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Vegetation Association of Bird of Paradise Community in Berber Village Forest, West Bonggo District, Sarmi Regency, Papua Province Indonesia

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A B S T R A C T
This research aims to determine the richness, diversity and dominance of tree and bird species, as well as analyzing the relationship between trees and bird communities in the Berber Village forest. Data collection methods include observation, exploration and Concentration Counts. Species richness analysis uses the Margalef Index. Diversity index, with the Shannon-Wiener equation, Dominance index using the dominance index. Assessment of the ecological function of trees using four assessment categories (very good, good, moderate and poor). A total of 36 individuals were observed, consisting of 23 males and 13 females. The richness of birds of paradise in Berber village forests is in the low category (0.4343) and is dominated by P. minor. Activity P. minor observed at various heights ranging from 21 to 64 meters above sea level (masl). Distribution of Bird of Cenderawasih activity (P. minor And C. king) shows a predilection for certain tree types and variations in height.

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INTRODUCTION

Birds are one of the components in the ecosystem that has an important role as a supporter of the life cycle of organisms. Birds have an important role in an ecosystem and are easily found in every type of habitat. One of the habitats for birds as a means of activity is a tree which serves as a playground. Trees as a habitat for certain animals is a basic thing that cannot be separated between the two. The dependence is closely related to what activities will be carried out. The canopy of certain trees is relatively open and will be utilized by birds to carry out their activities such as playing. Trees in a habitat or forest have an important role for every bird in that habitat, one of which is the Bird of Paradise. According to Raunsay; and Raunsay, Akobiarek & Ruamba, birds of paradise have a dependence on habitat/trees as a place to play, nest, mate, grow and feed.

In addition to having a distribution area as far as Maluku Latupapua, the Yellow Bird of Paradise (*P.minor*) is also distributed in Jayapura and Keerom districts. Sarmi is one of the districts in Papua Province that has a fairly abundant population of Yellow Bird of Paradise (P. minor) and is also supported by a fairly good habitat type.

Berber is one of the villages in the West Bonggo District of Sarmi Regency with forest resources, where vegetation structure has an important role as a habitat for birds of paradise to associate. The association between vegetation and birds of paradise is two things that are important and inseparable, for this reason, it is necessary to further study the association between the two, the abundance, dominance and diversity of birds of paradise.

This study was conducted to analyze the species, population, abundance, dominance, and diversity of birds of paradise and how they are associated with vegetation in the Berber village forest, West Bonggo District, Sarmi Regency, Papua Province.

METHODOLOGY

This research will be conducted in the village forest of Berber Village, West Bonggo District, Sarmi Regency, for 2 months from April to May 2024. The population in this study comprised all plants and birds in the Berber Village forest, while the sample focused on trees serving as playgrounds for birds of paradise, observed at specific observation points. Data for this research were sourced from both primary and secondary materials. Primary data were collected during the study, while secondary data encompassed references related to birds of paradise and other relevant sources. The methods employed in this study included observation and exploration. Observations of play trees for birds of paradise were conducted during their active playing times, with bird data collected using the Concentration Counts method, which, as noted by Alikodra, is effective for assessing populations of group-living animals. Observations occurred in the morning between 05.30 WIT and 07.30 WIT or in the afternoon between 16.00 WIT and 17.00 WIT. Tree data were gathered through the census method of vegetation inventory at the tree growth level across the forest area, a method chosen for its ability to provide more accurate data.

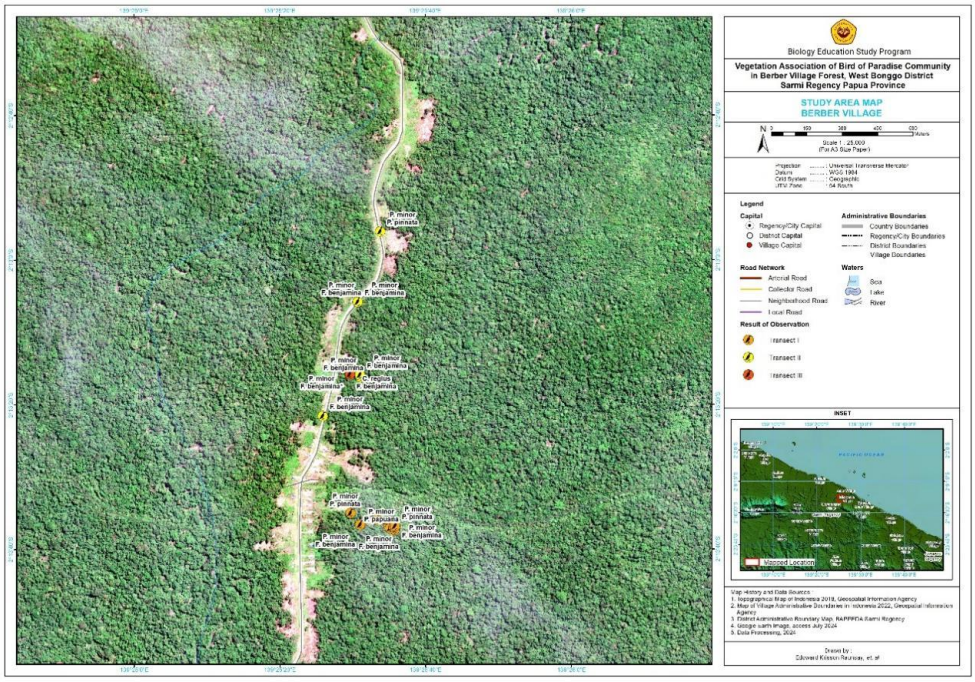

Figure 1. Map of Research Location

Data Analysis

The data analysis conducted includes:

a. Species richness analysis is a measure of the total number of species found in a community through the Margalef Index (DMg). The higher the index value, the species will have abundant species richness. The Margalef Index formula is as follows:

$$DMg = \frac{S-1}{\ln(N)}$$

Description:
DMg = Notation for Margalef Index;
S = Number of species found (species);
N = Total individuals of all species encountered

b. The diversity index is a mathematical measure of species diversity in a community. The species diversity index that will be used in this study is the Shannon-Wiener equation with the following formula:

$$H' = \sum \left(\frac{ni}{N} \ln \frac{ni}{N} \right)$$

Description:
H' = Shannon Wiener diversity index
ni = Number of individuals of the i-th species N = Total individuals of all species
The calculated value of the diversity index (H') shows that:
H'>3 : High species diversity
1>H'>3 : Medium species diversity
H'< 1 : Low species diversity

c. The species dominance index is determined by the number of individuals in each species found in the inventory. If the number of individuals is greater,

then the species will dominate the area.

d. An assessment of the ecological function of trees was conducted to determine the quantitative and descriptive value of tree vegetation. The results of the assessment will determine the level of comfort for users based on the ecological function of trees as temperature modifiers, air humidity controllers, noise absorbers, windbreaks, and habitats for the presence of animals (birds) (Table 1).
   Based on Hidayat, the ecological function assessment technique is carried out based on the ecological function components of tree vegetation on the site. The formula used to determine the criteria is as follows:

$$\text{KPI} = \frac{\textit{The number of each assessment criteria}}{\textit{The ideal number (maximum total) of each criterion}}$$

KPI: Key Performance Index

There are four categories of assessment (excellent, good, poor, and poor) given to each species through the function criteria given, in this study, three criteria from the best morphological characteristics of the tree correspond to its function. According to Hidayat, the most perfect value or score is 100% if each function criterion meets the most perfect assessment of the accumulation (Table 1). The percentage of weighting with 4 criteria is as follows:

1. Perfect (if criteria fulfillment ≥ 81%)
2. Good (if the criteria fulfillment is 61-80%)
3. Less good (if the fulfillment of criteria 41-60%)
4. Poor (if criteria fulfillment ≤ 40%)

Table 1. Ecological Function Variables and Assessment

Criteria Variables	Assessment Criteria
Temperature Modification as Branching Shading	▪ Branching 2 meters above the ground (Minister of Public Works Regulation Number: 05/PRT/M/2008) ▪ Large and wide canopy (Booth and Hiss, 2005) ▪ Slid leaf mass (Regulation of the Manister of Public Works Numbers: 05/PRT/M/2008
Air Humidity Control	▪ Horizontal branching pattern (Gray and Deneke 1978) ▪ Needle-leaved (Gray and Deneke 1978) Low leaf density (Biampoen et al. 2989)
Bird Presence	▪ Has nectar and flowers (Hernowo and Prasetyo 1989) ▪ Fruit-bearing tree spesies (Hernowo and Prasetyo 1989) ▪ Has an attractive trunk shape (Hernowo and Prasetyo 1989)

RESULTS AND DISCUSSION

Results

Overview of the Research Location

Berber Village is a preparatory village located in West Bonngo District, Sarmi Regency. This village has a total area of around 5,500 m². Berber Village is called a preparatory village because this village is still in the process of preparing for expansion and until now it is still included in the administrative area of Podena Village. This village can be accessed using four-wheeled vehicles and the like such as cars, buses, trucks and two-wheeled vehicles such as motorbikes. Travel distance from Jayapura Regency (Sentani city) to this village ranges from 5-7 hours depending on weather conditions that affect road conditions and from Sarmi city ranges from 4-5 hours with varying road terrain, ranging from paved roads to rocks. Road access to this village is relatively inadequate because the road is still a stretch of coral (Figure 1). However, Berber Village has several advantages such as the availability of a Community Health Center (PUSKESMAS) building and the availability of electricity for people living in the village.

Bird of Paradisaea Population in Berber Village Forest Area

Based on the results of observations of birds of *paradise* found at the observation site, they were identified directly based on audio (bird sounds) and visual (direct observation and documentation), two genera, namely the *Paradisaea genus* (*Paradisaea minor* Shaw, 1809) and the *Cicinnurus* genus (*Cicinnurus regius* Linnaeus, 1758) (Table 1). A total of 36 individuals were found and observed, consisting of 23 males and 13 females. The activities of birds of paradise observed were playing (in groups), perching (individuals), eating (in groups), and sleeping (individuals). The types of trees visited were *Pometia pinnata*, *Ficus benjamina*, *Prainea papuana*, and *Buchanannia sp.* (Table 2). The observation time interval in each transect is different, for transect I observations began at 15:30 - 17:10 WIT with cloudy weather conditions. In transect II observations began at 08.24 - 11.45 WIT with rainy weather conditions (drizzle), and transect III observations began at 12.11 - 12.17 WIT with cloudy sunny conditions (Table 3).

Table 2. Distribution of Birds of Paradise in the Observation Site (30-40 Minutes Observation Duration)

Time (WIT)	Coordinates	msl	Species	♂	♀	∑	Kel/Ind/Pas	Activities	Trees
Transect I (200 m)									
15.30	S 02°13'35.0" E 139°25'29.9"	64	*P. minor*	1	1	2	Couple	Play	*P. pinnata*
15.50	S 02°13'36.6" E 139°25'31.2"	21	*P. minor*	1		1	Individuals	Perch	*F.benjamina*
16.00	S 02°13'35.9" E 139°25'33.5"	41	*P. minor*	1		1	Individuals	Perch	*F.benjamina*
16.06	S 02°13'36.2" E 139°25'34.8"	37	*P.minor*	1		1	Individuals	Perch	*Palaquium* sp.
16.18	S 02°13'37.3" E 139°25'35.9"	39	*P. minor*	2	2	4	Couple	Eat	*F.benjamina*
16.35	S 02°13'37.1" E 139°25'35.3"	45	*P.minor*	1		1	Individuals	Perch	*P. papuana*
16.40	S 02°13'36.9" E 139°25'35.8"	33	*P. minor.*	1		1	Individuals	Perch	*F. benjamina*
16.55	S 02°13'36.8" E 139°25'36.0"	33	*P.minor.*	1		1	Individuals	Perch	*F. benjamina*
17.10	S 02°13'36.8" E 139°25'36.0"	33	*P.minor.*		1	1	Individuals	Sleep	*P. pinnata*
Total				9	4	13			
Transect	II (200 m)								
08.24	S 02°12'56.1" E 139°25'34.0"	112	*P. minor.*	1		1	Individuals	Perch	*P. pinnata*
08.36	S 02°13'05.8" E 139°25'30.9"	23	*P.minor.*	1		1	Individuals	Perch	*F. benjamina*
10.40	S 02°13'05.8" E 139°25'30.9"	23	*P. minor.*	1	1	2	Couple	Play	*F. benjamina*
10.50	S 02°13'21.6" E 139°25'26.1"	25	*P.minor.*	1	1	2	Couple	Play	*F. benjamina*
11.30	S 02°13'16.2" E 139°25'31.3"	40	*P.minor.*	2	1	3	Group	Play	*F. benjamina*
11.45	S 02°13'15.9" E 139°25'31.2"	45	*P. minor.*	2	2	4	Group	Play	*F. benjamina*
Total				8	5	13			
Transect	III (200 m)								
12.11	S 02°13'15.8" E 139°25'29.8"	*38*	*P. minor.*	5	4	9	Group	Play	*F. benjamina**
12.17	S 02°13'15.8" E 139°25'29.8"	*38*	*C. regius.*	1		1	Individuals	Play	*F. benjamina*
Total				6	4	10			
Total				23	13	36			

Notes: *associates with *Aspelnium nidus* (bird's nest spike) forming a nest

Ecological Index

Based on the results of the analysis of the Margalef species richness index, it was found that the species richness of birds of paradise in the Berber Village

Forest Area was in the low category (0.4343) and was dominated by one species, namely *P. minor* based on the dominance index. The results of the diversity analysis based on the Shannon Wienner index found that the level of bird of paradise diversity in the Berber Village Forest Area is low and has a spatial distribution based on the morality index is uniform (*uniform*) (Table 3).

Table 3. Ecological Index of Birds of Paradise in Berber Village Forest Area

Ecological Index	Transect I	Transect II	Transect III	Description
Margalef	0	0	0.4343	Low species richness*
Dominance	1	1	0.8	Dominant one type (*P. minor*)
Shannon Wienner (H')	0	0	0.3751	Low species diversity*
Morisita dispersion (I_d)	0.369	0.369	0.071	*Uniform* distribution*

Notes: * Index value < 1

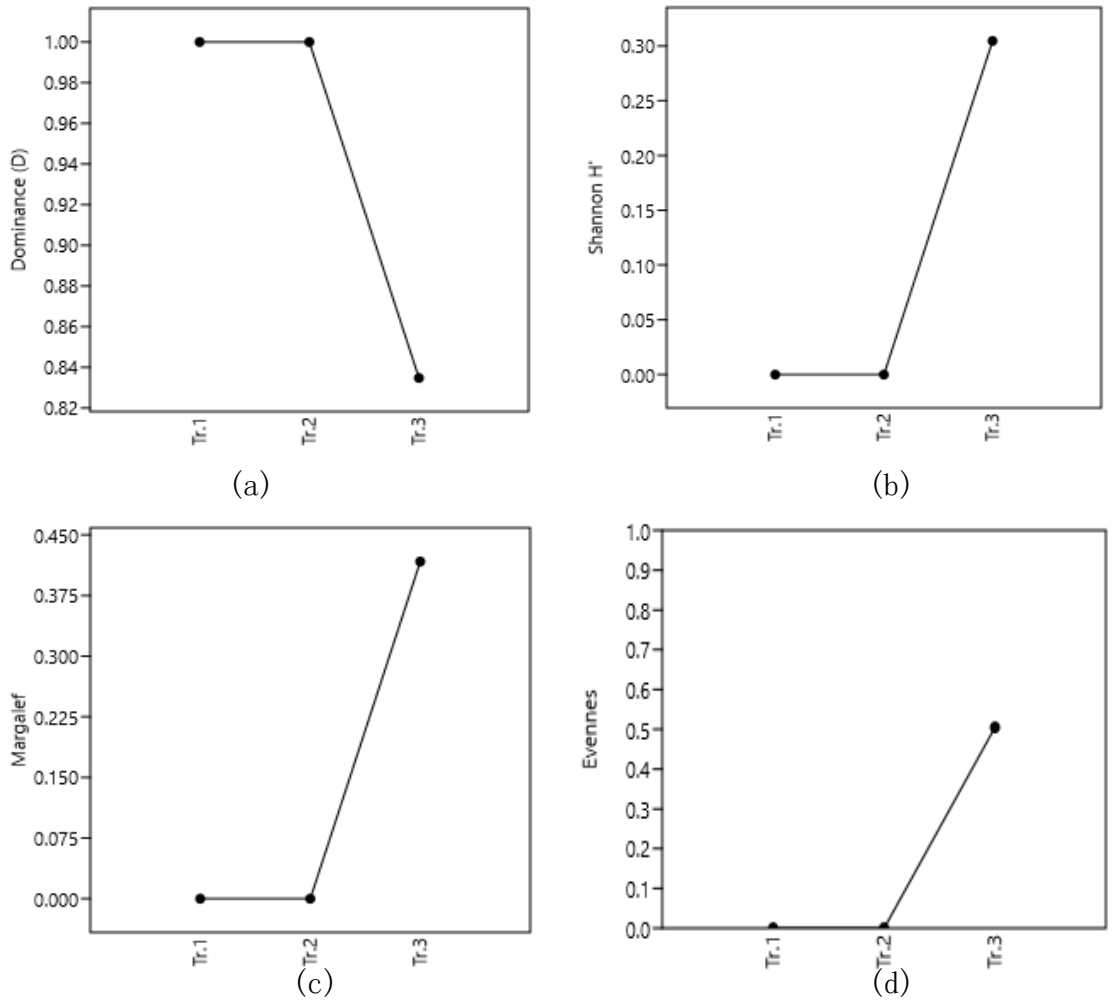

Figure 2. Alpha Diversity Indices (Plot Index) Ecological Indices of Birds of Paradise in Berber Village Forest Areatop

The Altitude of the Bird of Paradise Activity Area

In Transect I, bird activities of *P. minor were* found at various elevations ranging from 21 to 64 meters above sea level (masl). Activities included playing (pairs), perching (individuals), eating (pairs), and sleeping (individuals). The average elevation of bird activity sites in this transect was 38.44 meters above sea level. The observation points showed that.

P. minor was active in various tree species, such as *P. pinnata*, *F. benjamina,* and *Palaquium sp.* In Transect II, *P. minor was* also found at various elevations, ranging from 23 to 112 masl. Activities observed included playing (pairs and groups) and roosting (individuals).

Table 4. Elevation (masl) of Cenderawasih Bird Activity

Observation	Spesies		Ind/Pas/Kel	Activities
	P. minor	*C. regius*		
Transect I	*Elevation (above sea level)*			
Point 1	*64*		Couple	Play
Point 2	*21*		Individuals	Perch
Point 3	*41*		Individuals	Perch
Point 4	*37*		Individuals	Perch
Point 5	*39*		Couple	Eat
Point 6	*45*		Individuals	Perch
Point 7	*33*		Individuals	Perch
Point 8	*33*		Individuals	Perch
Point 9	*33*		Individuals	Sleep
Min.	*21*			
Max.	*64*			
Average	*38.44*			
Transect II	*Elevation (above sea level)*			
Point 1	*112*		Individuals	Perch
Point 2	*23*		Individuals	Perch
Point 3	*23*		Couple	Play
Point 4	*25*		Couple	Play
Point 5	*40*		Group	Play
Point 6	*45*		Group	Play
Min.	*23*			
Max.	*112*			
Average	*44.66*			
Transect III	*Elevation (above sea level)*			
Point 1	*38*		Group	Play
Point 2		*38*	Individuals	Play
Min.	*38*			
Max.	*38*			
Average	*38*	38		

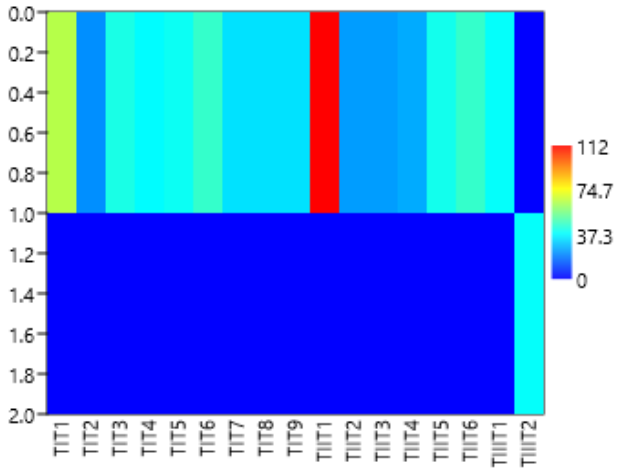

Figure 3. *Matrix Plot* Showing Cenderawasih Bird Activity by Elevation (masl) at Each Transect (T) with Different Encounter Points

Bird of Paradise Activity Tree in Berber Village Forest Area

Based on the data in Table 6, the activity distribution of birds of paradise (*P. minor* and *C. regius*) showed a trend towards specific tree species as well as elevation changes. *Ficus benjamina* (banyan) trees were the most common, with 12 interactions including a variety of behaviours such as perching, playing and feeding. *P. minor* species were found more frequently at different altitudes, suggesting habitat adaptability. In contrast, *C. regius was* only documented once in the same tree where play activities occurred. *Pometia pinnata* (Matoa) trees are also an important habitat for *P. minor*, especially at high altitudes (64 and 112 m above sea level). Sleeping, playing and roosting were some of the activities witnessed in this tree.

Table 5. Trees of Activity for Birds of Paradise Sightings

Family	Species	Local name	∑	Elevation (above sea level)	Bird species	Ind/Pas/Kel	Activities
				33	*P. minor*	Individuals	Sleep
Sapindaceae	*P. pinnata*	Matoa	3	64	*P. minor*	Individuals	Play
				112	*P. minor*	Couple	Perch
				21	*P. minor*	Individuals	Perch
				41	*P. minor*	Individuals	Perch
				39	*P. minor*	Couple	Eat
Moraceae	*F. benjamina*	Banyan	12	33	*P. minor*	Individuals	Perch
				33	*P. minor*	Individuals	Perch
				23	*P. minor*	Individuals	Perch
				23	*P. minor*	Couple	Play
				25	*P. minor*	Group	Play
				40	*P. minor*	Group	Play
				45	*P. minor*	Group	Play
				38	*P. minor*	Group	Play
				38	*C. regius*	Individual	Play
Moraceae	*P.papuana*		1	45	*P. minor*	Individuals	Perch
Sapotaceae	*Palaquium* sp.	Oil tree	1	37	*P. minor*	Individuals	Perch
Total			17				

Table 6. Assessment of the Ecological Function of Individual Trees based on KPIs

Species	Criteria, Function			Score (%)	Category
	K1	K2	K3		
P. pinnata	1	0.5	1	84	Very good
F. benjamina	1	0.5	1	84	Very good
P. papuana	1	0	1	67	Good
Palaquium sp.	1	0.5	1	84	Very good

Notes: 1=criteria met on each variable; 0.5=partially met; 0=not met

Table 6 shows the assessment of the ecological function of individual trees based on Indicator Assessment Criteria (KPI) which includes three main criteria (K1, K2, K3). *Pometia pinnata*, *Ficus benjamina*, and *Palaquium* sp. trees received the same score (84%) and were categorized as very good in fulfilling their ecological function. This score indicates that the three species significantly contribute to ecological functions in the forest habitat of Berber Village. Meanwhile, P. papuana scored 67% and was categorized as good. This decrease in score is due to the K2 criteria being only partially met, indicating that there are some deficiencies in fulfilling certain ecological functions compared to other species.

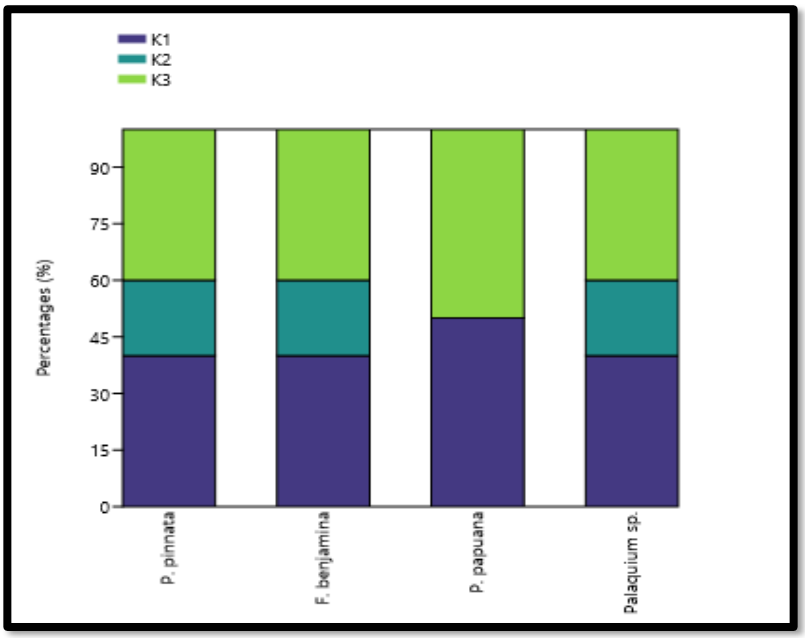

Figure 4. *Staked chart* (*Graph Style: Percentages*) Showing the Percentage Score of the Ecological Function Assessment (KPI) of Individual Trees with Bird of Paradise Activities Found in the Berber Village Forest Area

Figure 4 is a multilevel bar chart showing the percentage score of the ecological function assessment (KPI) of individual trees that serve as habitat for birds of paradise activities in the Berber Village Forest Area. This graph shows four tree species, namely *P. pinnata*, *F. benjamina*, *P. papuana,* and *Palaquium* sp., with three different assessment criteria: K1, K2, and K3.

- K1 (dark blue): Indicates the first criterion met.
- K2 (bluish green): Indicates the second criterion is partially met.

- K3 (light green): Indicates the third criterion is fully met.

Each bar on the graph shows the percentage distribution of fulfilment of each criterion by each tree species. Below is the breakdown for each tree species:

- *P. pinnata*: Meet K1 at 30%, K2 at 45%, and K3 at 25%.
- *F. benjamina*: Meets K1 by 30%, K2 by 45%, and K3 by 25%.
- *P. papuana*: Meet K1 by 45%, K2 by 15%, and K3 by 40%.
- *Palaquium* sp: Meet K1 at 30%, K2 at 45%, and K3 at 25%.

Discussion

Bird of Paradisaea Population in Berber Village Forest Area

In this study, two species of birds of *paradise*, *Paradisaea minor* and *Cicinnurus regius, were* found and recorded in the forest of Kampung Berber. Observations were made on three transects, each lasting 30 to 40 minutes. A total of 36 animals were recorded, 23 males and 13 females. Birds of paradise usually play, roost, eat and sleep. Playing in groups or pairs was the most common activity performed by *P. minor*, especially in *F. benjamina* trees. In addition, this species was found sleeping and roosting in *P. pinnata* and *P. papuana* trees.

The fact that *C. regius was* only seen once suggests that it was playing in *F. benjamina* trees. The data shows that certain tree species play an important role in the lives of Cenderawasih birds, both as their home and food source. Perhaps because of its fruit, *F. benjamina* is the most important tree for this bird. Berber Village has an ideal environment for bird of paradise conservation due to its rich and diverse forest. This study provides a strong basis for conservation and habitat maintenance plans for birds of paradise in Papua. The further focus could be directed towards a more detailed analysis of ecological interactions between birds of paradise and local vegetation, as well as how human actions impact the populations and behaviour of these birds. Further studies should also include population genetics analysis to understand population structure and gene flow between different habitats.

Ecological Index

The observed ecological index data can be used to determine the ecological conditions at the three transects. Species richness (Margalef Index) shows that the Margalef index value indicates the level of species richness of birds of paradise in each transect. In transects I and II, the Margalef index value was low (0), indicating that bird of paradise species richness in the area was low. At transect III, the Margalef index value was slightly higher (0.4343) but still showed low species richness.

Dominance (in the dominance index) indicates how dominant a species is in the community. In all three transects, one bird species, *P. minor*, dominated, although the degree of dominance differed slightly. Transects I and II showed complete dominance (1), while Transect III showed lower dominance (0.8), indicating little variation in species dominance there.

Community species diversity was measured by the Shannon-Wiener index. Transects I, II and III all showed low levels of species diversity, with index values of almost zero, according to the study. This suggests that the bird of paradise community does not have high species diversity, despite several species being observed.

Morisita dispersion values indicate the spatial distribution pattern of individuals in the population. All three transects show relatively uniform distribution patterns, although the the lower dispersion value of Transect III (0.071) indicates a slightly more uniform distribution pattern compared to Transects I and II. From this interpretation, it can be concluded that, although there is little variation between transects, the ecological condition of birds of paradise in the Kampung Berber Forest Area is dominated by a single species (*P. minor*), with *smaller* numbers of birds An interpretation can help further understanding of bird of paradise ecology in the area and support appropriate efforts for conservation and management.

Figure 2 shows four graphs showing the ecological indices for the three transects. Margalef Richness Index (a): Transects I and II have no richness index, indicating that there is no species diversity in the area. The Margalef index, which calculates the number of species and sample size, shows very low species diversity in the observed transects; transect III showed a slight increase to 0.4343, indicating slightly higher species richness, but still in the low category. Dominance Index (b): A dominance index of 1 in transects I and II indicates total dominance by one species, P. minor, while a dominance index of 0.8 in transect III indicates that there are few other species. With a dominance index of 1, P. minor dominates the community with little or no competition from other species. Shannon-Wiener Diversity Index (c): There is no diversity in Transects I and II as the Shannon-Wiener index is zero. As evidence of low diversity, transect III showed a small increase to 0.3751. The number and evenness of species are measured in this index; a low value indicates an uneven distribution and a low number of species. Morisita Scatter Index (d): The scatter index value of 0.369 for Transect I and II indicates that the distribution of individuals is relatively uniform. The lower index value for Transect III, 0.071, indicates a more even distribution of individuals compared to the other transects. The Morisita index measures spatial distribution, with values less than 1 indicating uniform distribution and values greater than 1 indicating clustered distribution.

In Berber Village Forest in West Bonggo Sub-district, Sarmi District, vegetative characteristics and bird of paradise communities are correlated. Studying species richness, dominance, diversity and spatial distribution on observed transects was the main focus. The Findings showed that one species, *P. minor*, dominated the study area, with low species richness and diversity. This suggests the presence of highly specialized habitats or possible disturbance of ecological conditions that benefit some species. The uniform distribution pattern suggests that the bird populations present evenly utilize the available habitat. This may be due to consistent vegetation cover or resource availability across transects.

Different levels of species diversity and dominance have been shown in previous studies in similar tropical forest habitats. For example, the study Frith & Beehle [13] in New Guinea showed that bird species diversity was greater in less disturbed forests; this suggests that habitat disturbance can significantly reduce bird diversity. The study of Coates [14] also emphasized how important undisturbed canopy cover is for maintaining Cenderawasih diversity.

Similar dominance patterns in disturbed habitats have been found by other studies, such as Raunsay, Kameubun, Antoh, Aisoi, & Kapitarauw which showed that dominance by some species that are highly resistant to habitat disturbance can occur. In addition, as shown by research conducted by Raunsay; Raunsay; Raunsay, Akobiarek & Ruamba, Cenderawasih populations are highly sensitive to changes in forest structure and composition. This can result in decreased diversity and changes in dominance patterns. Due to the high diversity and dominance observed in this study, targeted conservation efforts are essential. To support a wider range of species, habitat diversity must be protected and maintained. Conservation strategies should focus on preserving large, contiguous areas of intact forest to maintain ecological balance and prevent dominance by a single species.

The Altitude of the Bird of Paradise Activity Area

The average elevation of bird activity in this transect was 44.66 meters above sea level, which was slightly higher than Transect I. Bird activity in this transect was also distributed across various tree species, with *F. benjamina* dominating. In Transect III, *P. minor was* found at an elevation of 38m above sea level and showed group play activities, while *C. regius* was found at the same elevation as individual play activities. The average elevation in this transect was 38m above sea level, consistent with the single observation point.

The objective of this study was to determine the relationship between vegetation and Cenderawasih bird populations in Berber Village Forest in West Bonggo District, Sarmi Regency. Observations showed that birds of paradise, especially *P.minor*, were more active at low to medium elevations, and the distribution of their activities varied depending on the type of vegetation present. The results suggest that variations in vegetation types at different elevations play a significant role in assisting the activities of birds of paradise. The birds frequented certain tree species, such as P. pinnata, F.s benjamina, and Palaquium sp., suggesting that these species are more suitable for their home range.

This finding is supported by several previous studies. According to (Kencana, Yulianto, & Herlina stated that birds of paradise are more likely to live in habitats consisting of vegetation that provides protection and sufficient food sources. According to research conducted by Birdlife International, the availability of trees in habitats that can be used for nesting and roosting greatly affects the distribution of birds of paradise. According to research conducted by Frith & Beehler, vegetation in tropical rainforests is essential for the sustainability of bird of paradise populations. Apart from providing food,

vegetation also offers protection from predators. In addition, research conducted by Jones, Linsley, & Marsden, shed that birds of paradise prefer trees with dense canopies, which supports the finding that Ficus benjamina is one of the most visited trees. Elevation distribution is also an important factor in the ecology of birds of paradise. Research Diamond showed that the type of vegetation growing is affected by elevation variation, which in turn affects the distribution of bird species. This is in line with the finding that P. minor was found at elevations between 21 and 112m above sea level. In addition, this finding supports research conducted by Mack & Wright, which states that altitudinal variations in tropical rainforests provide different microhabitats that are critical for various bird species. In this regard, our the study increases our understanding of how birds of paradise use different tree types and elevations in their daily lives.

A matrix plot showing the activity of birds of paradise by elevation (masl) on each transect with different meeting points is shown in Figure 4. This matrix shows how the activity of *P. minor* and *C. regius is* distributed across the different observation sites. *P. minor* bird: *P. minor* activity was evenly distributed across almost all observation points in Transects I and II, with considerable variation in elevation, suggesting that this species is active at a wide range of elevations. However, *P. minor* activity was only recorded at one observation point that showed a specific elevation in Transect III. C. regius bird: C. regius bird activity was only recorded at Transect III, indicating that, compared to *P. minor*, this species prefers to climb. This distribution of activity suggests that each bird of paradise species has a different preference for climbing. *P. minor prefers* to hike more than *C. regius*, probably due to different ecological adaptations. Figure 5,4 shows how the Bird of Paradise activity is influenced by elevation and vegetation variation. Therefore, the distribution of bird activity across different elevations shows the close relationship between bird activity and vegetation at a given elevation.

Previous studies by Rowe & Rowe found that vegetation composition is influenced by elevation. Therefore, vegetation composition based on elevation will also have an impact on the distribution of bird activity. *P. minor* showed activity at various elevations, while *C. regius was* more restricted to certain elevations, according to the results of this study. According to research conducted by Koo, Blackburn, & Moritz; Tanalgo, Pineda, Agravante, & Amerol, variations in vegetation structure along with elevation strongly influence bird distribution in tropical forests. We found that *P. minor is* more flexible in its activities at various elevations. This may be the result of adaptation to different vegetation types at different elevations. Fischer, Lindenmayer, & Manning found that the availability of resources such as food and roosting sites changed with elevation, which had a major impact on bird activity. This is consistent with our findings, which show that *P. minor's* activities are spread across different elevations, but *C. regius is* restricted to certain elevations, suggesting a preference for resources available at certain elevations. Sheldon, Yang, & Tewksbury found that bird species in tropical highlands have different altitude preferences based on their ecological

adaptations. Our findings suggest that *P. minor* has a larger altitudinal range than *C. regius*, which is consistent with the different adaptation strategies of the two bird species.

Prabowo, Maryanto, & Yanuar found that vegetation at higher altitudes is more complex and supports more biological niches. These data reinforce our findig that *P. minor is* active at a wide range of altitudes, indicating flexibility in the exploitation of ecological niches. Cahyadi, Setiawan, & Utami, found that changes in altitude affect biodiversity through changes in habitat structure. This study validates our findings by showing that the distribution of bird of paradise activity varies with altitude and vegetation. Rahman, Iskandar, & Kusumawati showed that birds' elevation preference can be an indication of forest ecosystem health. Our results that *P. minor* shows activity at various elevations, while *C. regius is* more restricted, providing insight into the health and sustainability of the Berber Village forest ecosystem. Further details, Widyastuti & Mulyani underscore the need to understand the habitat preferences of bird species to develop effective conservation strategies. Our data revealed that *C. regius* has different elevation preferences, which is important when considering habitat management at certain elevations. Nugroho, Purnomo, & Santoso found that species with greater altitudinal adaptation are more resilient to environmental change. This is consistent with our findings, which revealed that P. minor has a wide range of activities, indicating more flexibility.

Bird of Paradise Activity Tree in Berber Village Forest Area

Research by Maharadatunkamsi, Setiawan, & Winarti found that *Ficus* trees provide abundant food resources and suitable roosting sites for a variety of bird species in tropical forests. This observation is consistent with our finding that *F. benjamina* is the most commonly used tree by *P. minor* and *C. regius*. Winarni, Setiawan, & Suyanto found that large, multi-branched trees are important perches and playgrounds for birds in tropical forests. *F. benjamina* trees, which were frequently utilized by *P. minor* in our study, fit this description, illustrating the relevance of tree structure in facilitating bird activity.

Prawiradilaga, Nurwatha, & Lestari found that trees of different heights provide diverse cover and supply for birds, allowing for diverse behaviours such as roosting and playing. Our data confirms this, as bird activity in *Ficus benjamina* trees varied with height. According to Iskandar certain trees in Papuan forests play an important role in bird diversity by providing diverse supplies for daily activities. This is consistent with our results that *F. benjamina* trees provide valuable habitat for *P. minor* and *C. regius*.

Supriatna, Wibowo, & Hartini highlighting the relevance of native trees such as *P. pinnata* in maintaining local ecosystems and biodiversity. Our findings suggest that *P. pinnata* is an important habitat for *P. minor*, especially at high altitudes, thus highlighting the need to conserve this rare tree species. Fadhilah [38] found that the availability and distribution of large trees in bird habitats have a major influence on their behaviours such as roosting and

playing. This is in line with our study which found that P. minor was often seen roosting and playing in F. benjamina trees.

According to Iqbal Palaquium sp. plays an important role in providing perches for birds in tropical forests. Our findings suggest that P. minor also requires Palaquium trees for roosting, highlighting the importance of these trees in Berber forest ecosystems Suryadi, Santoso, & Widodo; Suryadi found that trees of different heights can support a range of bird behaviours. Our findings show that P. minor activity occurs at a range of heights, highlighting the relevance of tree distribution in facilitating bird activity.

Purnama, Sasmita, & Widjaja found that trees with abundant fruits, such as Ficus, are very important as food sources for birds. Our findings suggest that F. benjamina is a tree frequently exploited by P. minor and C. regius, thus accentuating its value as a food source. Raunsay; Kencana, Yulianto, & Herlina, [18] found that tree diversity in tropical forests is critical to bird survival and activity. Our findings revealed that

P. minor utilized several tree species, including F. benjamina and P. pinnata, highlighting the importance of tree diversity in the forest environment of Berber Village. According to a study conducted by Purnama, Sasmita, & Widjaja; Raunsay F. benjamina trees are very important in supporting tropical forest ecosystems because they provide essential habitat and food sources for various bird species. This is in line with our results which show that F. benjamina has an excellent ecological function. Research by Nugroho highlighted the importance of P. pinnata trees in supporting biodiversity in the tropical forests of Papua. Our results showing excellent ecological functions of P. pinnata support this finding, confirming the important role of this tree in the local ecosystem. According to studies by Raunsay Palaquium sp. trees play a crucial role in providing perches and food for birds in tropical forests. This is consistent with our results which show that Palaquium sp. has an excellent ecological function.

Research by Raven & Wagner showed that trees with high ecological function tend to have higher bird densities around them. This is consistent with our findings that *F.benjamina* and *P.pinnata* have excellent ecological functions. Studies by Mason, et al highlighted the importance of tree diversification in supporting a range of bird activities. Our results support this by showing that various tree species such as *F. benjamina*, *P. pinnata,* and *Palaquium* sp. have high ecological functions. According to Leksono; Hardiwinoto, et al.; Triwanto, trees that meet strict ecological criteria tend to be better at supporting bird diversity. Our results showing high scores for *F. benjamina*, *P. pinnata* and *Palaquium* sp. trees support this conclusion. Studies by Mirmanto confirm the importance of endemic trees such as *P. pinnata* in supporting local ecosystems and biodiversity. Our results showing the excellent ecological functions of *P. pinnata* emphasize the importance of the conservation of this endemic tree species.

Research by Jones, Linsley, & Marsden showed that *F. benjamina* trees play an important role in providing habitat and food for birds in tropical forests. This is consistent with our results which show that *F. benjamina* has a high ecological function assessment score, fulfilling all criteria well. According

to Raunsay; Raunsay; (Raunsay, Kameubun, Antoh, Aisoi, & Kapitarauw, *P. pinnata* trees have a critical role in Papuan rainforest ecosystems due to their ability to provide perches and food sources for local birds. Our results support these findings by showing that *P. pinnata* fulfils all ecological function criteria very well. Studies by Bamotiwa, Labiro, & Ihsan found that *Palaquium* sp. trees are important habitats for various bird species, including Cenderawasih, due to their complex branch structure and fruit production. Our results support this by showing that *Palaquium sp.* has excellent ecological function, with high scores on all criteria. Research by Raunsay, Akobiarek, Matani, Ramandei, & Simbiak showed that *P. papuana* has some limitations in fulfilling certain ecological functions, although it still makes a significant contribution to bird habitat. This is in line with our results which show that *P. papuana* has a lower score on the K2 criterion but is still good overall. According to a study by Raunsay large trees with extensive canopies, such as *F. benjamina* and *P. pinnata*, tend to support higher bird diversity as they provide safe perches and abundant food sources. Our findings showing high scores for these two species support this view.

Research by Raunsay highlighted the importance of endemic trees such as *P. pinnata* in maintaining local biodiversity. Our results showing the high ecological functions of *P. pinnata* reinforce the importance of conservation of this endemic species. Studies by García; Smallwood & Wood show that trees with high ecological value tend to support more diverse bird activities. Our results show that high-scoring trees such as *F. benjamina* and *P. pinnata* do support a variety of bird activities such as roosting, playing and sleeping. According to research by Smallwood & Wood, the presence of trees with good ecological functions can increase bird population density in tropical forests. Our results showing high scores on *F. benjamina* and *P. pinnata* support this conclusion. Research by Niemi, et al shows that trees that fulfil various ecological function criteria tend to be more effective in supporting bird ecosystems. Our results showing fulfilment of the criteria by *F. benjamina*, *P. pinnata*, and *Palaquium* sp. reinforce this view. Studies by Saputri, Iswandaru, Wulandari, & Bakri emphasize that tree ecology is important to support the diversity of bird activities in tropical forests. Our results show that a range of tree species with high ecological functions support a variety of Cenderawasih bird activities, reinforcing the importance of tree diversification.

CONCLUSION AND RECOMMENDATION

The total population that was successfully found and observed was 36 individuals consisting of 23 males and 13 females. Bird of Paradise species richness in the Berber Village Forest Area is categorized as low (0.4343) and dominated by one species, namely *P. minor* based on the dominance index. *P. minor* bird activity was found at various elevations ranging from 21 to 64 meters above sea level (masl). The activity distribution of birds of paradise (*P. minor* and *C. regius*) showed a tendency towards certain tree species as well as elevation changes.

ADVANCED RESEARCH

This research focuses on the association between trees as habitats and Birds of Paradise. Therefore, further studies are deemed necessary on: 1) Identification of the types of food consumed by Birds of Paradise; 2) Analysis of the habitat characteristics of Birds of Paradise; 3) Analysis of the role of the community in the conservation of Birds of Paradise.

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