural resources especially trees, which supply nutrients for wild animals such as monkeys, birds, bats, squirrels and weasels, is being threatened. The current study aimed to investigate the composition and important value index of every type of plants used for wildlife feed. An inventory method was employed in plots of 20 m × 20 m for tree-level observation. This method would be useful to obtain the list of plant composition for wildlife feed and to determine some vegetation parameters including the density, domination, frequency, and important value index of the plants. This research showed that *Duobanga moluccana*, *Drancontomelon dao*, *Bacacaurea anguilata* Merr, *Theobroma cacao*, *Mangifera indica*, *Canarium casferum*, *Myristica fatua* and *Myristica sperciosa* are the composition of plants that could supply nutrients for the wild animals. The highest important value index (IVI) (52.78%) was observed in *Drancontomelon dao*. Medium IVI which ranged from (31.47-44.42%) was reported by *Duobanga moluccana*, *Bacacaurea anguilata* Merr, *Theobroma cacao*, *Canarium casferum*, *Myristica fatua*, and *Myristica sperciosa*. Meanwhile, the lowest IVI (29.52%) was found in *Mangifera indica*.

Keywords: Composition, important value index, wildlife feed, Bacan Island

1. Introduction

Indonesia is a rich country, especially in terms of forest biodiversity; a large number of flora and fauna depends on forestly habitat to keep survive. In terms of the richness of flora, it is estimated that there are more or less 40,000 plant species spread across forests in various regions of Indonesia [1]. However, Indonesia now is categorized as the second country on the highest number of all threatened species in the world based on IUCN [2]. Nevertheless, since the government has shared the forest management rights to civilians, forests exploitation becomes more serious concern [3]. The functions and the quality of the forests used to provide habitats for wild animals have been decreasing, either in numbers, types, or important value for both humans and the wildlife [4]. The amount of plants that are



useful for wild animals' life will also reduce, moreover, vanish in the near future if there is no more attention or proper handling on forest management [5]. The existence of a wide range of tree plants in the natural forests will help to supply resources needed by wild animals [6,7]. The trees can provide protection, food, habitats, shelters, and breeding ground for the offspring [8]. Forests communities that have a resembling vegetation structure to the natural forests would be an appropriate habitat for the birds and other mammals which feed on seeds and insects found in the forests [9,10].

Some experts of wildlife conducted research on plants and their parts such as fruit, seed, flower, or pollen that can be devoured by wild animals [11], for example wild boars (*Sus verrucosus*) consumed cassava (*Manihot utilisima*), bats (*Chiroptera*), and weasels (*Viverride*) feeding on bananas. So many kinds of birds fed byals nutrients from plants that grow either in the open or thick forests [12]. It was also reported that monkeys not only fed on fruits and seeds that could be found in the forests, but also devoured some agricultural products such as corn, peanuts, and bananas [9,13]. This research focused on identifying forest species, especially, on trees composition based on density, basal area, and size class distribution to calculate Importance Value Index (IVI) [14–16]. On a large scale, IVI of trees can be used as a marker of ecosystem type and assessing the sustainability of the forest [11]. Thus, providing management of forest conservation would be easier based on the ecosystem type [17–19].

2. Methods

This research attempted to investigate the composition and important value index (IVI) of every type of tree plant used by wild animals as the feed source. Due to the most frequent appearance of wild animals found in this area, Sawadai village, Bacan Island was determined as the current research place. An inventory method was employed to a 100 m × 1250 m transect divided into 20 m × 20 m plots for tree-level observation. Direct identification was conducted to all tree plant species with a diameter of > 20 cm found in the observation plots. This method was expected to generate a list of the trees composition mainly that could provide nutrients for the wildlife. Vegetation parameters include the density, domination, frequency, and important value index (IVI) of the trees.

The samples of the trees in each plot were identified according to the flora book [20]. The information related to whether the trees were consumed by the wild animals or not was gathered from local people. The data record and the calculation of some vegetation parameters such as relative density, relative domination, relative frequency, and important value index of the species [21] referred to the formula presented below:

$$\text{Relative density} = \frac{\text{number of individuals of species}}{\text{total number of individuals}} \times 100$$

$$\text{Relative dominance} = \frac{\text{dominance of species}}{\text{dominance of all species}} \times 100$$

$$\text{Relative frequency} = \frac{\text{frequency of species}}{\text{sum frequency of all species}} \times 100$$

$$\text{Importance value} = \text{Relative density} + \text{Relative dominance} + \text{Relative frequency}$$

3. Results

Based on the research findings, the composition of plant species used by the wildlife as the nutrient sources was successfully identified as follow (Table 1). The results of the recorded data and analysis on vegetation parameters including the important value index of every tree species are presented in Table 2.

Table 1. The composition of tree species used by wild animals in Bacan Island as the nutrient sources

No	Local Names	Scientific Names
1	Benuang	<i>Duobangga mollucana</i>
2	Bua Rau	<i>Drancontomelon dao</i>
3	Forest Starfruit	<i>Bacacurea anguilata</i> . Merr
4	Chocolate	<i>Theobroma cacao</i>
5	Mango	<i>Mangifera indica</i>
6	Forest Walnut	<i>Canarium casferum</i>
7	Forest Guava	<i>Myristica fatua</i>
8	Forest Nutmeg	<i>Myristica spercioca</i>

Based on the observation results, Bacan black monkeys (*Macaca nigra* Desmarest. 1822) were first ranked among other wild animals because their diet was mostly sourced from the tree, fruits, and seeds around the used plots on this research that were *Duobangga moluccana*, *Drancontomelon dao*, *Bacacurea anguilata* Merr, *Theobroma cacao*, *Mangifera indica*, *Canarium casferum*, *Myristica fatua*, and *Myristica sperciosa* [22]. Then, in the second place, birds (Aves) were reported to feed on *Duobangga moluccana*, *Drancontomelon dao*, *Bacacurea anguilata* Merr, *Mangifera indica*, and *Myristica fatua*. On the other hand, bats (*Chiroptera*) were observed that they consumed fruits from *Bacacurea anguilata* Merr, *Mangifera indica*, and *Myristica fatua*. It was also found that squirrels (*Scandentia*) ate fruits and seeds from *Bacacurea anguilata* Merr, *Theobroma cacao*, *Mangifera indica*, *Myristica fatua*, and *Myristica sperciosa*. Meanwhile, weasels (*Viverridae*) came the last as one of the wild animals that used *Bacacurea anguilata* Merr, *Mangifera indica*, *Myristica fatua* and *Myristica sperciosa* as the nutrient sources.

Table 2. Important value index of tree species for wildlife feedd in Bacan Island

No	Tree Species	Relative Density (%)	Relative Domination (%)	Relative Frequency (%)	Important Value Index (%)
1	<i>Duobangga mollucana</i>	9.23	18.20	8.85	36.28
2	<i>Drancontomelon dao</i>	20.45	13.73	18.60	52.78
3	<i>Bacacurea anguilata</i> . Merr	12.12	10.32	15.21	37.65
4	<i>Theobroma cacao</i>	10.13	15.32	19.02	44.47
5	<i>Mangifera indica</i>	7.24	12.23	10.05	29.52
6	<i>Canarium casferum</i>	15.09	9.82	8.05	32.96
7	<i>Myristica fatua</i>	14.41	9.49	11.02	34.92
8	<i>Myristica spercioca</i>	11.33	10.89	9.20	31.42
Total		100	100	100	300

Obviously, most of the wild animals which inhabit in Bacan Island devoured fruits that were still hanging on the trees, then birds and bat collected seeds that were spread over the ground, based on the information obtained from local people that reported the monkeys frequently appeared in the research site. In addition, some kinds of birds were easily spotted and quickly identified, there were white cockatoos (*Cacatua alba*), Taong birds, and the Papuan hornbills (*Rhyticeros plicatus ruficollis*)

widely distributed in Maluku areas [23]. Moreover, the local people also admitted that they often saw the forest monkeys eating some crops such as corn, banana, chocolate, and *dukuh*.

4. Discussion

The results listed in Table 1 show eight tree plants species normally consumed by the wildlife in the research plots. These plants species were an important nutrient source for the animals that live in Sawadai village, Bacan Island. *Benuang* (*Duobanga moluccana*), *Buah Rau* (*Drancontomelon dao*), forest starfruit (*Bacacaurea anguilata* Merr), mango (*Mangifera indica*), and forest guava (*Myristica fatua*) are served as the main source of energy for the tree-climbing mammals such as Bacan black monkeys (*Macaca nigra*) and other wild animals such as birds (*Aves*) that can easily move and be found many kinds of plants either in the open or thick forests [12,24]. Furthermore, those monkeys, birds, bats, squirrels, and weasels normally prefer to consume fruits from some tree species grown in the forests [25]. Monkeys also like to feed on seeds from the trees and other seeds produced by other types of plants. Monkeys eat not only fruits from the forests, but also some crops from nearby agricultural lands such as corn, peanuts, and bananas [9,26].

Then results presented in Table 2 show tree plant species with their Important Value Index (IVI); from the highest to the lowest there were *Drancontomelon dao*, *Theobroma cacao*, *Bacacaurea anguilata* Merr, *Duobanga moluccana*, *Myristica fatua*, *Canarium casferum*, *Myristica sperciosa*, and *Mangifera indica*. Based on the eight founded species, *Drancontomelon dao* apparently constituted as the most dominate plant on the research site, with the highest IVI of 52.78% of density, frequency, and domination. Compared to other tree plants, *Drancontomelon dao* also can be categorized as the one with the biggest number of individuals, thus they are expected for the next few years to support the adequate feedd provision for wild animals that inhabit in Sawadai village. Meanwhile, *Theobroma cacao*, *Bacacaurea anguilata* Merr, *Duobanga moluccana*, *Myristica fatua*, *Canarium casferum*, *Myristica sperciosa*, which have IVI between 31.47-44.42% can be put in the medium category as the complementary feedd sources because these plants are still available in a considerable amount in the nature in terms of number of individuals and frequency. The lowest IVI of 29.52% was observed in *Mangifera indica* which is also low in domination rate because the seeds are often devoured by wild animals. As a result, the ability of the seeds to spread in the soils would be limited [27].

The understanding of birds and bats that play a major role in distributing seeds of the trees is also significant because it can be served as a pollination agent or plant seeds distributor [28,29]. Bats and birds existing in the nature are involved in an essential way in the natural ecological chain [30]. However, when the seeds touch the ground, they are probably found and eaten by other wild animals such as monkeys, squirrels, and weasels so that the distribution of the seeds becomes uneven. As a result, the population of the trees starts decreasing and the tree regeneration will be more limited in the next few years. This phenomenon may adversely affect the provision of the feedd for the wildlife and also lower the IVI of the tree species in this area [31].

5. Conclusion

Based on the results of the research conducted in Sawadai village, Bacan Island, some conclusions can be drawn as follow: 1) eight tree species were found as nutrients provider for the wildlife, namely *Duobanga moluccana*, *Drancontomelon dao*, *Bacacaurea anguilata* Merr, *Theobroma cacao*, *Mangifera indica*, *Canarium casferum*, *Myristica fatua*, and *Myristica sperciosa*; 2) *Drancontomelon dao* had the highest IVI of 52.78%, the other trees such as *Duobanga moluccana*, *Bacacaurea anguilata* Merr, *Theobroma cacao*, *Canarium casferum*, *Myristica fatua*, and *Myristica sperciosa* were put in the medium category with an IVI range between 31.47-44.42%; then *Mangifera indica* had the lowest IVI of 29.52%; 3) monkeys, birds, bats, squirrels, and weasels were found as wild animals that consume food-fruits and seeds-from the trees.

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