# Richness, Diversity, and Conservation Status of Bird Species in Maron Beach, Semarang, Indonesia

#### Erik Prasetyo<sup>1)</sup> & Retno Wulandari<sup>2)</sup>

<sup>1</sup>Pelatuk Bird Study Club, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang email: erikprasetyo96@gmail.com

<sup>2</sup> Pelatuk Bird Study Club, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang email: retnow123@gmail.com

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Abstract: Birds are important species that play a role in maintaining ecosystem stability. The land-use functions by humans can cause decreasing diversity of bird species. The purpose of this study was to identify species richness, species diversity, and conservation status of birds in Maron Beach, Semarang. The research was conducted in January 2017 using the point count method by five points. Observations were made at 06.00 - 10.00 WIB with a duration of 15-30 minutes for each point. The results showed that there were 42 bird species from 20 families. The species richness index (R1) showed a 6.629 value which is classified as a high category. Diversity index (H') showed 2,915 value which is classified as a medium category. Conservation status of bird species that were protected by PP No. 7 1999, there were 7 bird species. Protected bird conservation status by P 106 2018, there were 3 bird species. The conservation status by IUCN is classified into 2 categories, that were Near Threatened (NT) and Least Concern (LC). The conservation status of international trade according to CITES indicates that no species are included in the list, but most of the bird species are traded locally.

Keywords: bird; conservation status; diversity; Maron Beach; richness

Abstrak: Burung merupakan spesies penting yang berperan dalam menjaga kestabilan ekosistem dan memiliki banyak manfaat. Pengalihan fungsi lahan oleh manusia dapat menyebabkan penurunan keanekaragaman jenis burung. Tujuan penelitian ini untuk mengidentifikasi kekayaan jenis, keanekaragaman jenis dan status konservasi burung di kawasan Pantai Maron, Semarang. Penelitian dilakukan pada bulan Januari 2017 dengan metode titik hitung sebanyak lima titik. Pengamatan dilakukan pada pukul 06.00 – 10.00 WIB dengan durasi 15 – 30 menit untuk tiap titik. Hasil penelitian menunjukkan terdapat 42 jenis burung dari 20 famili. Indeks kekayaan jenis (R1) sebesar 6,629 yang tergolong kategori tinggi. Indeks keanekaragaman jenis (H') sebesar 2,915 yang tergolong kategori sedang. Status konservasi jenis burung yang dilindungi PP No 7 Tahun 1999 terdapat 7 jenis burung. Status konservasi burung yang dilindungi P 106 Tahun 2018 terdapat 3 jenis burung. Status konservasi keterancaman jenis menurut IUCN tergolong dalam 2 kategori yaitu Near Threatened (NT) dan Least Concern (LC). Status konservasi perdagangan internasional menurut CITES menunjukkan tidak ada spesies yang masuk ke dalam daftar, namun sebagian besar jenis burung yang diperdagangkan di lingkup lokal.

Kata kunci: burung; keanekaragaman; kekayaan; pantai Maron; status konservasi .

## INTRODUCTION

Indonesia is one of the countries with the second-highest biodiversity after Brazil. Indonesia has 8,157 species of vertebrate fauna (mammals, birds, herpetofauna, and fish) (LIPI, 2014). Meanwhile of bird species, (Ruskhanidar & Hambal, 2007) stated, that were 1,539 species have been recorded in Indonesia, including migratory birds. Also, Indonesia has a high number of endemic bird species, namely 386 bird species (LIPI, 2014).

Birds have a role as biological agents in controlling various kinds of pests, such as rats and caterpillars. Besides, birds are used as food material by humans, help pollinate flowers, and help in the spread of plant seeds (Whelan et al., 2008). Birds can also be used as bioindicators for environmental changes. Therefore, birds become components of biodiversity that has an important role in maintaining ecosystem stability (Latumahina et al., 2020).

Human activities change the environment such as natural forests into plantations, agriculture, and infrastructure development to increase various types of industrial activities. The diversity of bird species is decreasing due to forest degradation and fragmentation, even causing the extinction of certain bird species that cannot adapt (Sodhi et al., 2011; Narayana, 2013). The development of land-use for human settlements and road construction resulted in a significant reduction in bird numbers (Fahrig & Rytwinski, 2009). Deforestation and changes in the natural environment are the most dominant factors in reducing bird population and diversity (Ayat & L. Tata, 2015).

Maron Beach is a tourist beach located in Tugurejo Village, Tugu District, Semarang City. Maron Beach is near to Semarang Ahmad Yani International Airport. Maron Beach is a type of sandy beach, rocky, and cliffs (<u>Prabowo et al., 2017</u>). The Maron Beach has several types of habitat such as mangrove forests, mudflats, rivers, fields, grasslands, and shrubs. The mangrove forests of the Maron Beach area are composed of *Rhizopora mucronata* and *Avicennia marina* (Tarigan et al., 2017).

The condition of Maron Beach is getting worse. The sandy and rocky beach structure is the result of reclamation. The Maron coast area has decreased land due to erosion. Also, the Maron beach environment has begun to be polluted by household waste that is dumped carelessly (Prabowo et al., 2017). Based on this, research was carried out in the Maron Beach to identify the

richness, diversity and conservation status of bird species in the area. The results of this study are also expected to be used as a reference in monitoring the diversity of bird species on the Maron Beach and take action bird conservation policies in the area.

# RESEARCH METHOD Study Area

The research was carried out in January 2017 at the location of the Maron Beach Area - 6.9545634°S, 110.3579064°E. Maron Beach is located in village Tugurejo Village, Tugu District, Semarang City, Central Java Province, Indonesia. (Figure 1). The observation point is based on the habitat varies in the Maron Beach.

#### **Procedures**

Data collection was carried out using the point count method (Bibby et al., 2000; Partasasmita et al., 2009; Safanah et al., 2017). There were 5 observation points with a distance between the points of 150 m and a radius of observation was 50 meters (Figure Observations were made in the morning at 06.00 - 10.00 a.m. with a duration of 15-30 minutes at each point. The main data observed were bird species and population. As supporting data, the activity of each bird species was also recorded. The identification of bird species was carried out based on characteristics referring to field guild book of Burung-burung di Sumatra, Java, Bali, & Kalimantan (Mackinnon et al., 2010).



Figure 1. Map of research location in Maron beach, Semarang

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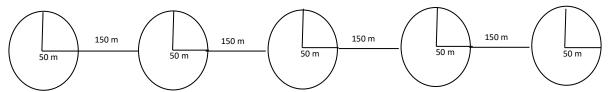


Figure 2. Model of research data collection technique

### **Data Analysis**

Data were analyzed to identify species richness, species diversity and conservation status for each bird species.

## Species richness index

The species richness index is the total number of species in a community, the number depends on the area and time of the study. The species richness index (RI) in this study uses the Margalef formula. The classification of the level of Margalef species richness is shown in Table 1 (Latumahina et al., 2020).

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

### Description:

R1 : Margalef's species richness index

S : number of species

N : total number of individuals

Ln : natural logarithm

**Table 1.** Criteria of species richness index

Value	Category		
R1 < 2,5	Low-level species	ecies richness	
2,5 > R1 < 4	Medium-level richness	species	
R1 > 4	High-level species richness		

### Species diversity index

Species dDiversity index is used to determine the distribution of the individuals found. In this study, the data were analyzed based on the Shannon - Winner species diversity index. The determination of the category of the level of species diversity is based on Table 2 (Magurran, 2004) (Safanah et al., 2017)(Latumahina et al., 2020).

$$H' = -\sum \left(\frac{Ni}{N}\right) Ln\left(\frac{Ni}{N}\right) \tag{2}$$

### Description:

H': Shannon-Wiener's diversity indexNi: number of individuals per i

N : total number of individuals

**Table 2.** Criteria of species diversity index

Value	Categor	Category v-level species diversity		
H' < 1	Low-level species			
1 > H' < 3	Medium-level	species		
	diversity			
H' > 3	High-level species diersity			

#### Conservation status

Every bird species found will be identified its conservation status based on the status of Indonesian legal protection (PP No. 7 of 1999 and P 106 of 2018), conservation status based on International Union for Conservation of Nature Redlist (IUCN Redlist), international trade status based on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

# RESULT AND DISCUSSION Bird species richness

Based on the observation, there were 42 bird species from 20 families (Table 3). In Table 1, it showed that most bird species found came Ardeidae, from the Charadriidae, Alcediniddae families. There were seven bird species found in the Ardeidae family, that were Javan pond-heron (Ardeola speciosa), Grey heron (Ardea cinerea), Plumed egret (Ardea plumifera), Purple heron (Ardea purpurea), Green-backed heron (Butorides striata), little egrett (Egretta garzetta) and yellow bittern (Ixobrychus sinensis). The Ardeidae family was often found because birds from this family have a habit of living, nesting, and foraging in riverbanks, coastal rivers, small ponds, and coastal (MacKinnon et al., 2010). This is by following the conditions of the research location, which is the habitat of rivers, ponds, and coastal waters.

Table 3. List of bird species in Maron beach, Semarang

No	Family	No	Species	English Name	Indonesian Name	Total
1.	Alcedinidae	1.	Halcyon cyanoventris	Javan Kingfisher	Cekakak Jawa	1
		2.	Todirhampus sanctus	Sacred Kingfisher	Cekakak Austrlia	1
		3.	Todirhampus chloris	Collared Kingfisher	Cekakak Sungai	3
		4.	Alcedo coerulescens	Cerulean Kingfisher	Raja Udang Biru	9
2.	Anatidae	5.	Anas gibberifrons	Sunda Teal	Itik Benjut	2
3.	Apodidae	6.	Apus pacificus	Fork-tailed Swift	Kapinis Laut	3
4.	Artamidae	7.	Artamus leucoryn	White-breasted Wood- swallow	Kekep Babi	3
		8.	Hirundo rustica	Barn Swallow	Layang-layang Api	1
		9.	Collocalia linchi	Cave Swiftlet	Walet Linchi	62
5	Ardeidae	10.	Ardeola speciosa	Javan Pond-Heron	Blekok Sawah	56
J	Titaciano	11.	Ardea cinerea	Grey Heron	Cangak Abu	3
		12.	Ardea plumifera	Plumed Egret	Kuntul Perak	1
		13.	Ardea purpurea	Purple Heron	Cangak Merah	3
		14.	Butorides striata	Green-backed Heron	Kokoan Laut	2
		15.	Egretta garzetta	Little Egret	Kuntul Kecil	9
				<del>-</del>		
_	G1	16.	Ixobrychus sinensis	Yellow Bittern	Bambangan Kuning	7
6.	Champephagidae	17.	Pericrocotus cinnamomeus	Small Minivet	Sepah Kecil	6
7.	Charadriidae	18.	Charadrius alexandrinus	Kentish Plover	Cerek Tilil	24
		19.	Charadrius hiaticula	Common Ringed Plover	Cerek Kalung Besar	32
		20.	Charadrius dubius	Little Ringed Plover	Cerek Kalung Kecil	5
		21.	Charadrius javanicus	Javan Plover	Cerek Jawa	2
		22.	Pluvialis fulva	Pacific Golden-plover	Cerek Kernyut	28
8.	Chloropseida	23.	Aegithina tiphia	Common Iora	Cipoh Kacat	2
9.	Columbidae	24.	Geopelia striata	Zebra Dove	Perkutut Jawa	1
		25.	Spilopelia chinensis	Eastern Spotted Dove	Tekukur Biasa	29
10.	Cuculidae	26.	Centropus bengalensis	Lesser Coucal	Bubut Alang-alang	3
11.	Dicaeidae	27.	Dicaeum trochileum	Scarlet-headed Flowerpecker	Cabai Jawa	13
12.	Estrildidae	28.	Lonchura maja	White-headed Munia	Bondol Haji	2
		29.	Lonchura leucogastroides	Javan Munia	Bondol Jawa	15
		30.	Lonchura punctulata	Scaly-breasted Munia	Bondol Peking	7
13.	Laniidae	31.	Lanius schach	Long-tailed Shrike	Bentet Kelabu	2
14.	Muscicapidae	32.	Rhipidura javanica	Pied Fantail	Kipasan Belang	4
15.	Nectarinidae	33.	Cinnyris jugularis	Olive-backed Sunbird	Burung Madu Srigannti	8
16.	Picidae	34.	Picoides moluccensis	Sunda Woodpecker	Caladi Tilik	1
		35.	Dendrocopus macei	Fulvous-breasted Woodpecker	Caladi Ulam	2
17.	Ploceidae	36.	Passer montanus	Eurasian Tree Sparrow	Burung Gereja Erasia	6
18.	Pycnonotidae	37.	Pycnonotus aurigaster	Sooty-headed Bulbul	Cucak Kutilang	97
19.	Scolopacidae	38.	Actitis hypoleucos	Common Sandpiper	Trinil Pantai	14
	1	39.	Tringa glareola	Wood Sandpiper	Trinil Semak	6
20.	Silviidae	40.	Orthotomus sutorius	Common Tailorbird	Cinenen Pisang	5
		41.	Prinia inornata	Plain Prinia	Perenjak Padi	2
		42.	Gerygone sulphurea	Golden-bellied Gerygone	Remetuk Laut	3

The group of birds found in the Charadriidae family were a five of plover species. The species of birds found were Kentish plover (Charadrius alexandrines), Little ringed plover (Charadrius dubius), Common ringed plover (Charadrius hiaticula), Javan plover (Charadrius javanicus) and Pacific golden plover (Pluvialis fulva). The third family was Alcedinidae, contains four species of birds, that were Javan kingfisher

(Halcyon cyanoventris), Sacred kingfisher (Todirhamphus sanctus), Collared kingfisher (Todirhamphus chloris) and Cerulean kingfisher (Alcedo coerulescens). The plover and kingfisher groups have a habit of foraging on the banks of rivers near the coast, mud and grass near the coast and even grass near the airport (MacKinnon et al., 2010).

The Margalef species richness index in the Maron Beach obtained a value of 6.629. This value showed that the Maron Beach area has a high level of species richness because the value was more than 4 (Latumahina et al., 2020).

## **Bird species diversity**

Based on the research results, it was found that the diversity index was 2,915. This shows that it is classified into a medium level of species diversity because it ranges from 1> 2,915 < 3. This shows that the Maron coastal area has varied habitats and is quite suitable for the survival of birds. Heterogeneous habitat variations can provide bird needs and increase species diversity (Araneda et al., 2018) (Jemal et al., 2020).

The existence of an animal species is determined by its food source and habitat suitability (Warsito & Bismark, 2010). According to Alikodra (2010), the high diversity of bird species in an area is supported by the high diversity of habitats because the habitat for wildlife generally functions as a place to find food, rest and nest. Habitat changes can lead to changes in bird composition and abundance components (Dewi, 2005).

The condition of bird species diversity can decrease due to increased land use (Rudini et al., 2016). The conversion of land functions is the main key controlling species diversity current and in the future (Luck et al., 2003)(Agyei-Ohemeng et al., 2017).



**Figure 3.** Bird species of Kentish plover (Charadrius alexandrines)

#### **Conservation status**

Conservation status under Indonesian law, kaccording to IUCN and international trade by

CITES are shown in Table 4. Status protection under Indonesian law, PP No. 7 of 1999 shows that there are seven species of birds protected. The protected birds are Cerulean kingfisher (Alcedo coerulescens), Collared kingfisher (Todirhamphus chloris), Sacred kingfisher kingfisher (Todirhamphus sanctus), Javan (Halcyon cyanoventris), Pied fantail (Rhipidura *javanica*), Olive-backed sunbird (Cinnyris jugularis) and Little egret (Egretta garzetta). Meanwhile, the protection status according to P. 106 of 2018 shows that there are three protected bird species. The protected birds are Javan plover (Charadrius javanica), Kentish plover (Charadrius alexandrines) and Pied fantail (Rhipidura javanica). Based on this, it shows that there are bird species protected by these two regulations, that is Pied fantail (Rhipidura iavanica).

According to the IUCN Redlist, the threat status of bird species in the Maron Beach is classified into two categories, that are Near Threatened (NT) and Least Concern (LC) (IUCN, 2012). There are two species of birds that are classified as NT, that are Sunda teal (Anas giberifrons) and Javan plover (Charadrius javanica). The conservation status of NT indicates that it is necessary to obtain conservation action so that it does not become extinct. Meanwhile, for the bird species classified in the LC, there are forty species. This shows that these bird species are at low risk of extinction and are still large in number, but further research is needed to determine population changes (Dewi et

The status of international trade according to CITES shows that there are no bird species that need to be highlighted (CITES, 2020). Even so, bird species in Maron beach are traded, that are Eastern spotted dove (Spilopelia chinensis), Zebra dove (Geopelia striata), Lesser coucal (Centropus bengalensis), Collared kingfisher (Halcyon chloris). Fulvous-breasted woodpecker (Dendrocopus macei), Common iora (Aegithina Sooty-headed bulbul (Pycnonotus tiphia), aurigaster), Long-tailed shrike (Lanius schah), Javan munia (Lonchura leucogastroides), and Scaly-breasted munia (Lonchura punctulate) (Haryoko, 2010). Based on this, it shows that these bird species are still traded locally.

Table 4. Conservation status of bird species in Maron beach, Semarang

		Conservation Status				
No	Species	HICN D - 4124	CIPEC	Indonesian I aw		
	-	<b>IUCN Redlist</b>	CITES -	PP 7 1999	P 106 2018	
1.	Actitis hypoleucos	Least Concern	-	-	-	
2.	Aegithina tiphia	Least Concern	-	-	-	
3.	Alcedo coerulescens	Least Concern	-	v	-	
4.	Anas gibberifrons	Near Threatened	-	-	-	
5.	Apus pacificus	Least Concern	-	-	-	
6.	Ardea cinerea	Least Concern	-	-	-	
7.	Ardea plumifera	Least Concern	-	-	-	
8.	Ardea purpurea	Least Concern	-	-	-	
9.	Ardeola speciosa	Least Concern	-	-	-	
10.	Artamus leucoryn	Least Concern	-	-	-	
11.	Butorides striata	Least Concern	-	-	-	
12.	Centropus bengalensis	Least Concern	-	-	-	
13.	Charadrius alexandrinus	Least Concern	-	-	v	
14.	Charadrius dubius	Least Concern	-	-	-	
15.	Charadrius hiaticula	Least Concern	-	-	-	
16.	Charadrius javanicus	Near Threatened	-	-	v	
17.	Cinnyris jugularis	Least Concern	-	v	-	
18.	Collocalia linchi	Least Concern	-	-	-	
19.	Dendrocopus macei	Least Concern	_	-	-	
20.	Dicaeum trochileum	Least Concern	_	_	-	
21.	Egretta garzetta	Least Concern	_	v	-	
22.	Geopelia striata	Least Concern	-	-	-	
23.	Gerygone sulphurea	Least Concern	-	-	-	
24.	Halcyon cyanoventris	Least Concern	-	v	=	
25.	Hirundo rustica	Least Concern	-	-	=	
26.	Ixobrychus sinensis	Least Concern	-	-	=	
27.	Lanius schach	Least Concern	-	-	-	
28.	Lonchura leucogastroides	Least Concern	-	-	-	
29.	Lonchura maja	Least Concern	-	-	-	
30.	Lonchura punctulata	Least Concern	-	-	-	
31.	Orthotomus sutorius	Least Concern	-	-	-	
32.	Passer montanus	Least Concern	-	-	-	
33.	Pericrocotus cinnamomeus	Least Concern	-	-	-	
34.	Picoides moluccensis	Least Concern	-	-	-	
35.	Pluvialis fulva	Least Concern	-	-	-	
36.	Prinia inornata	Least Concern	-	-	-	
37.	Pycnonotus aurigaster	Least Concern	-	-	-	
38.	Rhipidura javanica	Least Concern	-	v	v	
39.	Spilopelia chinensis	Least Concern	-	-	-	
40.	Todirhampus chloris	Least Concern	-	v	-	
41.	Todirhampus sanctus	Least Concern	-	v	-	
42.	Tringa glareola	Least Concern	-	-	-	

#### **CONCLUSION**

Based on the results and discussion, the following conclusions can be drawn:

- 1. In the Maron Beach, that were 42 bird species from 20 families were found with a species richness index (R1) of 6.629 which was high-level category.
- 2. The diversity index of bird species in the Maron Beach was 2,915 which was classified as medium-level category.

3. Conservation status of bird species, there were 7 protected species PP No. 7 of 1999, 3 protected species P 106 of 2018, classified as 2 IUCN categories (NT and LC) and not included in the internationally traded by CITES.

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#### **REFERENCES**

- Agyei-Ohemeng, J., Danquah, E., Yeboah Adu, B., & Yeboah, A. 2017. Diversity and Abundance of Bird Species in Mole National Park, Damongo, Ghana. *Journal of Natural Sciences Research*.7 (12): 20-33.
- Araneda, P., Sielfeld, W., Bonacic, C., & Ibarra, J. T. 2018. Bird Diversity Along Elevational Gradients in The Dry Tropical Andes of Northern Chile: The Potential Role of Aymara Indigenous Traditional Agriculture. *PLoS ONE*. 13 (12): 1–21.
- Ayat, A., & Tata, H. L. 2015. Diversity of Birds Across Land Use and Habitat Gradients in Forests, Rubber Agroforests and Rubber Plantations of North Sumatra. *Indonesian Journal of Forestry Research*. 2 (2): 103–120.
- Bibby, C. J., Burgess, N. D., & Hill, D. A. (2000). *Bird Census Techniques*. 2<sup>nd</sup> Edition. BirdLife International. Inggris
- Convetion on International Trade in Endangered Species of Wild Fauna and Flora CITES. 2020. Appendices I, II, and III. August. CITES
- Fahrig, L., & Rytwinski, T. 2009. Effects of Roads on Animal Abundance: an Empirical Review and Synthesis. Ecology and Society. *Ecology and Society*. 14 (1): 21–41.
- Haryoko, T. 2010. Komposisi Jenis dan Jumlah Burung Liar yang Diperdagangkan di jawa Barat. *Berita Biologi*. 10 (3): 385– 391.
- Jemal, Z., Girma, Z., & Mengesha, G. 2020. Bird Diversity in Nensebo Moist Afromontane Forest Fragment, South Eastern Ethiopia. *The Open Ornithology Journal*. 13 (1): 1–9.
- Latumahina, F. S., Mardiatmoko, G., & Sahusilawane, J. 2020. Richness, Diversity and Evenness of Birds in Small Island. *IOP Conference Series:*Journal of Physics. Conference Series 1463 (2020) 012023.
- Lembaga Ilmu Pengetahuan Indonesia (LIPI).

- 2014. Kekinian Keanekaragaman Hayati Indonesia 2014. LIPI Press. Jakarta.
- Luck, G. W., Daily, G. C., & Ehrlich, P. R. 2003. Population Diversity and Ecosystem Services. *Trends in Ecology and Evolution*. 18 (7): 331–336.
- Magurran, A. 2004. *Measuring Biologicial Diversity*. Blackwell Publishing. United Kingdom.
- Nainggolan, F. H., Dewi, B. S., & Darmawan, A. 2019. Status Konservasi Burung: Studi Kasus di Hutan Desa Cugung Kesatuan Pengelolaan Hutan Lindung Model Rajabasa Kecamatan Rajabasa Kabupaten Lampung Selatan. *Jurnal Sylva Lestari*. 7(1): 52–61.
- Narayana, B. L., Rao, V. V., & Pandiyan, J. 2013. Avifaunal Assemblages in Relation to Different Croplands/Habitats of Nalgonda District, Andhra Pradesh, India. *Int. J. LifeSc. Bt & Pharm. Res.* 2 (3): 212–224.
- Partasasmita, R., Mardiastuti, A., Solihin, D. D., Widjajakusuma, R., Prijono, S. N., & Ueda, K. 2009. Komunitas Burung Pemakan Buah di Habitat Suksesi. *Majalah Ilmiah Biologi: BIOSFERA*. 26 (2): 90-99.
- Prabowo, D., Muskananfola, M. R., & Purwanti, F. 2017. Analisis Kerentanan Pantai Maron dan Pantai Tirang Kecamatan Tugu, Kota Semarang. *Journal of Maquares*. 6 (4): 555–563.
- Rudini, Labiro, E., & Ihsan, M. 2016. Keanekaragaman Jenis Burung Pada Kawasan Hutan Lindung KPH Dampelas Tinombo di Desa Sibualong Kec. Balaesang Kab Donggala. *Warta Rimba*. 4 (2): 69–75.
- Ruskhanidar, & Hambal, M. 2007. Kajian Tentang Keanekaragaman Spesies Burung di Hutan Mangrove Aceh Besar Pasca Tsunami 2004. *J. Ked. Hewan.* 1 (2): 76–84.
- Safanah, N. G., Nugraha, C. S., Partasasmita, R., & Husodo, T. 2017. Keanekaragaman Jenis Burung di Taman Wisata Alam dan Cagar Alam Pananjung Pangandaran, Jawa Barat. 3 (2): 266–272.
- Sodhi, N. S., Sekercioglu, Ç. H., Barlow, J., &

- Robinson, S. K. (2011). *Conservation of Tropical Birds*. Wiley-Blackwell. United Kingdom.
- Tarigan, N. P., Purwanti, F., & Hendrarto, B. 2017. Kelayakan Wisata Alam Di Maroon Mangrove Edu Park Semarang. *Journal of Maquares*. 6 (3): 274–282.
- Warsito, H., & Bismark, M. (2010). Penyebaran dan Populasi Burung Paruh Bengkok pada Beberapa Tipe Habitat di Papua. *Jurnal Penelitian Hutan dan Konservasi Alam.* 7 (1): 93–102.
- Whelan, C. J., Wenny, D. G., & Marquis, R. J. 2008. Ecosystem Services Provided by Birds. *Annals of The New York Academy of Sciences*. 1134: 25–60.