

Bird diversity in Aketajawe Lolobata National Park

Andy Kurniawan¹, Nurdiana Abbas², Aqshan Shadikin Nurdin¹, Firlawanti Lestari Baguna¹, Fadila Tamnge^{1*}

¹Forestry Department, Faculty of Agriculture, Khairun University. Jl. Jusuf Abdulrahman Gambesi

²Student of Forestry Department, Faculty of Agriculture, Khairun University

Article Info	Abstract
<p>Article History: Received 7 March 2023; Accepted 23 October 2023; Published online 28 November 2023</p> <p>Keywords: Aketajawe Lolobata, Bird, Diversity, National Park</p>	<p><i>Research on richness and bird species diversity are important for conservation efforts in National Park. Currently, the Aketajawe Lolobata National Park (ALNP) is a habitat patch among industrial areas on Halmahera Island, so that it is important to carry out periodic bird inventories in the national park. Therefore, the need to study the current bird diversity and the status of bird species as a basis for future monitoring and implementation of appropriate conservation measures are important. Bird diversity research needs to be carried out because. Observation plots are placed at primary and secondary forest in Akejawi resort. The research was conducted on January to February 2022. Total observation point is 20 plots. The method was used by point count. The distance between the observation plot is 200 m and the radius of observation is 50 m. The observation were made in the morning (06.00-09.00 am). Repetition of observation on each habitat was carried out 10 times. Data were analyzed by using Shannon-Wiener Index Diversity. Based on findings, There were 345 individuals of 39 species from 19 families inhabited Akejawi Resort. Secondary forest had the highest diversity index when compared to primary forest. This study revealed that there were 9 birds originated from North Maluku and there were 15 species categorized as protected species. The latest data can provide opportunities for further research to reveal patterns of bird distribution and various protection measures due to the loss of forest areas around national parks.</i></p>

<http://dx.doi.org/10.24259/jpkwallacea.v12i12.25891>

* Corresponding author.

✉ E-mail address fadilatamnge@gmail.com (F. Tamnge)

INTRODUCTION

Birds are the only animals that are easily found in almost every habitat and their habitat cover various types of natural ecosystem to artificial ones with a wide distribution (Hadinoto et al., 2012). Birds are useful as seed dispersers, as pest controllers, and assist in pollination as well as environmental bioindicators (Clout & Hay, 1989; Dahiya et al., 2022). Alikodra (2002) and Ekarelawan (1990) add that birds have really important in terms of education, research, and for leisure and tourism interests. Birds need to be preserved because they have great benefits for human life, including controlling pest attacks, helping the pollination process, is a source of germplasm, having sounds that can create a pleasant atmosphere, as attraction recreation, having economic value, and as an object for education and research (Ontario et al., 1991).

One of the important conservation areas in the Wallacea region is Aketajawe Lolobata National Park. The Aketajawe, Lolobata, and the forest in them proposed to become National Park in 1995. Then in 1999 around 7,264,707 ha of forest in Maluku were designated as forest area with several categories. In 2004, based on the Decree of the Minister of Forestry Number 397/Menhut-II/2004 on protected forest area, permanent production forest and limited production forest, had changed the status to Aketajawe Lolobata National Parks (ALNP) with an area 167.300 Ha. This national park has a distinctive landscape and has varied habitats such as mangrove ecosystem, coastal forest, lowland swamp forest, river bank ecosystem, secondary and primary forest, mountain rain forest, grassland, and sub-alpin grass. The varied habitat makes this national park a potential habitat for birds (aketajawelolobata.org., 2023).

Various studies have been carried out to reveal the richness of fauna, especially birds

inhabited ALNP. The known potential fauna were 28 species of mammals, 211 species of birds, 38 species of reptiles, three species of dragonflies, 20 species of molluscas, and two species of grasshoppers (aketajawelolobata.org, 2023). However, in depth study still required to cover species in different types of habitat. Another reason is that the ALNP is considered the last bastion for the protection of biodiversity in North Maluku. The location of ALNP which is surrounded by nickel and gold mining companies is very important to neutralize pollutant gases released by industry and providing opportunities for the preservation of biodiversity, especially birds. The study aimed to examine bird species diversity in ALNP which will be used as a basis conservation management plan of bird species and the area protection.

METHODS

Study Sites and Plot

The study was conducted in secondary and primary forest of Resort of Akejawi. Akejawi Resort is located in Akejawi Village, South Wasilei District, East Halmahera Regency. Akejawi Resort area is the area with the largest

karst landscapes and has the most distribution of caves in North Maluku. Observation plots were placed in primary and secondary forest. Primary forest is located at an altitude of 51-143 masl, while secondary forest at an altitude of 36-191 masl. (Figure 1).

Data Collection and Analysis

The research was conducted in two types of habitat, namely primary and secondary forest in Akejawi Resort. The research was conducted from January to February 2023. Research on each habitat was carried out for 10 days of observation so that the total observation of birds in the field was 20 days. Repetition of observations in each habitat was carried out 10 times. Collecting data is only done in the morning (when the birds are actively looking for food). When conducting the pre-survey, the chances of encountering birds were dominant only in the morning, so it was decided that the bird data collection would only be carried out in the morning. Observations were not made on rainy days.

Bird identification was done by using point count (Bibby et al., 2000) (Figure 2). Observation

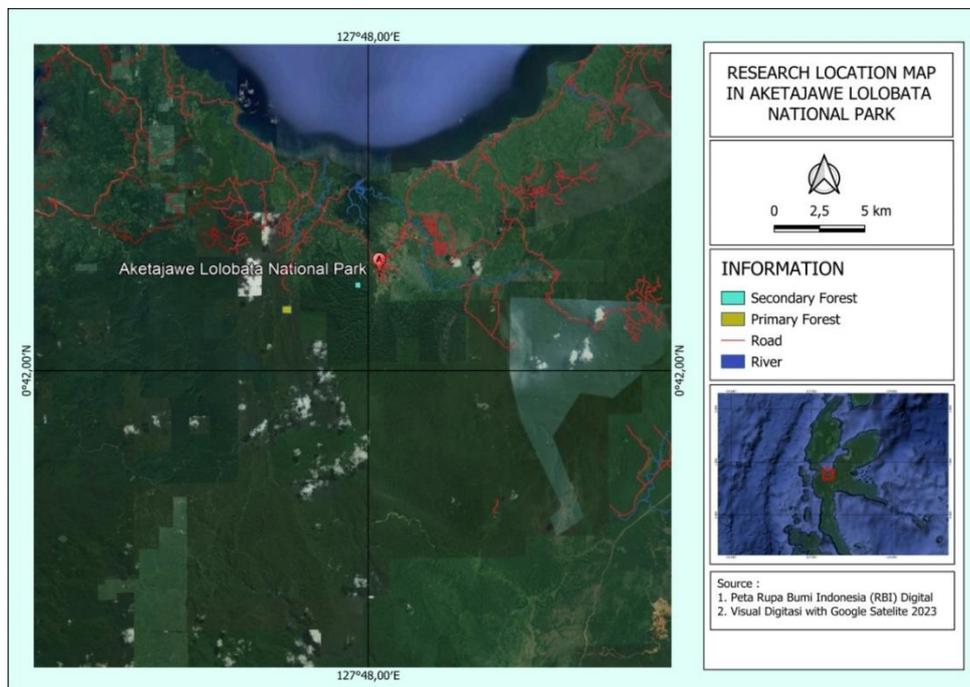


Figure 1. Mapping of habitat types in Resort Akejawi of Aketajawe Lolobata National Park, (1) Primary, (2) Secondary

plots in each habitat are 10 with a distance between plot of 200 m and observation radius of 50 m. observation at each plot was carried out for 10 minutes. Research activities were made in the morning (06.00-09.00 am). The decision to

observe was only made in the morning because the chance of encountering birds in the afternoon was almost non-existent. Recording was carried out on the species of bird and the number of individuals. Species diversity, richness, and

evenness were calculated using the Shannon Index of Diversity (Magurran, 2004).

$$H' = -\sum Pi \ln Pi \quad (1)$$

Remarks:

- H' = Species diversity index
- Pi = Significant value proportion
- ln = natural logarithm

To determine the amount of species richness, the Margalef Index is used (Ludwig & Reynold, 1988).

$$R_1 = \frac{(S-1)}{\ln(N)} \quad (2)$$

Remarks:

- R1 = species richness index
- S = number of species
- N = total number of individual

To determine the proportion of individual birds, the evenness index is used (Magurran, 2004).

$$E = \frac{H'}{\ln(S)} \quad (3)$$

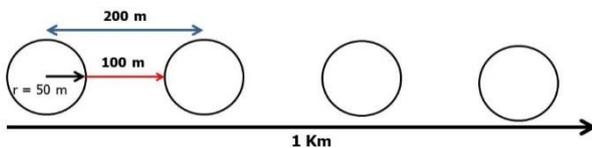


Figure 2. Illustration of plot placement

RESULTS

Richness, Diversity, and Evenness Index

Number of birds found in two types of habitat; primary and secondary forest in Akejawi Resort namely 345 individuals of 39 species and 19 families. Each habitat has a different composition of birds. The secondary forest had the highest number of bird species, namely 179 individuals from 36 species and 18 families, while the primary forest identified 166 individuals from 30 species and 18 families (Table 1).

The analysis results have shown a diversity index (H') in both habitats is 3.22 with evenness index (E) of 0.89 and richness index (R) of 5.99. Each habitat has a different index of richness, diversity and evenness. The research results show that the highest bird communities value is in secondary habitat (Table 2).

Conservation Status of Bird

The identification results show that there are 18 species from 10 families that are protected based on minister of Environment and Forestry Regulation No. P. 106/MENLHK/SETJEN/KUM.1/12/2018 of 2018 concerning protected plant and animal species. These 18 species are also on the IUCN (International Union for Conservation of Nature). The IUCN red list aims to provide information and analysis regarding the status, trends and threats to species to inform and accelerate action in biodiversity conservation efforts. Meanwhile, of the 18 species previously mentioned, there are five species of four families recorded in CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora). CITES is an international agreement between governments. Its aim to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species (Table 3).

DISCUSSION

Bird Communities

There are a couple of birds that are only found in the primary forest but not found in the secondary forest such as *Tanyiptera galatea* and *Corvus validus*. According to Coates and Bishop (2000), both of these species are quite common (it can be found anywhere and its distribution is common locally), inhabiting primary forests and selectively logged forests. Meanwhile, there are seven species of birds that are only found in the secondary forest but not found in the primary forest namely *Todiramphus diops*, *Coracina atriceps*, *Caloenas nicobarica*, *Myiagra galeata*, *Tanygnathus megalorynchos*, *Hypsipetes chloris* and *Aplonis metallica*. These species are quite common locally, inhabiting secondary forests, forest edges, montane forests, and cultivated lands (Coates and Bishop 2000).

The results of this study are inversely proportional to the research by (Dewi et al., 2007) conducted in Gunung Ciremai National Park, which found more birds in the primary forest namely 62 species. Meanwhile, other research that is in line with this research indicated that other habitats decreased bird numbers while secondary habitats increase the richness of bird species (Rohman et al., 2023; Tu et al., 2020). This can occur due to differences in the diversity of vegetation types in secondary and primary forests, the number of days, and observation plots. Habitat that have various types of vegetation will provide more types of

feed so that the choice of feed for birds will be more varied. Furthermore, the number of days and more observation plots will allow higher encounters with new species (Nainggolan et al., 2019; Tamnge et al., 2013). This is expected if observations are carried out with a longer

observation time and a wider area coverage, then the chances of encountering birds will be greater.

The results showed that the highest bird diversity index was found in secondary forests. This habitat in Akejawi Resort has a density level

Table 1. The composition of birds found in the primary and secondary forest

No	Family	Scientific Name	Habitat	
			Primary	Secondary
1		<i>Todiramphus diops</i>	0	2
2	Alcedinidae	<i>Ceyx lepidus</i>	4	3
3		<i>Tanysepta galatea</i>	1	0
4	Bucerotidae	<i>Rhyticeros plicatus</i>	27	16
5	Cacatuidae	<i>Cacatua alba</i>	13	15
6		<i>Lalage aurea</i>	2	3
7	Campephagidae	<i>Lalage parvula</i>	2	1
8		<i>Coracina atriceps</i>	0	1
9		<i>Caloenas nicobarica</i>	0	1
10		<i>Ducula basilica</i>	6	2
11	Columbidae	<i>Ducula perspicillata</i>	1	2
12		<i>Macropygia dorea</i>	1	1
14		<i>Ptilinopus hyogastrus</i>	0	1
15	Corvidae	<i>Corvus validus</i>	5	0
16	Cuculidae	<i>Centropus goliath</i>	1	3
17		<i>Surniculus lugubris</i>	1	2
18	Dicruridae	<i>Dicrurus atrocaeruleus</i>	12	3
19	Megapodiidae	<i>Megapodius freycinet</i>	10	11
20	Meliphagidae	<i>Melitograis gilolensis</i>	2	2
21		<i>Oriolus phaeochromus</i>	3	1
22		<i>Symposiachrus trivirgatus</i>	1	4
23	Monarchidae	<i>Myiagra alecto</i>	7	5
24		<i>Myiagra galeata</i>	0	4
25	Nectarinidae	<i>Leptocoma sericea</i>	4	11
26	Pachycephalidae	<i>Pachycephala macrorhyncha</i>	2	2
27	Paradisaeidae	<i>Semioptera wallacii</i>	12	2
28		<i>Lycocorax pyrrhopterus</i>	4	1
29	Pittidae	<i>Pitta maxima</i>	5	2
30		<i>Erythropitta rufiventris</i>	1	2
31		<i>Tanygnathus megalorynchos</i>	0	3
32		<i>Lorius garrulus garrulus</i>	2	10
33	Psittacidae	<i>Eclectus roratus</i>	11	12
34		<i>Eos squamata</i>	11	2
35		<i>Geoffroyus geoffroyi</i>	7	5
36		<i>Charmosyna placentis</i>	7	9
37	Pycnonotidae	<i>Hypsipetes chloris</i>	0	23
38	Sturnidae	<i>Aplonis metallica</i>	0	8
39	Zosteropidae	<i>Zosterops fuscifrons</i>	1	4
Total			166	179

Table 2. Bird diversity, richness, and evenness index in each habitat

Habitat	H'	E	R
Both	3.22	0.89	5.99
Primary forest	2.97	0.88	5.48
Secondary forest	3.15	0.88	6.55

Table 3. List of protected and endangered bird species

No	Famili	Nama Ilmiah	P.106 /2018	CITES	IUCN
1	Accipitridae	<i>Haliastur indus</i>	√	Ap.II	LC
2		<i>Tachyspiza henicogramma</i>	√	Ap.II	NT
3	Bucerotidae	<i>Rhyticeros plicatus</i>	√	Ap.II	LC
4	Cacatuidae	<i>Cacatua alba</i>	√	AP.II	EN
5	Columbidae	<i>Caloenas nicobarica</i>	√	Ap.I	NT
6	Corvidae	<i>Corvus validus</i>	√	-	NT
7	Megapodiidae	<i>Megapodius freycinet</i>	√	-	LC
8		<i>Semioptera wallacii</i>	√	-	LC
9	Paradisaeidae	<i>Lycocorax pyrrhopterus</i>	√	-	LC
10		<i>Pitta maxima</i>	√	-	LC
11	Pittidae	<i>Erythropitta rufiventris</i>	√	-	LC
12		<i>Tanygnathus megalorynchos</i>	√	-	LC
13		<i>Lorius garrulus garrulus</i>	√	-	VU
14	Psittacidae	<i>Eclectus roratus vosmaeri</i>	√	-	LC
15		<i>Eos squamata</i>	√	-	LC
16		<i>Geoffroyus geoffroyi</i>	√	-	LC
17		<i>Chamosyna placentis</i>	√	-	LC
18	Rallidae	<i>Habroptila wallacii</i>	√	-	VU

Ap. II = Appendix II (a list of species that are not threatened with extinction, but are potentially threatened with extinction if traded without regulation); LC = least concern; NT = near threatened; EN = endangered; VU =vulnerable

and tree species composition that is classified as dense to open canopy cover. Secondary forest is a forest that develops and grows naturally after changes or damage to the first forest. This research succeeded in revealing the fact that secondary forest which is considered to have a low level of diversity is proven not always correct. Bird diversity is not only influenced by vegetation composition, other factors that can influence are environmental factors such as weather, other livings things, pathogens, food factors, time of the year, spatial heterogeneity, competition, predation, environmental stability, and productivity (Krebs, 1978; Warmetan et al., 2015; Shah & Sharma, 2022).

Secondary forests with open canopies tend to allow the presence of bird species that are tolerant of this habitat. Some experts say that habitats that tend to be open have a positive impact on species density and increase in numbers (Mardiastuti, 2015). Several groups of birds can live sustainably until now because they have succeeded in creating a special niche for themselves to reduce competition for resource

needs and as a form of adaptation to environmental conditions (Mufti et al., 2011).

Bird Conservation

Birds are important species that play a role in maintaining ecosystem stability (Prasetyo & Wulandari, 2021). As one of the animals that are easy to see and enjoy the sound, many species of birds are in demand and sought after by humans to be caught from nature and maintained. These activities greatly affect the condition of the decline in the number of species and population in the forest. There are 18 out of 39 species are recorded as having their conservation status regulated according to animal and plant protection regulations, CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), and the IUCN Red List (Table 2).

Regulation in Indonesia that protect animals and plants is P. 108.MENLHK/SETJEN/KUM.1/12/2018. In this government regulation, there are 556 bird

species are recorded as protected. Meanwhile, international agreements or agreements that regulate wildlife trade, namely CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) (Soehartono & Mardiasuti, 2003; Cites.org, 2023). Its aim is to ensure that international trade in specimen of wild animals and plants does not threaten the survival of species. In CITES, there are 3 categories of Appendix (App.). App. I is all species that are prohibited in all forms of international trade. App. II is a list of species that are not threatened with extinction but may be threatened if trades continues without regulation and App. III is a list of protected species in certain countries along with the boundaries of their habitat areas, and one day the ranking may be raised to App. I or II.

Besides that, there is the IUCN red list which is a critical indicator of the health of the world's biodiversity. The red list is a list of species that are considered to be in danger of extinction (<https://www.iucnredlist.org/> 2022). The current IUCN red list criteria categories include extinct (ex), extinct in the wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU), and near threatened (NT). Least concern (LC), data deficient (DD), and not evaluated (NE).

It is recorded that bird species from the Psittacidae family are the most protected bird. This is because these species are the most widely traded and kept as pets, such as *L. garrulous*, *C. placentis*, *E. roratus*, *G. geoffroyi*, *E. squamata*, and *T. megalorynchos*. Meanwhile, species recorded as endemic to North Maluku are *S. wallacii*, *C. alba*, *L. pyrrhopterus*, and all species from the Psittacidae family. According to Tamnge (2013), endemic fauna is quite sensitive to change in habitat because they have narrow life range and limited resource support.

Birds conservation are not the only ones is the responsibility bird experts, conservation activists or the government, however all levels of society including communities around the Aketajawe Lolobata National Park (ALNP). There are several activities that can be implemented for bird conservation management in ALNP such as (1) maintaining habitat for various types of birds, (2) regular monitoring of the presence of bird, and (3) the existence of regulations that regulate and are agreed upon by the head of the national park, village head, communities, and other related parties regarding hunting of protected birds around national parks.

CONCLUSION

The secondary habitat has the highest number of species, richness and diversity

compared to the primary habitat. There are 18 out of 39 species found protected according to laws and government regulation, IUCN red list and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

ACKNOWLEDGMENT

We would like to thank Head of the Aketajawe Lolobata National Park for permit and support, Mr. Heri Wibowo and his staffs in the research sites. We also thank to our volunteers for their help in data collection and data analysis, especially Mas Roji, Nurul Aulia Abbas S.Hut, Fardiana R. Saleh S.Hut, Edriansyah Tjan S.Hut, Widyawati Yusuf S.Hut, Safri Hasan, Abdul Kadir Mariba, Adim Syarif S.Hut, Zulkarnain Riswan Umanahu, S.P., M.Si and Sabaruddin, S.Hut., M.Si.

AUTHOR CONTRIBUTIONS

AK: research conceptualization, research coordinator; NA: member contributor, research implementer; ASN: interpretation, map making; FLB: member contributor, manuscript writing, proofreading; FT: data analysis, data interpretation, manuscript writing.

CONFLICTS OF INTEREST

The authors declare there is no conflict of interest related to financial funding and authorship order for this article.

REFERENCES

- Aketajawelolobata.org. (2023). Profil Taman Nasional Aketajawe Lolobata. Retrieved from <https://aketajawelolobata.org/profil/>. 29 May 2023.
- Alikodra, H. (2002). *Pengelolaan Satwa Liar*. Fakultas Kehutanan IPB Bogor Pr, Bogor, Indonesia.
- Bibby, C., Jones, M., Marsden S. (2000). *Expedition Field Techniques Birds Surveys*. Expedition Advisor Centre, London.
- CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). (2023). CITES-listed species. <https://cites.org/eng>. 29 May 2023.
- Coates, B.J., Bishop, K.D. (2000). *Panduan Lapangan Burung-Burung di Kawasan Wallacea: Sulawesi, Maluku, dan Nusa Tenggara*. BirdLife International-Indonesia Programme, Jakarta, Indonesia.
- Clout, M., Hay, R. (1989). The importance of birds as browsers, pollinators and seed

- dispersers in the New Zealand forests. *New Zealand Journal of Ecology*, (12), 27-33.
- Dahiya, P., Singh, D., Delu, V., Yodha, K., Dahiya, T., Kour, A., & Punia, N. (2022). Role of birds in agroecosystem: A review on agricultural and economic ornithology. *The Pharma Innovation Journal*, 11 (7), 2300-2314. www.thepharmajournal.com.
- Dewi, Y., Mulyani, R.S., Santosa, Y. (2007). Keanekaragaman jenis burung di beberapa tipe habitat Taman Nasional Gunung Ciremai (skripsi). IPB University. Bogor.
- Ekarelawan, O.J.J.H.H. (1990). Pola pembinaan habitat burung di kawasan pemukiman terutama di perkotaan. *Media Konservasi*, 3 (1), 1-7.
- Hadinoto., Mulyadi, A., Siregar, A.I. (2012). Kenakeragaman jenis burung di Hutan Kota Pekanbaru. *J. Ilmu Lingkungan*, 6 (1), 25-42. <http://dx.doi.org/10.31258/jil.6.1.p.25-42>.
- IUCN Red List. (2022). The IUCN red list of threatened species. Retrieved from <https://www.iucnredlist.org/>. 29 May 2023.
- Krebs, C.J. (1978). *Ecology: The Experimental Analysis of Distribution and Abundance*. Harper and Row Publishers, New York, USA.
- Ludwig, J.A., & Reynolds, J.F. (1988). *Statistical Ecology: A Primer Methods and Computing*. John Wiley & Sons, New York, USA. p.200.
- Magurran, A.E. (2004). *Ecological Diversity and Its Measurement*. Princenton University Pr, New Jersey, UK.
- Mardiastuti, A. (2015). *Ekologi Satwa Pada Lanskap Yang Didominasi Manusia*. Fakultas Kehutanan IPB Bogor Pr, Bogor, Indonesia.
- Mufti, F., Diniarsih, S., Untung, M., Setyono, J., Amna, M., & Setyobudi, N. (2011). Diversity of birds in Tepus Village of Gunung Kidul District of Yogyakarta. *Proceeding ICBB (The International Conference on Bioscience and Technology)* 1 (1), 102011. Retrieved from <https://sunankalijaga.org/prosiding/index.php/icbb/article/view/174>.
- Nainggolan, F., Dewi, B., & Darmawan, A. (2019). Status konservasi burung: studi kasus di Hutan Cugung Kesatuan KPH lindung model Rajabasa Kecamatan Rajabasa Kabupaten Lampung Selatan. *J.Sylva Lestari*, 7 (2), 52-61. <http://dx.doi.org/10.23960/jsl1752-61>.
- Ontario, J., Hernowo J.B., Haryanto., & Ekarelawan. (1991). Pola Pembinaan Habitat Burung di Kawasan Pemukiman Terutama di Perkotaan. Departemen Konservasi Sumberdaya Hutan dan Ekowisata Fakultas Kehutanan IPB University, Bogor, Indonesia.
- Prasetyo, E., & Wulandari, R. (2021). Richness, diversity, and conservation status of bird species in Maron Beach, Semarang Indonesia. *Quagga: Jurnal Pendidikan dan Biologi*, 13 (1), 95-102. <https://doi.org/10.25134/quagga.v13i1.3664>.
- Rohman, S.N., Mardiastuti, A., & Mulyani, Y.A. (2023). Bird diversity in several land use types in Boyolali, Central Java. IOP Conf. Ser.: Earth Environ. Sci. 1220 012009. <https://doi.org/10.1088/1755-1315/1220/1/012009>.
- Soehartono, T., & Mardiastuti, A. (2003). *Pelaksana Konvensi CITES di Indonesia*. Japan International Cooperation Agency (JICA) Press, Jakarta, Indonesia.
- Shah, S.B., Sharma, H.P. (2022). Bird diversity and factors affecting bird abundance at Dullu Municipality, Dailekh, Nepal. *Biodiversitas*, 23 (3), 1535-1545. <https://doi.org/10.13057/biodiv/d230343>.
- Tamnge, F., Mulyani, Y.A., & Mardiastuti, A. (2013). Keanekaragaman jenis burung pada beberapa tipe habitat di Pulau Ternate. [thesis]. Fakultas Kehutanan IPB University, Bogor, Indonesia.
- Tu, H.M., Fan, M.W., & Ko, J.C.J. (2020). Different habitat types effect bird richness and evenness. *Sci Rep* 10, 1221. <https://doi.org/10.1038/s41598-020-58202-4>.
- Warmetan, H., Kesaulija, F.F., & Sadsoeitoeboen, B.M.G. (2015). Keragaman dan Status Konservasi Jneis Burung Air di Danau Yamor. *Jurnal Kehutanan Papuaasia*, 1 (2), 99-107. <https://doi.org/10.46703/jurnalpapuasia.Vol1.Iss2.35>.