

## Bird Diversity in Ake Jawi Village, Aketajawe Lolobata National Park, Halmahera, North Maluku

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**ABSTRACT.** Aketajawe Lolobata National Park is located in the Wallacea area with 167319.32 hectares. The park is home to 108 buffer villages, one of which is a bird-friendly village in Ake Jawi Village. This study aims to determine the types of birds, analyze diversity, dominance, and feeding habits. So, that when looking for certain types of birds is facilitated by knowing the chances of encounter seen from the abundance of species, as well as their favorite foods. For data collection the visual encounter survey (VES) method was recorded the types encountered along the observation path. The study identified 31 bird species grouped into 23 families and 31 genus, 15 of them are Indonesian endemics, and 12 species are endemics to North Maluku. Based on the Shannon-Wiener diversity index, Ake Jawi Village belongs to the medium category, with an index value of 2889, and a low dominance category with 0.098. The percentage of encounters with insect-eating birds (insectivore) such as the Glossy Swiftlet, Cotton-halmahera, and Goliath Lathe reached 12 species, followed by frugivores such as the Papuan Hornbill, White Cockatoo, and Gray-headed Walik by 11 species.

**Keywords:** Ake Jawi Village; birds diversity; dominance, feeding guilds; visual encounter survey (VES)

**Article History:** Received 31 January 2023; Received in revised form 18 March 2023; Accepted 18 May 2023; Available online 30 December 2023.

**How to Cite This Article:** Ramadani A, Assalam MH, Satrio MB, Nurhasanah AH, Setia TM. 2023. Bird Diversity in Ake Jawi Village, Aketajawe Lolobata National Park, Halmahera, North Maluku. *Biogenesis: Jurnal Ilmiah Biologi*. vol 11(2): 183–191. doi: <https://doi.org/10.24252/bio.v11i2.36802>.

### INTRODUCTION

Indonesia has high biodiversity, one of which is birds. Currently, Indonesia has 1,826 species of birds, 558 species are protected and 541 are endemic species (AR Junaid *et al.*, 2021; Von Rintelen *et al.*, 2017). The Wallacea region, there are 800 species of birds and 300 species of which are endemic birds. Supportive natural conditions greatly help the presence of endemic bird species, such as the expanse of the sea around the land we call an island. The areas included in this area are Sulawesi and its surrounding islands, the Maluku Islands, and the Nusa Tenggara Islands (Burung Indonesia, 2020; Rahmad, 2020). In terms of geography, the Wallacea is located between Sundaland and Sahul, so it has a high degree of diversification. The high diversity of birds and endemic species is based on the shape of the area in the form of islands, but the level of threat is also high due to the times, such as the transition of land functions into settlements and hunting to be owner-bird (McCullough *et al.*, 2022; Xie *et al.*, 2023). One of the efforts carried out by the government is to create a conservation area with various functions that are adjusted to the needs.

Based on a book published by Djuharsa (2017), Indonesia has 54 national parks spread across 34 provinces with an area of 16,304,707.13 hectares. The benefits of national parks that can be felt, namely as a place for research, education, culture, tourism, recreation, and a source of income for the surrounding community (Rhama, 2019). Aketajawe Lolobata National Park (TNAL) is a conservation area in North Maluku, Halmahera Island. This area is divided into two forest groups, namely the Aketajawe Forest Group and the Lolobata Forest Group. Geographically, it is located in Tidore City, Central Halmahera Regency, and East Halmahera Regency. The area has an area of 167,319.32 hectares, of which the Aketajawe Forest group covers 77,793.95 hectares and the Lolobata Forest group 89,525.37 hectares, accompanied by quite diverse landscapes (Firdausy *et al.*, 2021; Nurrani

and Tappa, 2013). Based on the research of Putra *et al.* (2022), a total of 59 species are located in Ake Jawi Resort, TNAL.

One of the wild animals that can live in various types of habitats and is widely used by humans is the bird (Darmawan, 2006). Based on BirdLife International (2004), North Maluku is one of the areas included as EBAs (Endemic Birds Areas) and has 13 points which are IBA areas (Important Bird Areas). Ake Jawi Village in TNAL is one of the areas included in the EBAs section, so that becomes an important area for birds, especially endemic birds. It is known that the national park has several zones, where the zone that can be empowered is the utilization zone. Therefore, the interests of natural tourism and other uses are in this zone, because the location, conditions and natural potential are designed to support this (Peraturan Menteri Kehutanan, 2006; Peraturan Menteri Lingkungan Hidup dan Kehutanan Peraturan Menteri, 2015). This location is in a primary forest area, so the canopy cover of the observation path is very tight.

The beauty of nature and avifauna diversity can be found in one of the buffer villages TNAL, Ake Jawi Village. On August 17, 2019, the village was declared a "Bird Friendly Village" due to the increasing number of bird-watching and photography tourists throughout the year. The birds in Ake Jawi Village are highly valued as assets that can improve the local economy, which makes them more guarded and protected. Various exotic and endemic birds can be found in this village, such as Wallace's Standardwing, Rail Drummers, Ivory-breasted Pitta, North Moluccan Pitta, and members of the Alcedinidae family (Burung Indonesia, 2021; Murniati and Amelia, 2021; Putra, 2019). Therefore, information about the diversity of bird species in developing ecotourism activities specifically for bird watching is needed. Apart from being ecotourism, birds also have an important role in nature, namely as pollinators, seed spreaders, pest control, and environmental bioindicators for good and bad (Sawitri *et al.*, 2010).

Putra *et al.* (2022) have conducted research on the potential of birdwatching in Ake Jawi Village. Therefore, this study in addition to identifying various species of birds found in Ake Jawi Village, Aketajawe Lolobata National Park, Halmahera, North Maluku. Researchers also analyze their diversity, abundance, and eating habits, so that when looking for certain types of birds is facilitated by knowing the chances of encounter seen from the abundance of species, as well as their favorite foods. The hypothesis proposed in this study is that there are various types of birds, with varying levels of dominance, and various types of bird feed available in the study area.

## MATERIALS AND METHODS

The research was conducted on 21-22 May 2022 in Ake Jawi Village, Aketajawe Lolobata National Park, Halmahera, North Maluku, located between 0°29'34.5" North Latitude and 127°44'35.5" East Longitude (Fig. 1). Data collection is done by following the available paths.

**Preparation of birdwatching.** The equipment used in this study included binoculars, digital cameras, writing implements, notebooks, watches, and a field guide book "Birds of the Indonesian Archipelago Greater Sundas and Wallacea" and a booklet "Birds in Indonesia: List and Status 2021 (AR Junaid *et al.*, 2021; Eaton *et al.*, 2021). Data collection used the Visual Encounter Survey (VES), records the types encountered along the observation path (Heyer *et al.*, 1994). Observations do at 07.00-12.00 and 18.00-20.00 (Harmoko and Sepriyaningsih, 2019; Riefani *et al.*, 2019). The records included: the type of bird and the number of individuals.

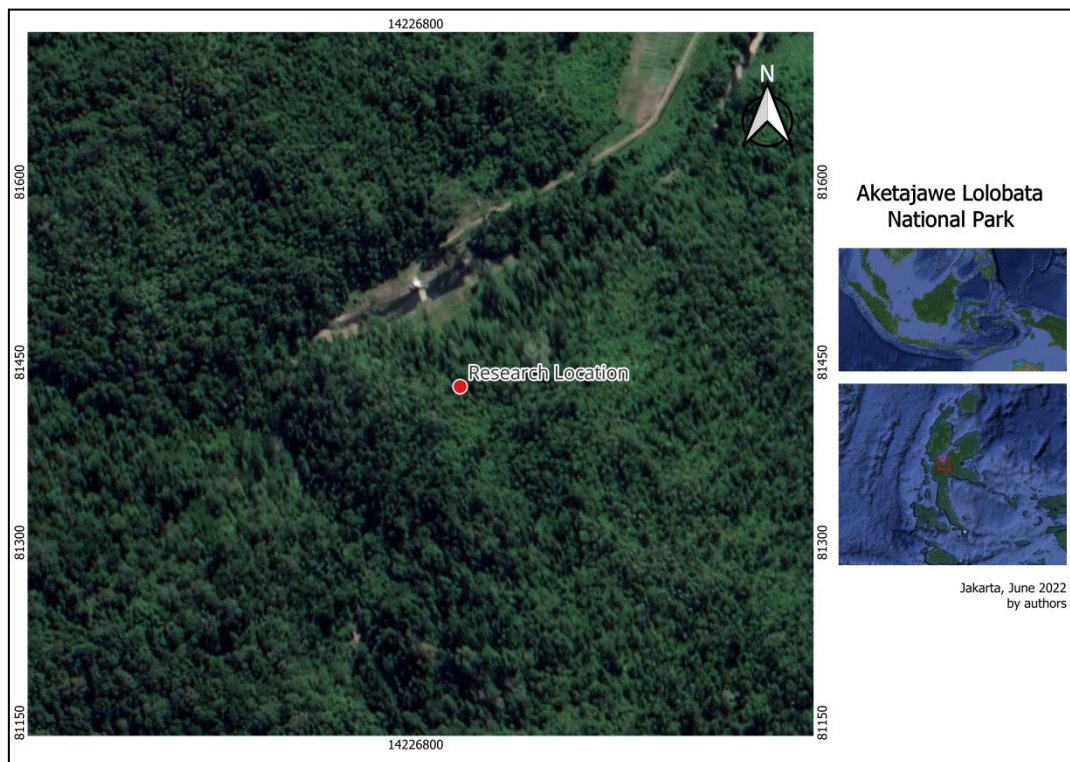
**Data analysis.** Bird data analysis carried out in a quantitative descriptive manner, including: species diversity index, and Simpson dominance index (D). Species diversity index Used to determine the diversity of bird species. In calculating the value of the species diversity index is determined by the Shannon-Wiener index (Huston and Huston, 1994) with the following equation:

$$H' = - \sum_{pi} pi \ln pi$$

$$pi = \frac{ni}{N}$$

$H'$  = Species diversity index  
 $p_i$  = Proportion of important values of the  $i$ -th kind  
 $\ln$  = Natural logarithm  
 $n_i$  = Number of individuals in type  $i$   
 $N$  = Number of individuals of all species

The range of the Shannon-Weiner diversity index is as follows  $H' < 1$  value : Low diversity, high ecological pressure;  $1 < H' < 3$  value : Medium diversity, moderate ecological pressure, and  $H' > 3$  value : High diversity, low ecological pressure



**Fig 1.** Map of observation locations in Ake Jawi Village, Aketajawe Lolobata National Park

Dominance is the ratio between the number of individuals in a species with the number of individuals in the entire species. Dominance value index can be calculated by (Daget, 1976):

$$D = \sum (p_i)^2$$

$$p_i = \frac{n_i}{N}$$

$D$  = Simpson dominance index  
 $p_i$  = Proportion of important values in type  $i$   
 $n_i$  = Number of individuals in type  $i$   
 $N$  = Number of individuals of all species

The range of the Simpson dominance index is as follows (Krebs, 1978):  $0 < D < 1$  value : Low dominance,  $D > 1$  value : High dominance

Data of bird feeding guilds grouped based on the six types of feeds, such as frugivore birds eat fruit, granivore birds eat grain, nectarivore birds eat nectar, insectivore birds eat insects, piscivore birds eat fish and carnivore birds eat meat (Mackinnon *et al.*, 2010).

## RESULTS AND DISCUSSION

There are 31 species of birds from 23 families and 31 genus detected in the field. Consisting of 15 Indonesia endemics and 12 species are endemics to North Maluku (Table 1). The number of birds found did not differ much from the results of Tabba and Nurrani (2016) on the buffer zone, because

Ake Jawi Village is in the TNAL buffer zone. However, when compared with recent research from (Putra *et al.*, 2022), there are 59 species found in the Ake Jawi Resort. The habitat of composition is a heterogeneous forest consisting of mixed gardens, pure gardens, inter-cropping gardens, community forests, rice fields, and horticulture. It makes a variety of bird species encountered, ranging from raptors to water birds can be found there (Nurrani *et al.*, 2014; Putri, 2015; Warsito and Bismark, 2010).

Based on the research results (Table 1), 11 bird species included in protected status Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Number P.106 of 2018 to stop population decline due to hunting; 5 species have Appendix I status (should not be used for anything), and four species have Appendix II status (will be endangered, if trade continues) with CITES; one species has NT (Near Threatened) status and one species has EN (Endangered) status with IUCN (Table 1). However, the areas within and around the national park area are still known to be the most vulnerable locations for the capture and trade of parrot species in Indonesia (Bashari, 2012; Hamdani *et al.*, 2022; Iskandar, 2014).

Based on the Atlas Burung Indonesia (2020), the Eclectus Parrot the fourth most kept and recorded as many as 50 were caught in 2012. Currently, there is also smuggling of two Eclectus Parrot and several other protected animals. However, this attempt was thwarted by forestry police officers and forest ecosystem controllers Bidang Konservasi Sumber Daya Alam Wilayah I Sorong Balai Besar Konservasi Sumber Daya Alam (BBKSDA) (Eka, 2022). Besides that, there are still many translocations of parrots, one of BBKSDA East Java to BKSDA Maluku, totaling 17, and one of them is a type of Umbrella Cockatoo (Aisyah, 2022; Rosyadi *et al.*, 2015; Tamalene *et al.*, 2019).

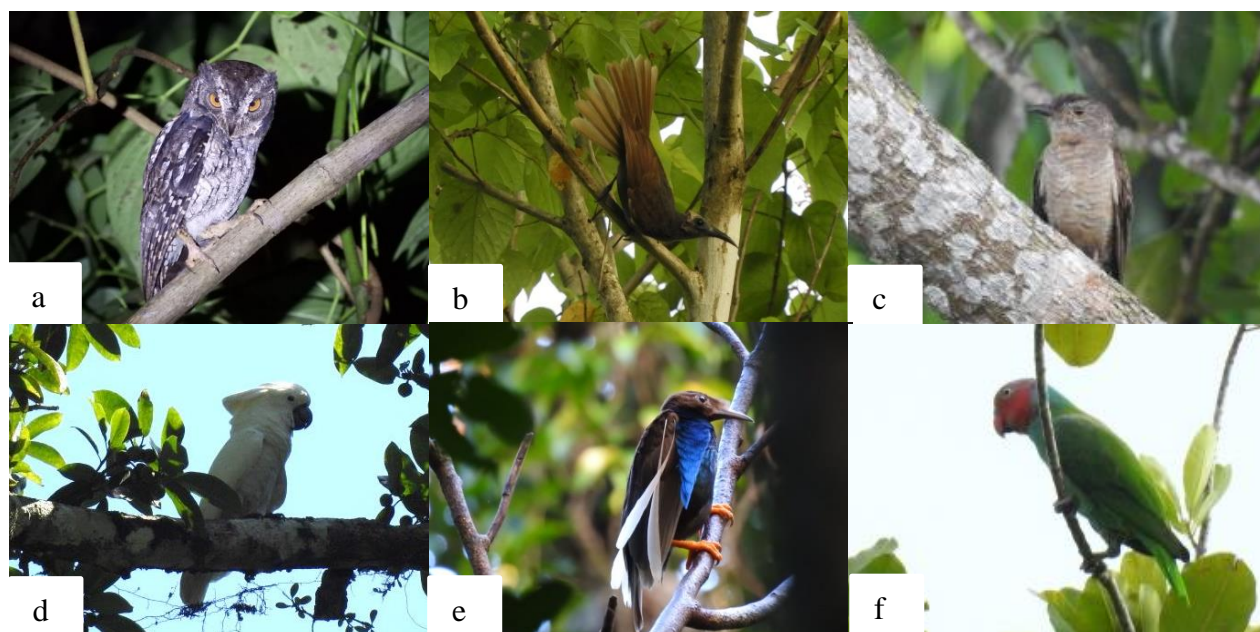
**Table 1.** Compositions of bird species based, on protection, trade, and threat status

Family	Scientific Name	Species Name	Total	IUCN	CITES	Permen P.106	Endemic Ind	Malut
Accipitridae	<i>Haliaeetus indus</i>	Brahminy Kite	1	LC	I	√		
Accipitridae	<i>Tachyspiza henicogramma</i>	Halmahera Goshawk	1	NT	I	√	√	√
Alcedinidae	<i>Tanyiptera galatea</i>	Common Paradise-kingfisher	1	LC				
Alcedinidae	<i>Todiramphus diops</i>	Blue-and-white Kingfisher	3	LC			√	√
Apodidae	<i>Collocalia esculenta</i>	Glossy Swiftlet	10	LC				
Ardeidae	<i>Egretta garzetta</i>	Little Egret	1	LC				
Bucerotidae	<i>Rhyticeros plicatus</i>	Blyth's Hornbill	30	LC	II	√		
Cacatuidae	<i>Cacatua alba</i>	Umbrella Cockatoo	1	EN	II	√	√	√
Campephagidae	<i>Lalage aurea</i>	Rufous-bellied Triller	2	LC			√	√
Columbidae	<i>Ptilinopus hyogastrus</i>	Grey-headed Fruit Dove	3	LC			√	√
Columbidae	<i>Macropygia doreya</i>	Sultan's Cuckoo Dove	1	LC				
Cuculidae	<i>Centropus goliath</i>	Goliath Coucal	1	LC			√	√
Cuculidae	<i>Cacomantis variolosus</i>	Australian Brush Cuckoo	2	LC				
Dicaeidae	<i>Dicaeum schistaceiceps</i>	Halmahera Flowerpecker	3	LC			√	√
Megapodiidae	<i>Megapodius freycinet</i>	Dusky Scrubfowl	1	LC		√	√	
Meliphagidae	<i>Melitograris gilensis</i>	White-streaked Honeyeater	1	LC			√	√
Meropidae	<i>Merops ornatus</i>	Blue-tailed Bee-eater	4	LC				
Monarchidae	<i>Symposiachrus trivirgatus</i>	Moluccan Spectacled Monarch	2	LC				
Nectariniidae	<i>Leptocoma aspasia</i>	Black Sunbird	6	LC				
Nectariniidae	<i>Cinnyris ornatus</i>	Ornate Sunbird	3	LC				
Paradisaeidae	<i>Lycocorax pyrrhopterus</i>	Halmahera Paradise-crow	3	LC	II	√	√	√
Paradisaeidae	<i>Semioptera wallacii</i>	Wallace's Standardwing	5	LC	II	√	√	√
Passeridae	<i>Passer montanus</i>	Eurasian Tree Sparrow	2	LC				
Pittidae	<i>Erythropitta rufiventris</i>	North Moluccan Pitta	2	LC		√	√	
Pittidae	<i>Pitta maxima</i>	Ivory-breasted Pitta	1	LC		√	√	√
Psittacidae	<i>Geoffroyus geoffroyi</i>	Red-cheeked Parrot	2	LC	I	√		
Psittacidae	<i>Eclectus roratus</i>	Eclectus Parrot	2	LC	I	√	√	
Pycnonotidae	<i>Hypsipetes chloris</i>	Halmahera Golden Bulbul	6	LC			√	√
Rhipiduridae	<i>Rhipidura leucophrys</i>	Wilie Fantail	10	LC				
Strigidae	<i>Otus magicus</i>	Moluccanscops Owl	2	LC	I			
Strunidae	<i>Aplonis metallica</i>	Metallic Starling	4	LC				

Notes: Ind= Indonesia; Malut= North Maluku

**Diversity of bird species.** Based on the Shannon-Wiener diversity index criteria, bird species diversity in Ake Jawi Village TNAL has an index value of 2.889 belongs to moderate diversity. The

vegetation structure in a habitat greatly influences the value of bird species diversity (Saputra *et al.*, 2020; Saputri *et al.*, 2022). It is evident from the research of Nurmaeti *et al.* (2018), that mixed vegetation has a greater variety of bird species encountered. Especially if the vegetation becomes a feeding guild and a place for the birds to take shelter, by all means, there will be more and more birds inhabiting that habitat.



**Fig 2.** Some types of insectivore (top) and frugivore (bottom) birds: a. Moluccanscops owl; b. White-streaked Honeyeater; c. Australian Brush Cuckoo; d. Umbrella Cockatoo; e. Wallace's Standardwing, F. Red-cheeked Parrot)

In addition, the density and openness of the canopy also affect encountered bird diversity. The more open habitat canopy, the greater encounter number of birds, and vice versa. However, if the open-titled habitat has a lot of human activity, it will reduce encounters with birds. The birds are sensitive to movement and sound around them, which can cause birds not to return to that location (Cholifatullah *et al.*, 2020; Hutami *et al.*, 2022; Nurmaeti *et al.*, 2018; Palupi and Basuki, 2019).

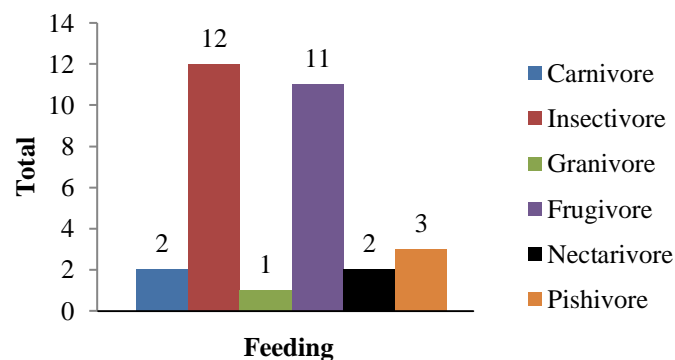
**Dominance of bird species.** Based on the Simpson dominance index criteria, the dominance of bird species in Ake Jawi Village, TNAL has a low dominance index value of 0.098 (Table 2), indicating that area has relatively equal representation and no species dominate over the others (Ekowati *et al.*, 2016; Pangau and Sufaati, 2012; Pertiwi *et al.*, 2021). Despite having a relatively high frequency of sightings, with an average encounter value of 12.5 the Blyth's Hornbill (*Rhyticeros plicatus*) does not contribute significantly to the dominance index.

**Table 2.** Dominance of birds species

Species Name	Value	Species Name	Value	Species Name	Value
Brahminy Kite	7,432	Goliath Coucal	7,432	Eurasian Tree Sparrow	0,000
Halmahera Goshawk	7,432	Australian Brush Cuckoo	0,000	North Moluccan Pitta	0,000
Common Paradise-kingfisher	7,432	Halmahera Flowerpecker	0,001	Ivory-breasted Pitta	7,432
Blue-and-white Kingfisher	0,001	Dusky Scrubfowl	7,432	Red-cheeked Parrot	0,000
Glossy Swiftlet	0,007	White-streaked Honeyeater	7,432	Eclectus Parrot	0,000
Little Egret	7,432	Blue-tailed Bee-eater	0,001	Halmahera Golden Bulbul	0,003
Blyth's Hornbill	0,067	Moluccan Spectacled Monarch	0,000	Wilie Fantail	0,007
Umbrella Cockatoo	7,432	Black Sunbird	0,003	Moluccanscops Owl	0,000
Rufous-bellied Triller	0,000	Ornate Sunbird	0,001	Metallic Starling	0,001
Grey-headed Fruit Dove	0,001	Halmahera Paradise-crow	0,001		
Sultan's Cuckoo Dove	7,432	Wallace's Standardwing	0,002		

Common Blyth's Hornbill are found living in groups, sometimes two, three, or even up to five or six individuals. Its habitat preference is lowland forest that is still undisturbed, accompanied by the presence of tall trees with large crowns. Generally, used by the hornbill as a feeding guild and nesting sites (Runtu *et al.*, 2023; Sia *et al.*, 2020).

**Feeding guilds.** Based on research conducted, 12 species of insectivore birds are more common in Ake Jawi Village (Fig. 2). As for the types of insect-eating birds found, namely: Glossy Swiftlet, Rufous-bellied Triller, Goliath Coucal, Australian Brush Cuckoo, White-streaked Honeyeater, Blue-tailed Bee-eater, Moluccan Spectacled Monarch, North Moluccan Pitta, Ivory-breasted Pitta, Halmahera Golden Bulbul, Willie Fantail, and Moluccanscops Owl. One of the commodities in the buffer zone is coconut trees. The presence of coconut trees attracts many insects to the nectar and flower buds of young coconuts (Apriyanto *et al.*, 2021; Hayata *et al.*, 2022; Tabba and Nurrani, 2016).



**Fig. 2.** Graphs of feeding guilds in Ake Jawi Village, Aketajawe Lolobata National Park

Apart from eating insects, there are 11 species of frugivore birds (Fig. 2). The types of fruit-eating birds encountered were: Blyth's Hornbill, Umbrella Cockatoo, Grey-headed Fruit Dove, Sultan's Cuckoo Dove, Halmahera Flowerpecker, Dusky Scrubfowl, Halmahera Paradise-crow, Wallace's Standardwing, Red-cheeked Parrot, and Eclectus Parrot. It is because many trees support bird feed, one of which is *Ficus benjamina*, infested by the Blyth's Hornbill (Tabba and Nurrani, 2016). These fruit-eating birds play a role in the seed dispersal process, making this role very important in the forest regeneration process (Firdayanti *et al.*, 2019; Putra and Nurlaily, 2021). The difference in the number of types found, one of the factors is due to the available feed sources. In the research site, there are indeed more large trees, some of which are fruit trees, while reeds and similar plants are rarely found in the region. Therefore, there are more species of insectivore and frugivore, compared to granivore.

## CONCLUSION

The results of this study found as many as 31 species of birds from 23 families and 31 genus, 15 of them are endemics to Indonesia, and 12 species are endemics to North Maluku. Ake Jawi Village, Aketajawe Lolobata National Park is included in the moderate diversity category with a diversity index value of 2.889; while the dominance is low with a value of 0.098; and the type of feed that dominates is the type of bird that eats insects (insectivore).

## ACKNOWLEDGEMENTS

Acknowledgments to Muhammad Bagus Satrio as a supporter of writing funds; Dr. Tatang Mitra Setia, M. Si. as dean and supervisor of BBC "Ardea" Faculty of Biology and Agriculture, Universitas Nasional; Halmahera Wildlife Photography as the organizer of HBR# 1; Mr. Heri as Head of Aketajawe Lolobata National Park; Mas David as the head of HBR#1 and who helped with the trip; Mas Adriel as the forest police at TNAL; Mr. Mahroji as the field guide; friends of the BBC "Ardea",

and all parties who have provided assistance and support during the activities and preparation of this scientific journal.

## REFERENCES

- Aisyah P. 2022. Hasil translokasi, burung kakatua hingga nuri akhirnya tiba di Maluku. <https://gardaanimalia.com/>.
- Apriyanto M, Riono Y, Marlina M, et al. 2021. Pengenalan hama dominan pada kelapa sawit pada kebun kebun masyarakat di Kecamatan Kuantan Hilir seberang Kabupaten Kuantan Singingi. *Jurnal Agro Dedikasi Masyarakat (JADM)*. vol. 2(2): 19-24. doi: <https://doi.org/10.31764/jadm.v2i2.5996>.
- AR Junaid, Jihad, Hasudungan F. 2021. Burung-burung di Indonesia: daftar dan status 2021. *Burung Indonesia*. <https://www.burung.org/2021/12/28/burung-burung-di-indonesia-daftardan-status-2021/>.
- Atlas Burung Indonesia. 2020. Atlas Burung Indonesia: wujud karya peneliti amatir dalam memetakan burung nusantara. Batu: Yayasan Atlas Burung Indonesia.
- Bashari H. 2012. Survei avifauna di dalam Kawasan Taman Nasional Aketajawe Lolobata, Halmahera, Maluku Utara. BirdLife International. 2004. Important bird areas in Asia: key sites for conservation. Cambridge, UK: BirdLife International.
- Burung Indonesia. 2020. Apa kabar burung-burung di Wallacea? <https://www.burung.org/>.
- Burung Indonesia. 2021. Burung-burung di Indonesia: daftar dan status 2021. Bogor: Burung Indonesia. <https://www.burung.org/informasi-burung/daftar-spesies-burung-di-indonesia/>.
- Cholifatullah F, Ramadani A, Nurhasanah AH, et al. 2020. Utilization of tree canopies by avifauna in two types of habitat in Telaga Warna Nature Tourism Park, Bogor, West Java. *Indonesian Journal of Biotechnology and Biodiversity*. vol. 4(2): 62-70. doi: <https://doi.org/10.47007/ijobb.v4i2.60>.
- Daget J. 1976. Les modeles mathematiques en ecologie. Masson, Paris: Collection d'ecologie 8.
- Darmawan MP. 2006. Keanekaragaman jenis burung pada beberapa tipe habitat di Hutan Lindung Gunung Lumut Kalimantan Timur. (Tesis). Bogor: Institut Pertanian Bogor.
- Djuharsa E. 2017. Pariwisata alam: 54 taman nasional Indonesia : jelajah keindahan panorama dan keunikan fenomena alam Indonesia: Direktorat Jenderal Konservasi Sumber Daya Alam Ekosistem, Kementerian Lingkungan Hidup dan Kehutanan.
- Eaton J, van Balen B, Brickle N. 2021. Birds of the Indonesian archipelago Greater Sundas and Wallacea. Barcelona: Lynx Edicions.
- Eka A. 2022. Niat dibawa keluar Papua, burung nuri dan puluhan satwa berhasil disita. <https://gardaanimalia.com/>.
- Ekowati A, Setiyani AD, Haribowo DR, et al. 2016. Keanekaragaman jenis burung di Kawasan Telaga Warna, Desa Tugu Utara, Cisarua, Bogor. *Al-Kauniyah: Jurnal Biologi*. vol. 9(2): 87-94. doi: <https://doi.org/10.15408/kauniyah.v9i2.3355>.
- Fachrul MF. 2012. Metode sampling bioekologi. Jakarta: Bumi Aksara.
- Firdausy MS, Wintari IAGL, Hernowo JB, et al. Year. Community of psittacidae family in Aketajawe Lolobata National Park North Maluku. Paper presented at the Joint Symposium on Tropical Studies (JSTS-19). doi: <https://doi.org/10.2991/absr.k.210408.039>.
- Firdayanti A, Amirullah A, Muhsin M. 2019. Perilaku makan burung julang sulawesi (*Aceros cassidix*) di Kawasan Hutan Maligano Suaka Marga Satwa Buton Utara Sulawesi Tenggara. *BioWallacea: Jurnal Penelitian Biologi (Journal of Biological Research)*. vol. 6(2): 976. doi: <http://dx.doi.org/10.33772/biowallacea.v6i2.8823>.
- Hamdani A, Ahmad Z, Roini C. 2022. Pengetahuan dan sikap masyarakat terhadap konservasi burung paruh bengkok di Kecamatan Kepulauan Joronga. *JURNAL BIOEDUKASI*. vol. 5(1): 64-72. doi: <http://dx.doi.org/10.33387/bioedu.v5i1.4403>.
- Harmoko H, Sepriyaningsih S. Year. Potensi wisata pengamatan burung (birdwatching) di Danau Aur Kabupaten Musi Rawas Provinsi Sumatera Selatan. Paper presented at the Prosiding Seminar Nasional Hayati. doi: <https://doi.org/10.29407/hayati.v7i1.598>.
- Hayata H, Nasamsir N, Saputro PH. 2022. Populasi dan keanekaragaman serangga penyerbuk di kebun kelapa sawit Desa Rantau Kapas Bukit Paku Kabupaten Batanghari. *Jurnal Media Pertanian*. vol. 7(2): 132-138. doi: <http://dx.doi.org/10.33087/jagro.v7i2.161>.
- Heyer W, Donnelly M, McDiarmid R. 1994. Measuring and monitoring biological diversity: standard methods for amphibians. Washington: Smithsonian Institution Press.
- Huston MA, Huston MA. 1994. Biological diversity: the coexistence of species: Cambridge University Press.
- Hutami AT, Utami AT, Ramadhyanti D, et al. 2022. Keanekaragaman jenis burung di Taman Kota Spatodea dan Tabebuya, Jakarta Selatan. doi: [https://doi.org/10.21009/Bioma18\(1\).5](https://doi.org/10.21009/Bioma18(1).5).
- Iskandar J. 2014. Dilema antara hobi dan bisnis perdagangan burung serta konservasi burung. *Chimica et Natura Acta*. vol. 2(3). doi: <https://doi.org/10.24198/cna.v2.n3.9165>.
- Krebs CJ. 1978. Ecology; the experimental analysis of distribution and abundance.
- Mackinnon J, Phillips K, van Balen B. 2010. Burung-burung di Sumatera, Jawa, Bali, dan Kalimantan. Bogor: Puslitbang Biologi - LIPI/ BirdLife Indonesia.

- McCullough JM, Oliveros CH, Benz BW, et al. 2022. Wallacean and Melanesian islands promote higher rates of diversification within the global passerine radiation corvids. *Systematic Biology*. vol. 71(6): 1423-1439.
- Murniati S, Amelia RN. 2021. Persepsi masyarakat Desa Ake Jawi terhadap keberadaan Taman Nasional Aketajawe Lolobata (TNAL) Kabupaten Halmahera Timur. *JPG (Jurnal Penelitian Geografi)*. vol. 9(2): 115-123. doi: <http://dx.doi.org/10.23960/jpg>.
- Nurmaeti C, Abidin Z, Prianto A. 2018. Keanekaragaman burung pada zona penyangga taman nasional gunung ciremai. *Quagga: Jurnal Pendidikan dan Biologi*. vol. 10(2): 54-59. doi: <https://doi.org/10.25134/quagga.v10i2.1297>.
- Nurrani L, Bismark M, Tabba S. 2014. Tipologi penggunaan lahan oleh masyarakat pada zona penyangga Taman Nasional Aketajawe Lolobata di Kabupaten Halmahera Timur. *None*. vol. 11(3): 29121. doi: <https://dx.doi.org/10.20886/jpsek.2014.11.3.13>.
- Nurrani L, Tabba S. 2013. Persepsi dan tingkat ketergantungan masyarakat terhadap sumberdaya alam Taman Nasional Aketajawe Lolobata di Provinsi Maluku Utara. *Jurnal Penelitian Sosial dan Ekonomi Kehutanan*. vol. 10(1): 61-73. doi: <https://dx.doi.org/10.20886/jpsek.2013.10.1.61-73>.
- Palupi MR, Basuki B. Year. Penentuan frekuensi dan tingkat tekanan bunyi efektif untuk mengusir burung di Kawasan Bandara Ahmad Yani Semarang. Paper presented at the Pertemuan dan Presentasi Ilmiah Standardisasi. doi: <https://dx.doi.org/10.31153/ppis.2019.38>.
- Pangau MZ, Sufaati S. 2012. Keragaman burung pemakan buah (avian frugivora) di hutan dataran rendah Jayapura, Papua. *Jurnal Biologi Papua Vol 4 (1): 1*. vol. 7. doi: <https://doi.org/10.31957/jbp.529>.
- Peraturan Menteri Kehutanan. 2006. Pedoman zonasi taman nasional. Permenhut No. P.56/MenhutII/2006.
- Peraturan Menteri Lingkungan Hidup dan Kehutanan Peraturan Menteri. 2015. Kriteria zona pengelolaan taman nasional dan blok pengelolaan cagar alam, suaka margasatwa, taman hutan raya, dan taman wisata alam. Permen LHK No. P.76/Menlhk-Setjen/2015.
- Pertiwi HJ, Alkatiri AB, Lestari H, et al. 2021. Keanekaragaman jenis burung di Cagar Alam Pulau Dua, Banten. *BIOSEL (Biology Science and Education): Jurnal Penelitian Science dan Pendidikan*. vol. 10(1): 55-70. doi: <http://dx.doi.org/10.33477/bs.v10i1.1641>.
- Putra A. 2019. Ake Jawi menjadi desa ramah burung pertama di Maluku Utara. <http://ksdae.menlhk.go.id/>.
- Putra ADK, Sjfani N, Hadun R, et al. 2022. Keragaman jenis avifauna dan potensi pengembangannya untuk ekowisata birdwatching di Resort Ake Jawi, Taman Nasional Aketajawe Lolobata. *Jurnal Penelitian Hutan dan Konservasi Alam*. vol. 19(2): 231-248. doi: <https://doi.org/10.20886/jphka.2022.19.2.231-248>.
- Putra ILI, Nurlaily NA-Z. 2021. Asosiasi jenis-jenis burung di Kemantren Kraton, Ngampilan, dan Gondomanan, Kota Yogyakarta. *Biotropika: Journal of Tropical Biology*. vol. 9(2): 105-114. doi: <https://doi.org/10.21776/ub.biotropika.2021.009.02.02>.
- Putri I. Year. Pengaruh kekayaan jenis tumbuhan sumber pakan terhadap keanekaragaman burung herbivora di Taman Nasional Bantimurung Bulusaraung, Sulawesi Selatan. Paper presented at the Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia. doi: <https://doi.org/10.13057/psnmbi/m010338>.
- Rahmad R. 2020. Wallacea adalah sepenggal surga di bumi. <https://www.mongabay.co.id/>.
- Rhama B. 2019. Taman nasional dan ekowisata (Vol. 1): Bhayu Rhama.
- Riefani MK, Soendjoto MA, Munir AM. 2019. Bird species in the cement factory complex of Tarjun, South Kalimantan, Indonesia. *Biodiversitas*. vol. 20(1): 218-225. doi: <http://dx.doi.org/10.13057/biodiv/d200125>.
- Rosyadi I, Tetuka B, Embeua E, et al. 2015. Perilaku memelihara burung paruh bengkok di maluku utara. *Acta VETERINARIA Indonesiana*. vol. 3(2): 51-57. doi: <https://doi.org/10.29244/avi.3.2.51-57>.
- Runtu J, Pollo HN, Nurmawan W. 2023. Inventarisasi Jenis Dan Sebaran Pohon Pakan Julang Sulawesi (*Aceros cassidix*) di Taman Hutan Raya Gunung Tumpa HV Worang, Sulawesi Utara. *Silvarum*. vol. 2(1): 20-24. doi: <https://doi.org/10.35791/sil.v2i1>.
- Saputra A, Hidayati NA, Mardiasuti A. 2020. Keanekaragaman burung pemakan buah di hutan kampus Universitas Bangka Belitung. *EKOTONIA: Jurnal Penelitian Biologi, Botani, Zoologi dan Mikrobiologi*. vol. 5(1): 1-8. doi: <https://doi.org/10.33019/ekotonia.v5i1.1943>.
- Saputri AI, Iswandar D, Wulandari C, et al. 2022. Studi korelasi keanekaragaman burung dan pohon pada lahan agroforestri Blok Pemanfaatan KPHL Batutege. *Jurnal Belantara*. vol. 5(2): 232-245. doi: <https://doi.org/10.29303/jbl.v5i1.854>.
- Sawitri R, Mukhtar AS, Iskandar S. 2010. Status konservasi mamalia dan burung di Taman Nasional Merbabu. *Jurnal Penelitian Hutan dan Konservasi Alam*. vol. 7(3): 227-239.
- Sia MY, Pattinasarany CK, Tuhumury A. 2020. Habitat dan perilaku burung julang irian (*Rhyticeros plicatus*) di Resort Masihulan Seksi Wilayah I Taman Nasional Manusela. *Jurnal Hutan Tropis*. vol. 8(2): 139-152. doi: <http://dx.doi.org/10.20527/jht.v8i2.9045>.
- Tabba S, Nurrani L. 2016. Distribution of avifauna in Aketajawe Lolobata National Park based on zone and land cover typology. *Jurnal Wasian*. vol. 3(1): 25-38. doi: <https://doi.org/10.20886/jwas.v3i1.891>.
- Tamalene MN, Hasan S, Kartika K. 2019. Local knowledge and community behavior in the exploitation of parrots in surrounding area of aketajawe lolobata national park. *Biosfer: Jurnal Pendidikan Biologi*. vol. 12(1): 24-33. doi: <https://doi.org/10.21009/biosferjpb.v12n1.24-33>.



- Von Rintelen K, Arida E, Häuser C. 2017. A review of biodiversity-related issues and challenges in megadiverse Indonesia and other Southeast Asian countries. *Research Ideas and Outcomes*. vol. 3: e20860.
- Warsito H, Bismark M. 2010. Penyebaran dan populasi burung paruh bengkok pada beberapa tipe habitat di Papua. *Jurnal Penelitian Hutan dan Konservasi Alam*. vol. 7(1): 93-102. doi: <https://doi.org/10.20886/jphka.2010.7.1.93-102>.
- Xie J, Xie B, Zhou K, et al. 2023. Evolution of bird habitat quality driving mechanisms and ecological network weights. *Global Ecology and Conservation*. e02618.