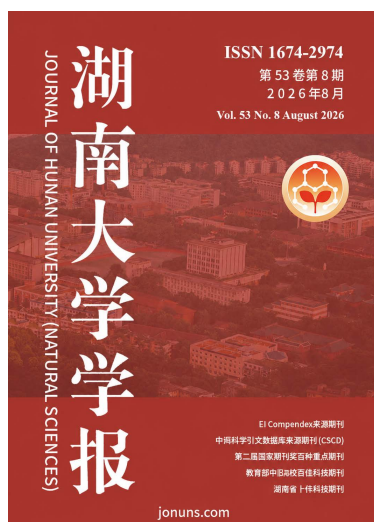




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Species Diversity and Population Density of Bucerotidae Birds in Pocut Meurah Intan Grand Forest Park, Aceh Province

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Abstract: Pocut Meurah Intan Grand Forest Park (Tahura) in Aceh Province, Indonesia, is a protected nature conservation area currently facing serious threats from human activities, such as habitat fragmentation, forest conversion, illegal logging, and bird hunting. These disturbances have adversely affected the diversity and population density of hornbill species (Bucerotidae) within the park. This study aimed to assess the diversity and population density of Bucerotidae using a survey-exploratory method. Data were collected through line transects and concentration counts across three stations, each containing five observation points. Station 1 and Station 3 represented primary forest areas, while Station 2 was exposed to human encroachment. Species diversity was analyzed using the Shannon-Wiener Index, and population density was estimated through the Eisenberg formula. Researchers recorded 118 individuals representing five hornbill species: *Buceros rhinoceros* Linnaeus (rhinoceros hornbill), *Buceros*



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bicornis Linnaeus (great hornbill), *Aceros undulatus* Shaw (wreathed hornbill), *Anthracoceros albirostris* Shaw (oriental pied hornbill), and *Rhinoplax vigil* J. R. Forster (helmeted hornbill). A total of 118 individuals representing five Bucerotidae species were recorded across the three observation stations. *Aceros undulatus* was the most abundant species, with 48 individuals (40.68%), followed by *Anthracoceros albirostris* with 38 individuals (32.20%). The calculated diversity index ($\hat{H} = 1.295$) reflected moderate species diversity. Population densities were found to be 2.10 individuals/km² at Station 1, 1.60 at Station 2, and 2.20 at Station 3. The lowest density at Station 2 highlights the negative impact of habitat degradation, emphasizing the urgent need for focused conservation efforts.

Keywords: Bird Population, Bucerotidae, Species Diversity, Tahura Pocut Meurah Intan.

印度尼西亚亚齐省Pocut Meurah Intan大森林公园犀鸟科鸟类的物种多样性与种群密度

摘要：印度尼西亚亚齐省Pocut Meurah Intan大森林公园（Tahura）是一处受保护的自然保护区，目前正面临栖息地破碎化、林地转化、非法采伐和鸟类捕猎等人为活动造成的严重威胁。这些干扰已对公园内犀鸟科（Bucerotidae）鸟类的物种多样性和种群密度产生不利影响。本研究采用探索性调查法，旨在评估犀鸟科鸟类的物种多样性和种群密度。研究通过样线调查法和集中计数法，在3个调查站点采集数据，每个站点设置5个观测点。站点1和站点3位于原始森林区域，站点2则受到人类侵占活动的影响。物种多样性采用Shannon - Wiener多样性指数进行分析，种群密度采用Eisenberg公式进行估算。研究共记录到118只犀鸟科鸟类，隶属于5个物种，分别为马来犀鸟（*Buceros rhinoceros* Linnaeus）、双角犀鸟（*Buceros bicornis* Linnaeus）、花冠皱盔犀鸟（*Aceros undulatus* Shaw）、冠斑犀鸟（*Anthracoceros albirostris* Shaw）和盔犀鸟（*Rhinoplax vigil* J. R. Forster）。其中，花冠皱盔犀鸟数量最多，共记录48只，占40.68%；其次为冠斑犀鸟，共记录38只，占32.20%。计算得到的Shannon - Wiener多样性指数（ $\hat{H} = 1.295$ ）表明该区域的物种多样性处于中等水平。站点1、站点2和站点3的种群密度分别为2.10只/km²、1.60只/km²和2.20只/km²。站点2的种群密度最低，表明栖息地退化对犀鸟种群产生了负面影响，并凸显了采取针对性保护措施迫切性。

关键词：鸟类种群；犀鸟科；物种多样性；Pocut Meurah Intan大森林公园

1. Introduction

Pocut Meurah Intan Grand Forest Park (Taman Hutan Raya or Tahura) is a designated nature conservation area in Aceh Province, Indonesia, spanning approximately 6,220 ha at elevations between 500 and 1,800 m above sea level [1-3]. Geographically, it is situated between 05°24'–05°28' N and 95°38'–95°47' E and administratively covers parts of Aceh Besar and Pidie Districts [1, 3]. The park contains a mosaic of forest and non-forest habitats and is increasingly affected by forest conversion, agricultural expansion, fire, and other anthropogenic pressures [2-4].

Among the biodiversity at risk are hornbills (Bucerotidae), whose occurrence and persistence depend strongly on forest condition, nesting resources, and food availability. Local and regional studies have documented habitat deterioration and variation in hornbill distribution under different habitat conditions [2, 4, 5].

Conservation of hornbills in Indonesia is also linked to wildlife-trade regulation and community-level conservation challenges [6, 7]. Hornbills are large,

distinctive birds characterized by prominent bills and casques and by species-specific morphometric traits [8-10]. Many species are strongly associated with forest habitats, and their abundance and breeding activity are influenced by habitat modification and fruit availability [11, 12]. Hornbills also play an important role in frugivory and seed dispersal in tropical Asian forests [13].

Ecosystem degradation can reduce ecological integrity and alter resources required by hornbills. Recent studies have documented spatial and temporal changes in hornbill populations associated with differing levels of forest disturbance and have emphasized forest degradation as an important biodiversity concern [14, 15].

Previous research in Pocut Meurah Intan Grand Forest Park has examined canopy conditions in Bucerotidae habitat and bird diversity across different habitat types [16, 17], while other studies at the same site have documented hornbill food and nesting trees and the effects of deforestation on hornbill food plants [1, 2]. Despite these contributions, information integrating Bucerotidae species diversity and population density

across contrasting habitat conditions remains limited. Hornbills are also useful at the landscape scale for identifying areas of conservation importance [18].

Recent studies in Aceh have further documented hornbill diversity, canopy structure, and the effects of deforestation on hornbill food plants [2, 16, 19]. Collectively, these findings highlight the importance of targeted assessments of Bucerotidae communities in Pocut Meurah Intan Grand Forest Park. Such information is essential for understanding spatial variation in hornbill communities and for supporting habitat management and conservation strategies.

The novelty of this study lies in its integrated assessment of species diversity and population density of hornbills (Bucerotidae) in Pocut Meurah Intan Grand Forest Park, Aceh Province, Indonesia. Previous studies conducted in the same area have primarily examined overall bird diversity across different habitat types and the relationship between canopy cover and Bucerotidae habitat. In contrast, the present study provides a more comprehensive assessment of the Bucerotidae community by incorporating species richness, diversity, evenness, dominance, abundance, and species-specific population density. These findings provide baseline

information for assessing the status and structure of hornbill communities and may contribute to the development of more effective habitat management and conservation strategies for Bucerotidae in Pocut Meurah Intan Grand Forest Park.

2. Materials and Methods

2.1. Research Location, Period, Equipment, and Species Identification

This study was conducted in Pocut Meurah Intan Grand Forest Park (Tahura), Aceh Province, Indonesia. The research area lies within the geographical coordinates of 05°24'–05°28' N and 95°38'–95°47' E (Figure 1). Data were collected from February to September 2021. The field equipment utilized included a pair of binoculars (Bushnell 10–70×70), a handheld global positioning system (Garmin GPSmap 62sc), a digital camera (Sony Alpha FE 70–200 mm), a stopwatch (Casio HS-3), a hand tally counter (HEA6594 HS6594), a 100-meter measuring tape (Roll Roll Fiber 100 m RUSH), a sampling point map of the study site, and standard field stationery. Species were identified using Birds of Bali, Sumatra and Java [10].

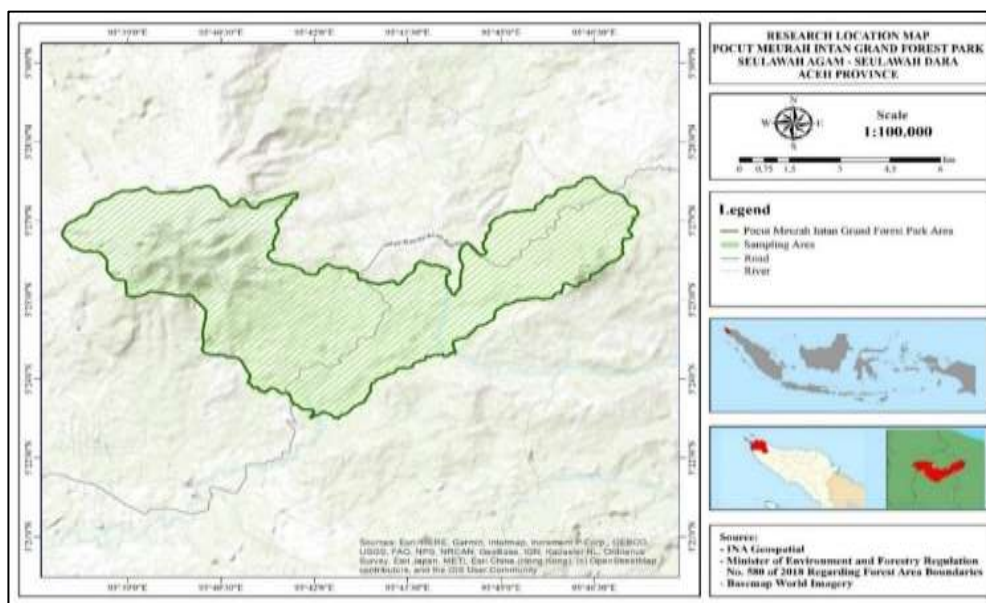


Figure 1. Research Location Map

2.2. Preparation and Data Collection

Data collection was conducted using an exploratory survey approach through direct field observations of the study area. The diversity and population density of Bucerotidae species were assessed using a combination of line transect and concentration count methods [20–22]. The research area was stratified into three stations, each representing different habitat conditions and topographical features. Station 1 was characterized by primary forest dominated by pine vegetation, Station 2 represented a disturbed area affected by human encroachment, and Station 3 comprised undisturbed primary forest.

At each station, five concentration count points were established, yielding a total of 15 observation points (Figure 2). The observation points were selected based on habitat type, topography, accessibility, and expected hornbill movement patterns [5]. Existing pathways were used as the main transect lines. A minimum distance of 600 m was maintained between adjacent observation points. Five observation points were established at each of the three stations, resulting in a total of 15 observation points across the study area. The total transect length across the three stations was approximately 9 km. Field observations were conducted by 10 observers, with two

observers assigned to each observation point during each survey session.

Observations were carried out during peak avian activity periods, specifically from 06:00 to 11:00 and 15:00 to 18:00 [11, 23]. Bird species enumeration employed the Timed Series Counts (TSCs) method, recording bird species within fixed time intervals. Each TSC session lasted 1 hour and was divided into continuous 15-minute observation intervals. To obtain representative data, observations were conducted with

seven replicate surveys per month from February to September. Standard bird-survey procedures were followed to minimize repeated counting of the same individuals [21]. Parameters recorded included the Bucerotidae species observed, the number of species present, and the number of individuals per species. Habitat conditions at each observation point were also recorded to provide ecological context for Bucerotidae occurrence and distribution.

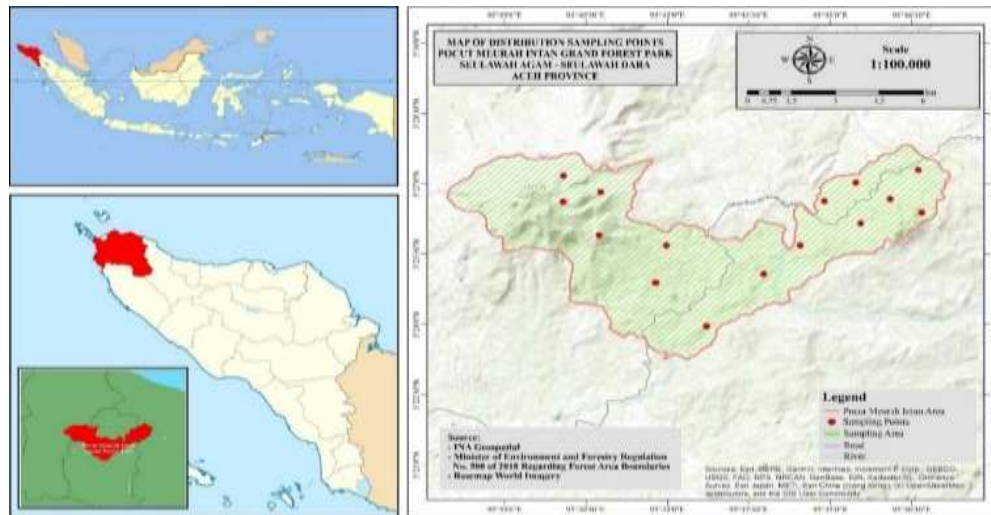


Figure 2. Map of Distribution Sampling Points

Food trees used by hornbills (Bucerotidae) were identified through direct field observations. The species diversity of hornbill food trees was assessed using a combination of transect and quadrat methods. Observation sites for food trees and nesting trees were established along the daily movement routes of hornbills and selected using purposive sampling. Food plant species and nesting trees were identified based on direct observations of feeding activity, feeding traces, and plant remains left by the birds.

2.3. Data Analysis

Data were analyzed using descriptive and quantitative approaches. The species composition of Bucerotidae recorded in Pocut Meurah Intan Grand Forest Park, Aceh Province, was summarized descriptively and presented in tables and figures. Quantitative analyses were performed to assess species abundance, relative abundance, diversity, evenness, dominance, and population density.

Species abundance was determined from the number of individuals recorded, whereas relative abundance was calculated as described below.

a. Species Abundance (p_i)

The abundance of each Bucerotidae species was expressed as the total number of individuals of that species recorded during the survey (n_i).

b. Relative Abundance (RA)

The relative abundance of each Bucerotidae species was calculated as the proportion of individuals of species i relative to the total number of Bucerotidae individuals recorded, expressed as a percentage [21]:

$$RA_i = n_i / N \times 100\%$$

where:

RA_i = relative abundance of species i (%);

n_i = number of individuals of species i ; and

N = total number of individuals of all Bucerotidae species recorded.

Species diversity was assessed using the Shannon-Wiener diversity index (H'), which incorporates both species richness and the relative abundance of individuals among species. The index was calculated following standard approaches used in bird and hornbill ecological studies [21, 24]:

$$\hat{H} = -\sum p_i \ln p_i$$

where:

$\hat{H}$ = Shannon–Wiener diversity index;

p_i = proportion of individuals belonging to species i ;

n_i = number of individuals of species i ;

N = total number of individuals of all species recorded; and

S = total number of species recorded.

$$p_i = n_i / N$$

Species diversity was classified based on the Shannon-Wiener diversity index (H') according to the criteria adopted from [25]. H' values < 1 were categorized as low diversity, values of 1-3 as moderate diversity, and values > 3 as high diversity.

The population density of Bucerotidae birds was estimated from the number of individuals recorded along the surveyed transects and the corresponding survey area, expressed as individuals per square kilometer (individuals/km²). The strip-transect density equation applied in previous hornbill population studies was used [22, 26, 27]:

$$D = ND/2W(L)$$

Information:

D = Population density (individuals/km²)

ND = Number of individuals recorded

L = Total transect length (km)

W = Survey width (km) [22, 26, 27]

3. Results and Discussion

3.1. Abundance and Diversity of Bucerotidae Birds in Pocut Meurah Intan Grand Forest Park, Aceh Province

Five Bucerotidae bird species were identified in Pocut Meurah Intan Grand Forest Park, Aceh Province. These include the rhinoceros hornbill (*Buceros rhinoceros* Linnaeus), great hornbill (*Buceros bicornis* Linnaeus), wreathed hornbill (*Aceros undulatus* Shaw), oriental pied hornbill (*Anthracoceros albirostris* Shaw), and helmeted hornbill (*Rhinoplax vigil* J. R. Forster). Species and Conservation Status of Bucerotidae Birds in Pocut Meurah Intan Grand Forest Park, Aceh Province are illustrated in Figure 3 and Table 1.

As shown in Table 1, 118 Bucerotidae individuals were recorded in Pocut Meurah Intan Grand Forest Park, Aceh Province. Among the species, the wreathed hornbill (*Aceros undulatus* Shaw) had the highest population (48 individuals), followed by the oriental pied hornbill (*Anthracoceros albirostris* Shaw) with 38 individuals, the great hornbill (*Buceros bicornis* Linnaeus) with 22 individuals, and the rhinoceros hornbill (*Buceros rhinoceros* Linnaeus) with 8 individuals. The helmeted hornbill (*Rhinoplax vigil* J. R. Forster) was the least abundant (two individuals).

The community was strongly dominated by *Aceros undulatus* (40.68%) and *Anthracoceros albirostris* (32.20%), which together accounted for 72.88% of all individuals recorded.

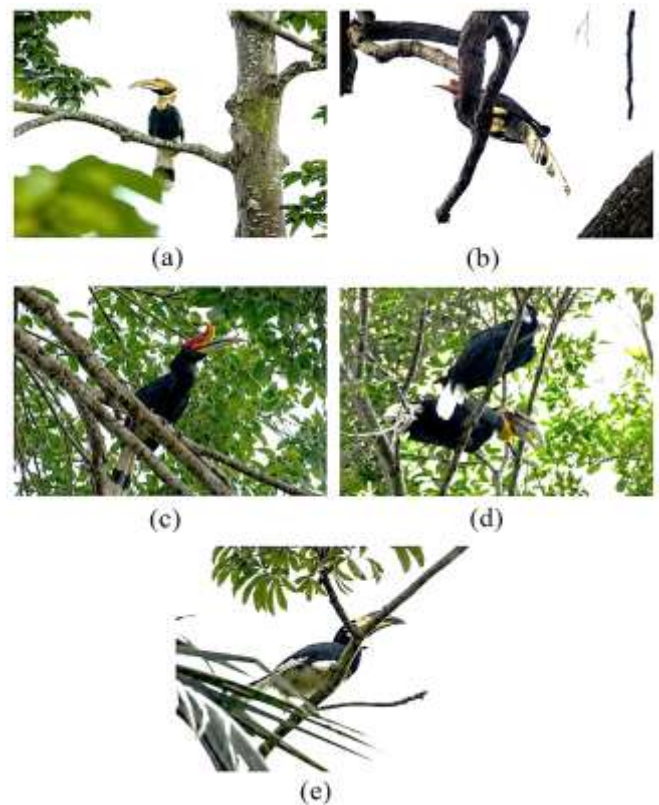


Figure 3. Bucerotidae bird species in Tahura, Pocut, Meurah Intan, Aceh Province; (a) the great hornbill (*Buceros bicornis* Linnaeus), (b) the helmeted hornbill (*Rhinoplax vigil* J. R. Forster), (c) the rhinoceros hornbill (*Buceros rhinoceros* Linnaeus), (d) the wreathed hornbill (*Aceros undulatus* Shaw) and (e) oriental pied hornbill (*Anthracoceros albirostris* Shaw).

In contrast, *Rhinoplax vigil* represented only 1.69% of all individuals and was detected exclusively at Station 3. Although the low number of observations may reflect low local abundance, it may also result from the species' large spatial requirements, habitat specificity, or low detectability. Consequently, the two observations should not be interpreted as direct evidence of a small population size. Nevertheless, the occurrence of *Rhinoplax vigil* is conservation-relevant because the species is strongly associated with mature forest habitat and large nest trees and is considered highly sensitive to habitat disturbance.

The calculated species diversity index for Bucerotidae in the park was $\hat{H} = 1.296$, indicating a moderate level of diversity. This suggests that the area supports a reasonable variety of Bucerotidae species, with a diversity range that is neither excessively high nor low, thus indicating that the habitat in Pocut Meurah Intan Forest Park can adequately sustain the population of these birds.

The diversity of Bucerotidae species in Pocut Meurah Intan Grand Forest Park varied across the different observation stations. Stations 1 and 3 demonstrated higher species diversity indices compared to Station 2. A detailed overview of species diversity,

the number of species, and the population of Bucerotidae birds at each observation station is provided in Figure 4.

Based on the data presented in Figure 4, the diversity of Bucerotidae bird species at the observation stations in Pocut Meurah Intan Grand Forest Park was found to be moderate, with species diversity indices ($\hat{H}$) of 1,231 at Station 1, 1,024 at Station 2, and 1,364 at Station 3. These values suggest that the habitat conditions for Bucerotidae birds in Tahura Pocut Meurah Intan, Aceh Province, remain relatively healthy, providing adequate

resources for these species. However, the habitat is less complex or diverse than in areas with high species diversity. Regarding species richness, Stations 1 and 3 hosted five Bucerotidae species, while Station 2 supported only three. These findings indicate that the habitats at Stations 1 and 3 continue to support Bucerotidae populations in the region, while Station 2 may face ecological limitations affecting species presence. The Abundance of Bucerotidae species in Pocut Meurah Intan Grand Forest Park is presented in Table 2.

Table 1. Species and Conservation Status of Bucerotidae Birds in Pocut Meurah Intan Grand Forest Park, Aceh Province

Scientific Name	Local Name	Conservation Status	Assessment Year	Source
<i>Buceros rhinoceros</i> Linnaeus	Rhinoceros hornbill	VU	2018	IUCN Red List
<i>Buceros bicornis</i> Linnaeus	Great hornbill	VU	2020	IUCN Red List
<i>Aceros undulatus</i> Shaw	Wreathed hornbill	VU	2018	IUCN Red List
<i>Anthracoceros albirostris</i> Shaw	Oriental pied hornbill	LC	2020	IUCN Red List
<i>Rhinoplax vigil</i> J. R. Forster	Helmeted hornbill	CR	2020	IUCN Red List

Note: VU–Vulnerable; LC–Least Concern, CR–Critically Endangered

Table 2. Abundance of Bird Species in Pocut Meurah Intan Grand Forest Park, Aceh Province

Scientific Name	Local Name	Number of individuals per Station			Total Number of Individuals	Relative Abundance (%)
		1	2	3		
<i>Buceros rhinoceros</i> Linnaeus	Rhinoceros hornbill	4	0	4	8	6.78
<i>Buceros bicornis</i> Linnaeus	Great hornbill	6	6	10	22	18.64
<i>Aceros undulatus</i> Shaw	Wreathed hornbill	18	10	20	48	40.68
<i>Anthracoceros albirostris</i> Shaw	Oriental pied hornbill	14	16	8	38	32.20
<i>Rhinoplax vigil</i> J. R. Forster	Helmeted hornbill	0	0	2	2	1.69
		42	32	44	118	100%

Table 3 presents the results of the species diversity analysis of Bucerotidae birds in Pocut Meurah Intan Grand Forest Park, Aceh Province. It details the calculated values of species diversity across the study area.

Table 3. Diversity of Bird Species in Pocut Meurah Intan Grand Forest Park, Aceh Province

Scientific Name	Local Name	Number of Individuals / Station			Total Number (Σ)	Diversity Index ($\hat{H}$)
		1	2	3		
<i>Buceros rhinoceros</i> Linnaeus	Rhinoceros hornbill	4	0	4	8	0.182
<i>Buceros bicornis</i> Linnaeus	Great hornbill	6	6	10	22	0.313
<i>Aceros undulatus</i> Shaw	Wreathed hornbill	18	10	20	48	0.366
<i>Anthracoceros albirostris</i> Shaw	Oriental pied hornbill	14	16	8	38	0.365
<i>Rhinoplax vigil</i> J. R. Forster	Helmeted hornbill	0	0	2	2	0.069
Total		42	32	44	118	1.295

Note: The category of species diversity index is classified as medium ($\hat{H}$ = 1.295). VU – Vulnerable; LC – Least Concern, CR – Critically Endangered

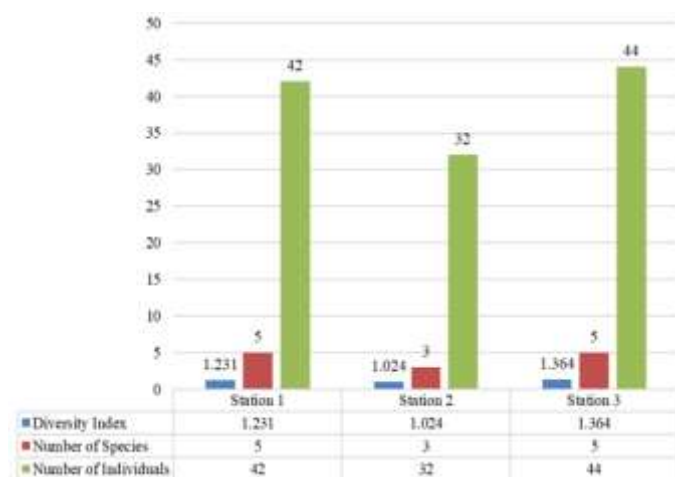


Figure 4. Species Diversity, Number of Species, and Number of Individuals of Bucerotidae in the Pocut Meurah Intan Grand Forest Park Based on Observation Station

The moderate diversity observed in the study area should be interpreted in the context of habitat condition and resource availability. Local habitat deterioration and broader evidence on biodiversity threats indicate that habitat loss can reduce the capacity of forest landscapes to support wildlife populations [4, 28].

Bird occurrence and diversity can vary with habitat type, vegetation structure, and food availability, while habitat destruction remains a major threat to species persistence [28, 29].

Pocut Meurah Intan Grand Forest Park has experienced forest conversion and other land-cover changes associated with anthropogenic activities [2, 3, 16]. Such habitat alteration can modify vegetation structure and resource availability, factors that are important in shaping bird richness and distribution [29-31]. These patterns provide ecological context for the lower richness and population density observed at Station 2, although the relationship should be interpreted descriptively because no inferential statistical test of habitat effects was conducted.

3.2. Bucerotidae Bird Population in Tahura Pocut Meurah Intan, Aceh Province

The research on the population of Bucerotidae birds in Pocut Meurah Intan Grand Forest Park, Aceh Province, revealed 118 individuals across the study area. The population density of Bucerotidae birds varied across the observation stations, with Station 1 showing a density of 2.10 individuals per km², Station 2 at 1.60 individuals per km², and Station 3 at 2.20 individuals per km². These findings highlight the spatial distribution of Bucerotidae birds within the park. The population density data for Bucerotidae birds in Pocut Meurah Intan Grand Forest Park is illustrated in Figure 5.

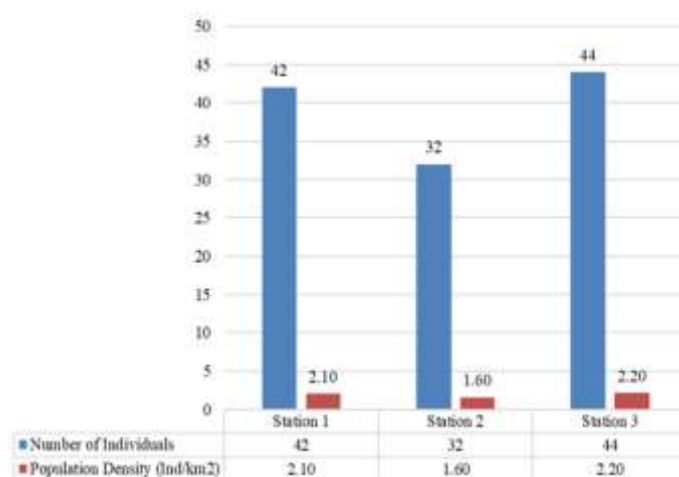


Figure 5. Population Density of Bucerotidae in Pocut Meurah Intan Grand Forest Park, Aceh Province

Figure 5 shows that stations 1 and 3 exhibit higher population densities of Bucerotidae birds compared to Station 2. The distribution of Bucerotidae bird populations in Pocut Meurah Intan Grand Forest Park, Aceh Province, is may be associated with by the habitat conditions at each station. Data from the study indicate that Stations 1 and 3 still maintain abundant nest trees and food sources for Bucerotidae birds. Notable food plants include the Common yellow-stem fig (*Ficus fistulosa* Reinw ex Blume), Weeping fig (*Ficus benjamina* L.), White fig (*Ficus virens* W.A.T.), Soft bollygum (*Litsea glutinosa* (Lour.) C.B. Robinson), Rambai (*Baccaurea bracteata* Müll.Arg.), Council tree (*Ficus altissima* L.), Luwungan (*Ficus hispida* L.), Java fig (*Ficus ampelas* Burm.F), Common red-stem fig (*Ficus variegata* ex Blume), Rangas (*Gluta aptera* Wood), Kapur (*Dryobalanops sumatrensis* (J.F. Gmelin) Kosterm.), Meranti (*Shorea stenophthera* Burck. F.), and Lagan (*Dipterocarpus kunstleri* King).

The habitat conditions at Station 2, which exhibit a lower population density of Bucerotidae birds compared to the other stations, are less supportive of the activity and presence of these birds. Several areas within this station have undergone deforestation due to various anthropogenic activities, including illegal logging, the establishment of community business premises, forest fires, and the conversion of forested land into agricultural areas. These areas have been cleared to accommodate the cultivation of various horticultural crops, including cocoa, sweet potatoes, oil palm, bananas, corn, and other agricultural plants, as well as physical development projects. These disturbances have likely contributed to the reduced population density of Bucerotidae birds at Station 2.

Food-tree and nest-tree availability may contribute to the observed differences among stations. Hornbills depend strongly on fruiting trees, especially figs, and food-tree availability can vary spatially and temporally [24, 32, 33]. Hornbills also influence the dispersal of

large seeds, reinforcing the ecological importance of maintaining diverse fruiting-tree communities [34].

The lower population density at Station 2 may be associated with greater habitat disturbance and reduced availability of food and nesting resources. Local deforestation has been linked to declines in hornbill food-plant diversity [2], while studies elsewhere report relationships between habitat modification, fruit availability, forest degradation, and hornbill abundance or breeding activity [12, 15].

Hunting and other anthropogenic pressures may further affect hornbill populations. Community-based research in Indonesia identifies socio-economic and conservation dimensions of hornbill exploitation [7], and a recent systematic review highlights habitat loss and hunting among major conservation concerns for Indonesian hornbills [8]. Evidence from tropical logged forests further emphasizes the conservation implications of logging and hunting pressures on bird communities [35].

3.3. Diversity of Hornbill Food Plant Species in Pocut Meurah Intan Grand Forest Park, Aceh Province

The diversity of food plant species used by hornbills (Bucerotidae) in Pocut Meurah Intan Grand Forest Park is presented in Table 4. Table 4 shows that Stations 1 and 3 were characterized by a relatively high abundance of tree species used as food resources by hornbills (Bucerotidae), including *Ficus fistulosa* Reinw. ex Blume, *Ficus benjamina* L., *Ficus virens* W.A.T., and *Baccaurea bracteata* Müll.Arg. Based on the diversity index, the overall values recorded at each station were 2.61 at Station 1, 2.41 at Station 2, and 2.49 at Station 3. These results indicate that the three stations exhibited relatively similar levels of food-tree diversity, although the species composition and relative contribution of individual species varied among stations. The physiognomic characteristics of these habitats, together with the plant species serving as food resources for hornbills in Pocut Meurah Intan Grand Forest Park, are presented in Figure 6.

Table 4. Diversity of Food Plant Species Used by Hornbills (Bucerotidae) in Pocut Meurah Intan Grand Forest Park

Family	Scientific Name	Local Name	Diversity Index ($\hat{H}$) / Station		
			1	2	3
Arecaceae	<i>Corypha utan</i> Lam	Gebang palm	0.17	-	0.13
Euphorbiaceae	<i>Blumeodendron kurzii</i> J.J.Sm.(Hook.f.)	Kurzii's blumeodendron	0.2	0.17	0.21
Moraceae	<i>Ficus benjamina</i> L.	Ficus tree	0.22	0.13	0.24
	<i>Ficus fistulosa</i> Reinw. ex Blume	Common yellow-stem fig	0.21	0.14	0.14
	<i>Ficus variegata</i> Blume	Common Red Stem Fig	0.18	0.23	0.2
	<i>Ficus hispida</i> L.	Rough-leaved fig	0.21	0.24	0.25
	<i>Ficus altissima</i> Blume	Council tree	0.23	0.25	0.22
	<i>Ficus schwarzii</i> Koord	Wild fig tree	0.21	0.20	0.23
	<i>Ficus ampelas</i> Burm.F	Rampelas	0.17	0.20	0.2
	<i>Ficus caulocarpa</i> (Miq.) Miq.	Stem-fruited fig	0.16	0.16	0.07
	<i>Ficus virens</i> Aiton	White fig	0.16	0.15	0.19
	<i>Syzygium cumini</i> (L.) Skeels	Black plum	0.19	-	-
Phyllanthaceae	<i>Baccaurea bracteata</i> Müll.Arg.	Golden tampoi	0.15	0.25	0.18
Lauraceae	<i>Litsea glutinosa</i> (Lour.) C.B. Robinson	Indian laurel	0.15	0.29	0.23
Total			2.61	2.41	2.49

Note:

$\hat{H}$ = Diversity Index

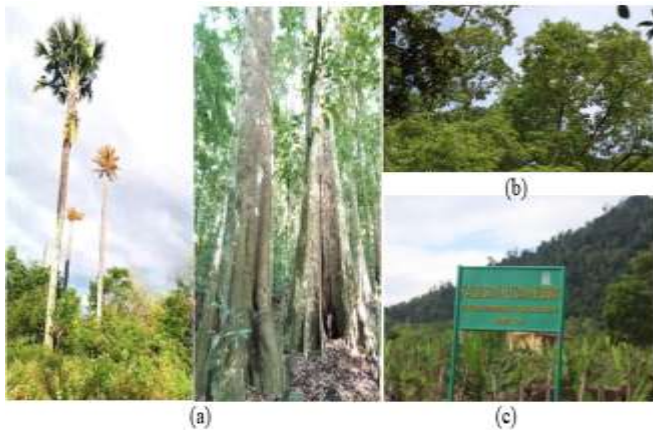


Figure 6. Habitat physiognomy, Bucerotidae bird feed plants in Tahura Pocut, Meurah Intan, Aceh Province; (a) one of the tree species that has the potential to be a Bucerotidae nest tree and bird feed tree, (b) Bucerotidae bird feed tree species, (c) the conversion of the Tahuran Pocut Meurah Intan forest into a horticultural garden.

The prominent representation of *Ficus* species is ecologically important because this genus provides key food resources for frugivorous birds, including hornbills (Bucerotidae). Research in Way Canguk, Bukit Barisan Selatan National Park, showed that hornbill occurrence was closely associated with food-tree availability and that *Ficus* was an important food-tree group [32].

4. Conclusion

The study identified five species of Bucerotidae recorded at the research site: *Buceros rhinoceros* Linnaeus (rhinoceros hornbill), *Buceros bicornis* Linnaeus (great hornbill), *Aceros undulatus* Shaw (wreathed hornbill), *Anthracoceros albirostris* Shaw (oriental pied hornbill), and *Rhinoplax vigil* J. R. Forster (helmeted hornbill). The study recorded five Bucerotidae species comprising 118 individuals in Pocut Meurah Intan Grand Forest Park. *Aceros undulatus* showed the highest relative abundance (40.68%), whereas *Rhinoplax vigil* had the lowest abundance (1.69%). The overall diversity index ($\bar{H} = 1.295$) indicates moderate species diversity, suggesting that the study area continues to provide important habitat for hornbill populations. Population density estimates, calculated using the Eisenberg formula, revealed variation across the three observation stations. Station 1 exhibited a density of 2.10 individuals/km², Station 2 recorded 1.60 individuals/km², and Station 3 had the highest density at 2.20 individuals/km². These findings indicate that Stations 1 and 3, both of which represent relatively undisturbed primary forest habitats, support higher hornbill population densities compared to Station 2, which is more heavily affected by anthropogenic disturbance. The lower density observed at Station 2 suggests a possible association between human activity and hornbill population levels, emphasizing the importance of preserving intact forest areas to support hornbill conservation.

Declarations

Author Contributions

Conceptualization, S.K. and D.; methodology, S.K., D. and M.A.S.; software, M.R.; validation, D., M.A.S. and M.R.; formal analysis, S.K., M.A.S. and M.R.; investigation, S.K.; resources, S.K., D. and M.R.; data curation, S.K. and M.R.; writing—original draft preparation, S.K.; writing—review and editing, D., M.A.S. and M.R.; visualization, S.K. and M.R.; supervision, D. and M.A.S.; project administration, S.K. and D. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

Data Availability Statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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Institutional Review Board Statement

Ethical review and approval were not required for this study because the research involved only non-invasive field observations of free-ranging wild birds, without capture, handling, experimental manipulation, or procedures affecting animal welfare.

Conflicts of Interest

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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