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Vegetation Stratum Condition on Bird Diversity in Gunungkelir, Yogyakarta, Indonesia

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ABSTRACT

Indonesia is an archipelago located in a tropical climate zone that is home to 17% of the world's creatures, but human disturbances still threaten the existence of bird species in Indonesia. This encourages bird conservation efforts both through conservation areas and community forests. This study aims to determine the diversity and interaction of birds with the vegetation stratum in the community forest of Gunungkelir Hamlet, Jatimulyo Village, Kulon Progo Regency, Yogyakarta. This research was conducted from February to March 2024, using a combination of line transect, point count, and rapid assessment methods for bird observation. Data were analyzed using diversity index (H'), evenness (E), and relative abundance. Vegetation stratum data used in vegetation analysis through nested plot sampling to obtain the Important Value Index (IVI). The results showed that there were 21 species from 13 bird families; the diversity value obtained on the three lanes was 2.62 on lane 1, 1.84 on lane 2, and 1.79 on lane 3. The *Albizia chinensis* species had the highest IVI value at the seedling and sapling levels, with (67%) and (76.4%), respectively; then cloves obtained the highest IVI value at the pole and tree levels with (84.5%) and (81.3%). The majority of birds, comprising as many as 15 species, were found in stratum C, followed by stratum D, which had as many as 8 species, stratum E with 3 species, stratum B with 2 species, and no birds were found in stratum A. The most common form of vegetation utilization found was resting. Birds utilized the stratum layer to rest, play, and find food. Understanding bird ecology also means understanding human safety in wisely managing forest ecosystems.

Keywords: Ecology; Stratification; Community Forest; Biodiversity; Bird; Vegetation

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1. Introduction

Indonesia is an archipelago located in a tropical climate zone with high biodiversity. Diverse ecosystems make Indonesia a habitat for 17% of the world's bird species [1]. The diversity of ecosystems also creates different bird species communities in each region. Abundant natural resources fulfil and maintain the life needs of birds.

Bird habitat conditions continue to face pressure every year, largely because the importance of birds to the environment has not received sufficient attention in society. Overhunting, lack of conservation efforts, environmental pollution, and deforestation are among the factors contributing to population decline and the loss of bird species in nature. Logging activities and forest land-use changes have also caused sensitive bird species to decrease in population density. This is explained in existing research that one of the factors influencing bird diversity and numbers is how the forest is managed [2]. Hunting activities have also reduced bird populations in nature, which can be prevented if people have a sense of concern for wildlife.

Birds have good adaptability and high mobility, which makes the distribution of birds wide and allow them to live in various types of ecosystems as needed [3]. Some types of ecosystems that can support bird life include secondary forest ecosystems and community forests. One of the community forests that also serves as a location for bird habitat conservation is the community forest in Jatimulyo Village, Kulon Progo. Bird conservation programs are implemented to increase bird populations that have declined due to hunting. Although the purpose of community forests is to improve community welfare through commodities, community forests that are still maintained in their diversity of vegetation types are able to support wildlife. People's forests with a high diversity of plant species are able to provide a more suitable habitat for wildlife [4]. This condition is an attraction in itself, so this research is important to do as a description of the diversity, presence, and interaction of birds in community forest habitats through vegetation stratum as an important element in bird survival.

2. Methodology

2.1. Material and Methods

This study examines the condition of tree vegetation in the Gunungkelir people's forest, which serves as habitat for bird grazing. Trees have branches that are one of the places where birds roost. Trees also produce fruit, which is a source of animal feed. The parameters used such as tree height, tree type, and how birds use the vegetation layer implement that birds depend on forests for their livelihood so that vegetation data becomes an essential subject in knowing the existence of animals. This parameter will be a reference for the description of how the shape of the tree used by birds can be known, so that from this information the characteristics of suitable habitat conditions can be known.

Data were collected from February 21 to March 6, 2024, at 06.00–09.00 and 15.00–17.00 WIB. The research was conducted in the Gunungkelir community forest, Jatimulyo Village, Kulon Progo District, Yogyakarta, which has an area of 168 ha with coordinates 7°44'00 “LS and 110°6'30”BT. The community forest that became the research location is under the auspices of the Kelompok Tani Hutan Wanapaksi (KTH) or Wanapaksi Forest Farmer Group, which is a community forest farmer group in Jatimulyo Village.

Gunungkelir Hamlet is one of the hamlets in Jatimulyo Village, Special Region of Yogyakarta, which has the nickname of a bird-friendly village. This village has been developing birdwatching ecotourism since 2018 as a livelihood for the community. Although the community forest in Gunungkelir Hamlet is not a forest intended as a conservation forest, the existence of birds in this hamlet has been recognized by many people including foreigners.

The equipment used in this study included binoculars, mobile phone camera, Canon 550D camera, hagameter, diameter tape, roll meter, raffia, tallysheet, stationery, Global Positioning System (GPS), and the book “Birds of the Indonesian Archipelago [5]. The data collection technique was carried out by sampling method using the point count method or index point of abundance (IPA), which consisted of 9 observation plots. The point count method is carried out by observers standing at an observation point and counting and identifying birds seen within a certain time interval, which is done repeatedly. The observation location was carried out on a circular observation plot with a diameter of 25 m, the same as the width of the nested plot sampling shown in **Figure 1**. The ob-

servation time for each calculation point was 15 minutes, including a 2-minute environmental adaptation time [6]. Visibility is determined by the ability of the observer and the density of the tree; the presence of a dense tree can affect the observer's visibility because it is easily blocked by leaves and twigs. Observation points were established through systematic sampling, with 3 points in each lane. The distance between points was 150 meters to avoid recording birds repeatedly.

To collect data on the structure and composition of vegetation at the research site using a purposive sampling method with 27 nested sampling plots. The sampling plots were made in the form of a square shown in **Figure 2**, the size of 2x2 m is recommended for seedlings, 7x7 m for sapling level, 10x10 m for pole level, and 25x25 m for tree level [7].

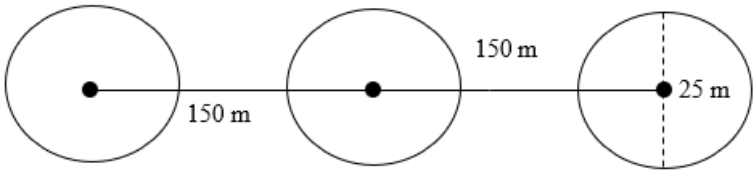


Figure 1. Point Count.

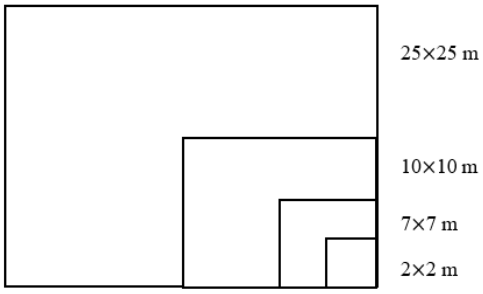


Figure 2. Nested plot sampling.

The number of sample plots is determined using the sampling intensity for forest inventory activities [8]. The sampling intensity used in planted forests which have relatively lower diversity than natural forests requires a low sampling intensity; therefore, the intensity used is 1%. The habitat conditions that tend to be the same in plantations in each part make it unnecessary to observe the entire forest. It also concerns the effectiveness of research, both in terms of time and human effort. These sample plots will be placed in bird-watching locations that represent the environmental conditions of birdlife [9].

$$n = (i.N)/A$$

Description:

n = number of sample plots
i = sampling intensity
N = forest area
A = main plot area

2.2. Data Analysis

The results of bird observations will be analyzed descriptively and quantitatively using indices of diversity, evenness, and abundance of species. Bird data analysis is calculated using several methods, including:

Relative abundance

To determine the relative abundance at the location of bird species data collection [10].

$$\text{Relative abundance} = \frac{\text{Abundance of a species}}{\text{Abundance of all species}} \times 100\%$$

Species diversity index (H')

The species diversity of an individual can be determined using the Shannon-Wiener diversity index:

$$H' = \sum\{(ni/n)\ln(ni/n)\}$$

Description:

H' = Shannon-Wiener diversity index
ni = Number of individuals of each type
n = Number of individuals of all species

The Species Evenness Index (E)

This index is used to determine the evenness of each

species in a community encountered [11]. To determine the degree of evenness of species at the location of bird species data collection, the following formula is used:

$$E = H' / Ln\ S$$

Description:

E = Species evenness index

H' = Shannon-Wiener diversity index

S = Number of species found

If the value of E is close to 1 (one), then it is stated in an evenly distributed condition, while if the value of E is close to 0 (zero), then it is stated in an uneven condition.

To analyze the vegetation data, calculations were made using [12]:

Density

$$density = \frac{\text{number of individuals of a species}}{\text{sample unit area}}$$

$$relative\ density = \frac{\text{density of a species}}{\text{total density of species}} \text{ x } 100\%$$

Frequency

$$frequency = \frac{\text{number of plots of a species}}{\text{total plots}}$$

$$relative\ frequency = \frac{\text{frequency of a species}}{\text{total frequency}} \text{ x } 100\%$$

Dominance

$$dominance = \frac{\text{basal area of a species}}{\text{area of sample unit}}$$

$$relative\ dominance = \frac{\text{dominance of a species}}{\text{dominance of total species}} \times 100\%$$

Tree base area

$$tree\ base\ area = 1/4\ \pi\ d^2$$

Analysis of vegetation data that has been obtained through the nested sample plot method is analyzed to find the Important Value Index (IVI).

Forest profile data will utilize tree height, crown width, trunk height (excluding branches), and tree location in an observation plot 75 m long and 25 m wide as shown in **Figure 3**. The data that has been obtained will be analyzed using SExl-FS software to display a three-dimensional forest profile model. The forest profile model also displays the number of stratums in each community observed.

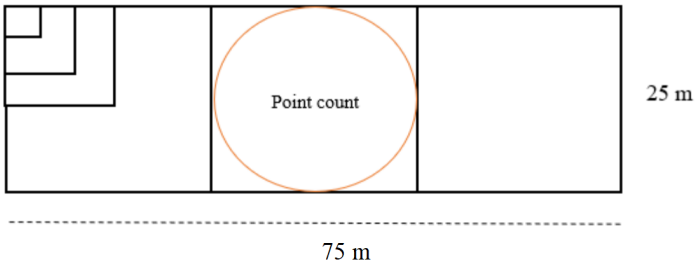


Figure 3. Forest profile plot.

3. Results and Discussion

3.1. General Site Conditions

The location of the vegetation analysis was in the agroforestry forest of Gunungkelir Hamlet, which is in a hilly area. Environmental parameters are presented in **Table 1**, which outlines some of the abiotic conditions of the research site in Gunungkelir Hamlet, Jatimulyo Village, Kulon Progo Regency. The ecosystem component plays a crucial role in describing the condition of the ecosystem within the community forest.

Table 1. Condition of the Kulon Progo Environment.

Parameter	Unit	Score
Temperature	°C	26,3
Precipitation	mm/month	988,8
Altitude	m	601–700

Source: BPS Kulon Progo 2023.

The condition of community forest land in Gunungkelir hamlet uses an agroforestry system that combines forestry plants with annual crops. The composition of vegetation that makes up agroforestry land is dominated by Multi Purpose Tree Species (MPTS), which are plants that have ecological and economic benefits [13]. This combination will affect the distribution of birds, playing a role in ecological functions of agroforestry land. Trees on agroforestry land will form a more complex forest stand, providing shelter for birds to nest.

The results of vegetation analysis show that the most vegetation found in the three observation paths is in stratum C. Path one has a total percentage of stratum C vegetation as much as 40% of the total amount of vegetation on the path. The order of highest to lowest percentage in line one is followed by stratum D as much as 26%, stratum B 22%, and stratum E 12%. Then in path two, stratum C has the highest value of 60%, followed by stratum D as much as 23%, stratum B 9%, and stratum E 8%. Furthermore, in path three, the highest vegetation is also located in stratum C, with sequential values from the highest percentage, namely stratum C 62%, stratum D 15%, stratum E 13%, and stratum B 10% (**Figure 4**).

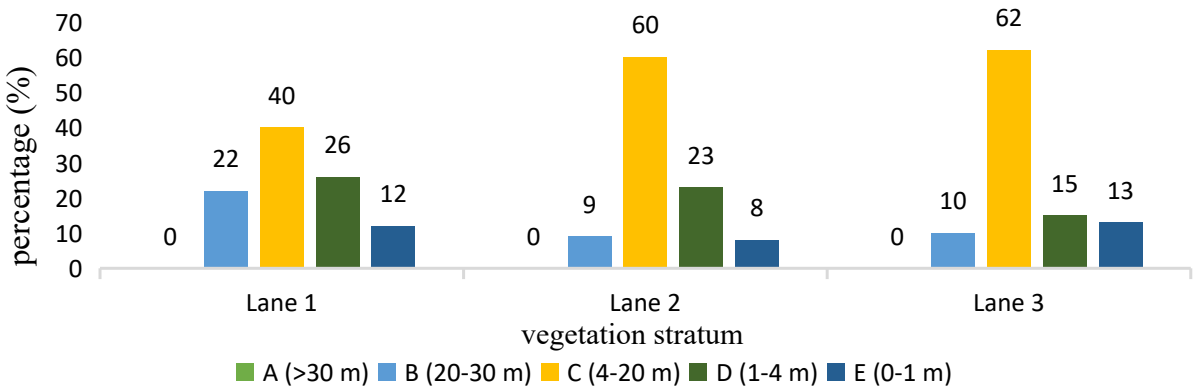


Figure 4. Percentage of trees per vegetation stratum.

The large amount of stratum C vegetation is due to the result of tree planting efforts to maintain the presence of trees. This location is also an implementation area for creating artificial bird nests as part of the bird nest adoption program (**Figure 5**). Many artificial nests and bird-watching spots were found, such as small ponds and fruit trees that were deliberately left unharvested by residents for bird food.

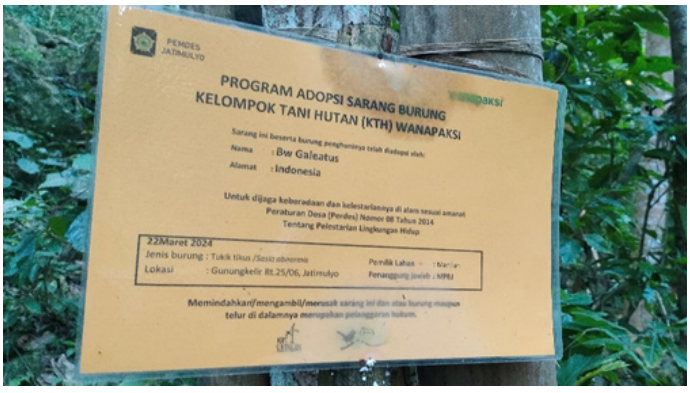


Figure 5. Bird adoption program certificate.

The presence of vegetation in stratum E has a relatively low percentage, because community forest land is often traversed by the community, which causes plants on the surface to tend to be exposed due to being trimmed or damaged by trampling to open road access. Some vegetation sampling plots also partially overlap with community gardens. The growing conditions in the community garden have a fairly open planting surface

from weeds due to weeding, which aims to protect the main plants from undergrowth and weeds.

The results of vegetation analysis show that the dominant vegetation types at the IVI value of each tree life stage are *Albizia chinensis* and *Syzygium aromaticum*. The number of species that are not too many and diverse characterizes community forests, which are generally only overgrown by certain species. The composition of vegetation types that grow includes many types of trees that have market value such as *A. chinensis* and *S. aromaticum*. This is in accordance with the function of community forests, which also serve the economic needs of the surrounding community [14].

Based on the results of the analysis of seedling vegetation in **Figure 6**. shows the acquisition of the highest IVI value in the *A.chinensis* species with a value of 67%, this species is found in each seedling sampling plot. The *A.chinensis* species grow a lot in community forests from the results of natural forest budding. However, the lowest IVI value was 4% in *Hibiscus tiliaceus* seedlings; the small number of *H.tiliaceus* trees caused the density and frequency values to be low in the community forest area.

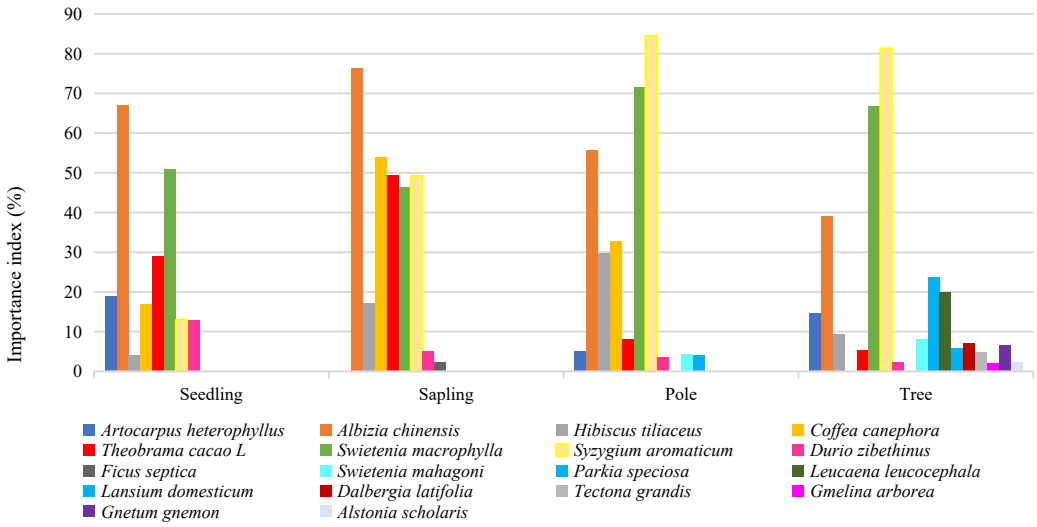


Figure 6. Index of Important Values of Vegetation in Padukuhan Gunungkelir.

The results of the sapling level vegetation analysis in **Figure 6**. shows the results of vegetation analysis at the sapling level the *A.chinensis* species has an IVI value of 76% which is the highest value. This species in the sapling phase is quite often found with densities seen in several sampling plots. *A.chinensis* has a fairly small diameter in the sapling phase compared to some other vegetation. It is shown in the relative dominance that coffee plants have a higher percentage of dominance or land cover, which is 31%, while *A.chinensis* has a rate of 19%.

The results of the pole level vegetation analysis show that of *S.aromaticum* has a value of 84%, which is the largest IVI value in the pole phase. The density of clove plants has a smaller amount compared to *Coffea canephora*. While *S.aromaticum* plants have a dominance of 34%, with a significant value gap from other plants.

The results of vegetation analysis at the tree level show that *S.aromaticum* trees have the largest IVI value of 82%. The plant itself is the type that is the most widely cultivated commodity in Gunungkelir Hamlet.. This value explains that *S. aromaticum* plants are plants that are highly maintained by the local community as one of the village's commodities. The high value of the important value index explains that this type of plant is an essential type for the ecosystem in Gunungkelir Hamlet. While the smallest IVI value is in the *Gmelina arborea* species with a value of 2.42%, the *G.arborea* species is a tree with a minimal amount, like the type of *Alstonia scholaris* and *Durio zibethinus*.

The vegetation of the Gunungkelir Hamlet community forest, which has been converted into commercial plants, is not the main purpose of being used as a location for bird protection. According to research on this topic, urban forests and community forests that tend to be

homogeneous often exhibit suboptimal diversity [15]. The economic mindset of the community is also one of the factors that makes community forests unsuitable locations for wildlife conservation. People's forests have also been heavily influenced by human intervention, so that in some situations, maintaining the existence of native vegetation in certain areas is no longer a priority, as people prefer to plant species with higher commercial value.

Even so, several regions and villages have implemented efforts to preserve birds in people's forests. These efforts are carried out not only as a protection effort, but also the community uses the existence of animals as a source of income through ecotourism. The condition of community forests managed by the community, with the planting of native plants and diverse types, can attract animals, especially birds, to take shelter there. In addition, sustainable management of community forests can also reduce soil degradation, improve water quality, and deforestation [16].

3.2. Bird Observation Results

Based on observations on three lanes in Gunungkelir Hamlet, 21 bird species from 13 families were identified. The community forest of Gunungkelir Hamlet is known to have threatened bird species. This can be seen from **Table 2** through the IUCN status, such as *Rubigula dispar* and *Alophoixus bres*, which have a risk status higher than LC (*Least Concern*). Conservation status is also seen from the Minister of Environment and Forestry Regulation No. 106/2018 on protected flora and fauna species, which only *Aethopyga mystacalis* is protected. Some animal species are able to survive various pressures from human presence due to their adaptability [17]. The existence of food sources is one of the main factors that allows the bird to maintain its presence in a habitat.

Table 2. Composition of bird species observed in Gunungkelir Hamlet.

Family	Species	Conservation Status		
		IUCN	CITES	Ministerial Regulation
Pycnonotidae	*Rubigula dispar*	VU	-	NP
	Alophoixus bres	EN	-	NP
Aegithinidae	*Aegithina tiphia*	LC	-	NP
Estrildidae	*Lonchura punctulata*	LC	-	NP
Dicruridae	*Dicrurus macrocercus*	LC	-	NP
Alcedinidae	*Ceyx rufidorsa*	LC	-	NP
	Halcyon cyanoventris	LC	-	NP
Pellorneidae	*Malacocincla sepiaria*	LC	-	NP
	Pellorneum capistratum	LC	-	NP
Picidae	*Dinopium javanense*	LC	-	NP
	Yungipicus moluccensis	LC	-	NP
Apodidae	*Rhaphidura leucopygialis*	LC	-	NP
Cisticolidae	*Orthotomus ruficeps*	LC	-	NP
	Orthotomus sutorius	LC	-	NP
Nectariniidae	*Arachnothera robusta*	LC	-	NP
	Anthreptes malacensis	LC	-	NP
	Aethopyga mystacalis	LC	-	P
Dicaeidae	*Dicaeum trochileum*	LC	-	NP
	Dicaeum trigonostigma	LC	-	NP
Muscicapidae	*Enicurus leschenaulti*	LC	-	NP
Phasianidae	*Gallus gallus*	LC	-	NP

Description :
*IUCN 2023 : LC = *Least Concern*, NT = *Near Threatened*, VU = *Vulnerable*, EN = *Endangered.*
* Minister of Environment and Forestry Regulation No. 106/2018 on Protected Flora and Fauna Species:
P = Protected, NP = Not protected.

3.3. Diversity, Evenness, and Abundance Indices

Based on the data analysis conducted, the diversity index obtained in each observation lane is shown in **Table 3**. In the first lane, the highest diversity index value was obtained, which was 2.62. Then the second and third lines have diversity index values that tend to be the same, namely 1.84 and 1.79.

Bird diversity on lane one has a significant difference compared to the other lanes. This is because lane one, located near the Wanapaksi KTH secretariat, is often used as a birdwatching spot. This causes differences in the treatment of existing environmental conditions, such as the number of artificial nests found for the bird nest adoption program. As in previous research, in secondary forests or agroforestry land in community forests, bird diversity is also influenced by human behavior towards birds [18]. Community forest land is managed not only to meet the needs of the economy, but also to care for bird habitats in terms of their welfare. This effort can increase the possibility of existing bird species and individuals increasing.

The results of the evenness index analysis of the three lanes show that each lane has a fairly high evenness index value. Although the highest value was obtained in lane 1 with a value of 0.97, which was then followed by lane two with 0.89 and 0.86 in the third lane, the difference in value was not too significant. Overall, in each observation lane, the species evenness index value falls within the high category E > 0.75. The evenness index value provides an overview of the evenness of the species present and identifies any dominating species. Factors of high evenness values are influenced by competition in a stable habitat, such as the availability of diverse food for each species and sufficient quantities [19]. In general, low evenness index values indicate the presence of dominating species and unstable bird communities. A low evenness index value indicates that the species dominates an area.

The results of data analysis on relative abundance are presented in **Figure 7**. The highest species abundance index in lane one is (*Rhaphidura leucopygialis*) with a percentage of 13%, and the smallest percentage of abundance is in the (*Pellorneum capistratum*), (*Dicrurus macrocercus*), (*Ceyx rufidorsa*), and (*Orthotomus sutorius*) with a percentage of 3%. Then in the second lane, the highest percentage was in the (*Rubigula dispar*) species with a value of 35% in **Figure 8**, and the lowest in (*Orthotomus sutorius*), (*Arachnothera robusta*), (*Aethopyga mystacalis*), and (*Dicaeum trochileum*) with a value of 5%. In lane three, it was found that the (*Dicaeum trigonostigma*) had the highest abundance value with 37%, while the lowest value was 5% for (*Aegithina tiphia*), (*Anthreptes malacensis*), (*Dinopium javanense*), and (*Gallus gallus*).

The abundance of birds is related to the availability of food; the large number of individuals illustrates that the habitat visited has the ability to provide sufficient food. The presence of bird populations is in line with the availability of food for animals in the habitat [1]. Insufficient food availability will lead to fierce competition between individuals and species, placing greater pressure on each individual.

According to previous research related to the use of vegetation by birds, there are at least three things that can affect the abundance of a species, including the characteristics of colonized species, habitat suitability, and adaptation of a species [20]. *R. dispar* and *D. trigonostigma* are quite common types of birds that eat fruits, seeds, and insects. The existence of fruits themselves in the community forest of Gunungkelir Hamlet is quite numerous, as shown by the plants planted by the community, such as bananas, cacao, and coconuts, which are types of vegetation that are a source of food for the birds. The Pycnonotidae family of birds is often found in secondary forests and border forests because they have more open forest conditions [20].

Table 3. Diversity and evenness indices.

Lane	Number of Species	Diversity Index	Evenness Index
1	15	2.62	0.97
2	9	1.84	0.89
3	8	1.79	0.86

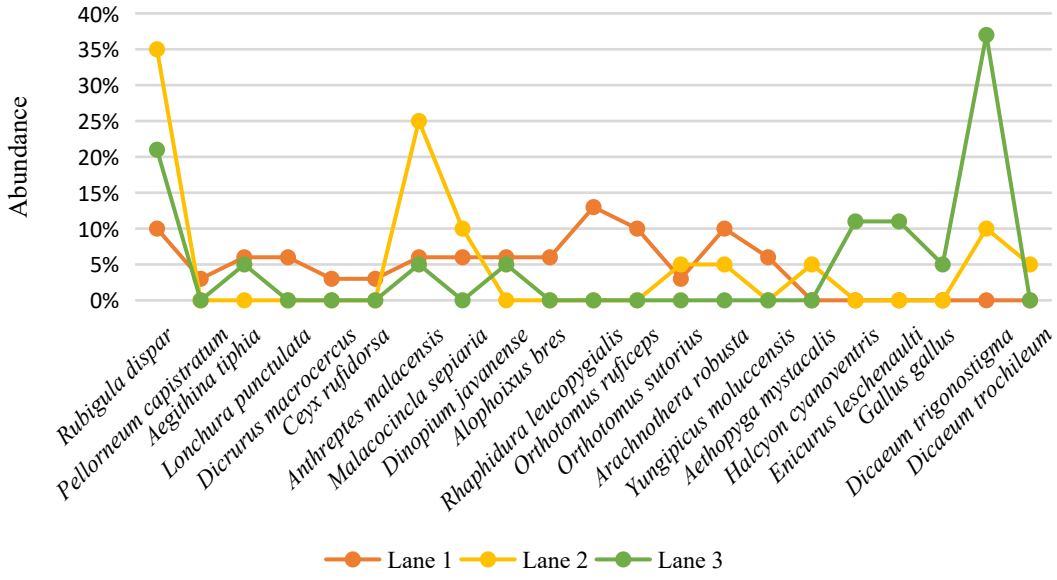


Figure 7. Abundance of bird species.

(a) **(b)**

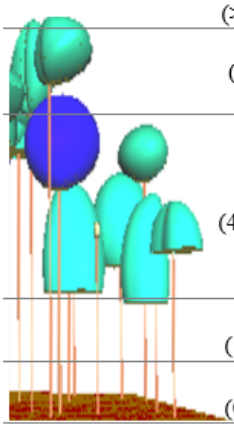
Figure 8. (**a**) *Rubigula dispar*; (**b**) *Dicaeum trigonostigma.*

3.4. Use of Vegetation Stratum Space by Birds

The use of vertical vegetation structures in birds depends on the ability of birds to utilize opportunities and adaptations to their habitat to obtain sufficient resources [21]. The presence of bird species in a particular stratum illustrates that the species has a need to be in the stratum it inhabits or passes through. **Figure 9** shows bird species found in two or more stratum layers indicate that the species has a wide vertical utilization area.

The results of bird observations on vegetation structure, as indicated by vertical distribution, show that stratum C has the highest number of species. Stratum C is the forest layer below the tree canopy, characterised by varied vegetation, which makes it suitable for protecting small birds from predatory birds. The form of vegetation utilization by birds in each vegetation stratum is mostly as a resting place. This is shown in **Figures 2** and **3**, where the two bird species found in stratum B, 100% of the number of species or all bird species use it as a resting place. Then, in stratum C, 10 bird species, or 66% of the total number of birds found in this stratum, use it as a resting place, while 33% of the species, or 5 species, play here, and 6% of the species, or 1 species, eat here. In stratum D, birds still use it as a resting location, with 80% of the total species found and 25% or 2 species using it as a feeding location. In stratum E, 66% of the total species found utilized the stratum as a resting place and 33% as a place to play. Forms of utilization, such as playing, eating, and nesting, are quite difficult to find when making direct observations because these behaviors are only carried out for a short time.

To provide a clear picture of vegetation utilization, see **Table 4** on the use value of vegetation. From the observations obtained, the types of vegetation used by birds in both tree and non-tree vegetation. The use value shows the comparison of the form of use or benefit in each type of bird, which is divided into four main behaviors.



Vertical stratum	Number of types	Form of utilization			
		Rest	Play	Nesting	Feeding
A (>30 m)	0	0	0	0	0
B (20-30 m)	2	100%	0	0	0
C (4-20 m)	15	66%	33%	0	6%
D (1-4 m)	8	75%	0	0	25%
E (0-1 m)	3	66%	33%	0	0

Figure 9. Distribution of birds in vegetation stratum.

Table 4. Use value and utilization of vegetation by birds in Gunungkelir Hamlet.

No.	Species	Number of Bird Species	Value of Form of Use			
			Rest	Play	Nesting	Eat
Tree						
1.	*Hibiscus tiliaceus*	2	100%	0	0	0
2.	*Albizia chinensis*	7	100%	0	0	0
3.	*Syzygium aromaticum*	6	84%	16%	0	0
4.	*Swietenia macrophylla*	5	100%	0	0	0
5.	*Parkia speciosa*	1	100%	0	0	0
Non-tree						
1.	*Cocos nucifera*	5	80%	0	0	20%
2.	*Calliandra calothyrsus*	4	25%	50%	0	25%
3.	*Alpinia galanga*	1	100%	0	0	0
4.	*Gigantochloa atter*	3	66%	33%	0	0
5.	*Theobrama cacao L*	2	100%	0	0	0
6.	*Arenga pinnata*	1	100%	0	0	0

The use of vegetation by birds in Gunungkelir Hamlet has different results in each type of vegetation. Based on the table above, it is shown that in tree species, *A. chinensis* is the type of tree that is used the mostby seven species. While the *Parkia speciosa* tree has the least use of vegetation, which is only one species. In the form of use, most birds use vegetation for resting. Resting behavior in birds is like perching. Then there are other behaviors observed is play behavior by chirping. The form of utilization in tree vegetation is only found in resting and playing behavior. The percentage of vegetation use by birds reached 100%, meaning that all bird species that use a particular type of vegetation exclusively use it as a resting place. It has indeed been studied that the majority of trees do not produce fruits and seeds that can be consumed by birds [22]. The existence of trees is utilized by birds as a resting place, such as perching on tree branches and making nests. The species *A. chinensis* is

a tree characterised by a fairly wide crown and numerous branches. This attracts a variety of birds perched on the tree. The wide crown is also used by birds as a location to examine the surrounding environment for potential dangers and foraging.

In the use of non-tree vegetation, the most is found in *Cocos nucifera*, it is shown in the table that *C.nucifera* are utilized by five bird species. Then, for the use of non-tree vegetation types, the least is the type of palm and galangal, with a total of one type. The use of space in non-tree vegetation tends to be more varied than trees. As shown in **Table 4**, there are bird species that use vegetation as a source of food and play. The species observed were from the Nectariniidae family, such as *A.mystacalis* and *A.malacensis*. These species are known to consume flower nectar as their main food source. However, it is possible that these species eat small anthropods as another food source.

4. Conclusions

Based on the results of research observations, the total number of bird species obtained was 21. The results of the diversity index analysis showed that lane 1 had the highest index value of 2.62. Lane one has a stratum vegetation percentage that tends to be evenly distributed compared to other lanes. In lane 2, stratum C has the highest value as much as 60% and stratum E 8% as the lowest value. Then, in lane 3, stratum C has the highest value of 62%, and stratum B as the lowest value of 10%.

Bird habitat conditions in lane one are suitable environment for birds of small size due to sufficient food sources and the presence of vegetation that provides a comfortable place to live. This is shown by the fact that the majority of birds are found in the lower part of high tree crowns in vegetation stratum C, with a vertical coverage of 4-20 meters. The vegetation stratum plays a crucial role in providing birds with a place to roost, nest, and shelter from predators. The existence of birds is influenced by human activities.

Community forests that serve as habitats for animals must be well-managed through special strategies to prevent habitat destruction. In addition, intensive supervision by the community is also carried out to maintain the quality of nature; these efforts are important to maintain one of the sources of livelihood for the community.

Author Contributions

Conceptualization: B.M.H.D.; Methodology: B.M.H.D., I.N.N., G.M.; Formal Analysis: B.M.H.D., I.N.N., G.M.; Investigation: B.M.H.D.; Resources: B.M.H.D.; Data Curation: B.M.H.D.; Writing – Original Draft: B.M.H.D.; Writing – Review & Editing: B.M.H.D., I.N.N., G.M.; Visualization: B.M.H.D.; Supervision: I.N.N., G.M.; Project Administration: I.N.N.; Funding Acquisition: I.N.N. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

This study was conducted in accordance with the ethical standards of the Sebelas Maret University and was approved by the Institutional Review Board (IRB) of Forest Management Department.

Informed Consent Statement

This study involved non-invasive observation and was conducted with prior permission and informed agreement from local authorities and community representatives. No personal or sensitive information was collected from individuals.

Data Availability Statement

All data supporting this study are provided as supplementary information accompanying this paper.

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Conflict of Interest

The authors declare no conflict of interest.

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