

Bird Diversity in Asam Kumbang Crocodile Breeding Area Medan Selayang District Medan City

Erni Jumilawaty¹, Febri Ramadhani¹,

¹Departement of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan, Indonesia

Abstract. Asam Kumbang Crocodile Breeding is a breeding ground for crocodiles that contain several birds. Species diversity is indicated by differences in the types of organisms. One of the most diverse organisms of its kind is birds. Birds in this region are able to settle down and coexist with crocodiles. Crocodiles are one of the predators of bird. It aims to identify the diversity of birds and status of protected birds at the research site. The method used in this study were point count method, thus resulted in 12 species of birds belonging to 5 ordo, 6 family, and 11 genus. The most common birds species found on the 3rd observation with as many as 9 species of birds, while the least species of birds found on the 4th observation as many as 5 species of birds. Diversity index value (H') of bird in location classified into category of “moderate category” with the results of analysis 1,171 and the indeks equitabilitas value of 0,47. According to the Ministry of Environment and Forestry Regulation 2018, there are 2 types of birds found in the study area of birds found in the study site.

Keyword: Asam Kumbang, Breeding Area, bird diversity

Received 10th June 2021 | Revised 25th July 2021 | Accepted 25th August 2021

Introduction

Diversity is an abundance related to the number, type, shape, appearance and nature of various levels of living things. The diversity of living things is also known as biodiversity which consists of three levels, namely: gene diversity, species diversity and ecosystem diversity. Gene diversity can be influenced by the carrier factors in the chromosomes. Species diversity is influenced by morphological and anatomical factors of living things that differ between species or species. Ecosystem diversity is influenced by abiotic factors that can cause differences in the types of living things between ecosystems [1].

Species diversity in living things can be identified and measured according to research needs, one of the species of living things whose species diversity can be measured is birds. Birds are

**Corresponding author at: Departement of Biology, Faculty Mathematics and Natural Science, Universitas Sumatera Utara, Jalan Bioteknologi No. 1 Kampus, Padang Bulan, Medan 20155, Sumatera Utara, Indonesia

E-mail address: erni1@usu.ac.id

wild animals that can be found in various types of habitats such as coastal forest, lowland forest, hill forest and mountain forest [2]. Several types of birds are also able to live in several different types of habitats because they have the ability to adapt to the environment they live in. The adaptability of birds to different environments can be found in the Acid Beetle Crocodile Captive in Medan City, North Sumatra. This area is one of the bird habitats which is a type of wetland, because there is a pool of water in the form of a crocodile pond. Wetlands are ecosystems that are flooded by water with long periods of time for the development of vegetation and other specially adapted organisms [3].

Habitats that can support the existence of birds are places that are able to provide a source of food, a place for nesting and reproduction and far from predators. Habitat is generally used by birds as a place to rest, nest, breed and shelter from predators [4].

Birds in the Asam Kumbang Crocodile Captivity are able to live permanently and side by side with crocodiles. Crocodiles are one of the predators for birds. Birds do not feel threatened by the presence of crocodiles in the same area. There is a reciprocal relationship between birds and crocodiles. Birds place nests on trees so they cannot be reached by crocodiles and feel protected from other predators (humans), while crocodiles get food in the form of eggs and chicks that fall from the tree [5]. Studies and information on the diversity of bird species found in the Asam Kumbang Crocodile Captivity have not been known until now. In accordance with the description above, a study entitled "Diversity of Bird Species in the Acid Beetle Crocodile Breeding Area was conducted, Medan Selayang District, Medan City".

2. Research Methods

2.1. Time and Location of Research

The research was carried out from December 2018 to January 2019 at the Asam Kumbang Crocodile Breeding, Medan Selayang District, Medan City. Identification of bird species found and data analysis was carried out in January 2019 at the Animal Systematics Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, University of North Sumatra, Medan.

2.2 Area Description

The research location is located on Jalan Bunga Raya II, Asam Kumbang, Medan Selayang District, Medan City, North Sumatra Province (Figure 1). This area is a crocodile breeding place with an area of 2 hectares and in it there is a 1 hectare pond, and there is vegetation in the form of Chinese petai trees which are used by birds as nesting and perching places.



Figure 1 Location of Observation of Acid Beetle Crocodile Breeding

2.3 Data Collection

The collection of data on the diversity of bird species was carried out using two methods, namely observation and interviews. Observations were made for 5 days of data collection using the Point Count method [6]. The point count method is carried out by walking slowly, quietly and observing birds using binoculars and taking photos of birds using a digital camera at a certain point, then recording the number and types of birds encountered using counters and stationery. The points used as observation points are 5 counting points, the distance between the points is 15 meters, and the viewing distance is 25 meters with an observation time of 20 minutes at each point (Figure 2). Observations were made in the morning at 06.00-10.00 WIB and in the afternoon at 14.00-18.00 WIB.

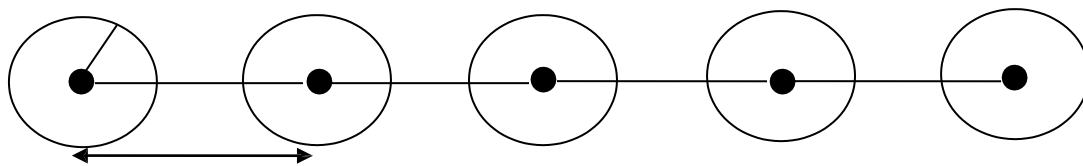


Figure 2 Forms of Observation Points using the Point Count Method

2.4. Identification of Bird Species

Identification of bird species is carried out directly in the field and continued in the Animal Systematics Laboratory by looking at photos of bird species that have been taken using the bird species identification book [7].

2.5. Data Analysis

Bird data obtained in the field during observations were then processed and counted, including: diversity index (H') and evenness index (E). [8,9].:

2.5.1. Shannon Wiener Diversity Index (diversity)

$$H' = \sum_{i=1}^S pi \ln pi \tag{1}$$

Information :

H' = diversity index Shannon Wiener

Pi = proportion of species to i in community (ni / N)

In = logaritme nature

0 < H' < 2,302 = Low Diversity

2,302 < H' < 6,907 = Moderate Diversity

H' > 6,907 = High DIversity

2.5.2. Equitability Index (Uniformity)

$$E = \frac{H'}{H Max} \tag{2}$$

E = Equitability Index

H max = ln S (S = number of genera).

3. Result and Discussion

3.1. Diversity of Bird Species in the Acid Crocodile Breeding Area Beetle, Medan Selayang District, Medan City

The results of research that have been carried out in the Asam Kumbang Crocodile Breeding Area, Medan Selayang sub-district, Medan city, there are as many as 12 bird species belonging to 5 orders, 6 families, 11 genera, as shown in Table 1 below.

Table 1 Types of birds found in the Asam Crocodile Farm Beetle, Medan Selayang District, Medan City

No	Ordo	Famili	Types of birds		Data capture to				
			Scientific Name	Local Name	1	2	3	4	5
1	Columbiformes	Columbidae	<i>Streptopelia chinensis</i>	Tekukur biasa	✓	-	-	-	-
			<i>Geopelia striata</i>	Perkutut Jawa	✓	✓	-	-	✓
2	Coraciiformes	Alcedinidae	<i>Halcyon pileata</i>	Cekakak Cina	-	-	✓	-	-
3	Gruiformes	Ralliade	<i>Amaurornis phoenicurus</i>	Kareo padi	✓	-	-	✓	-

			<i>Gallinula chloropus</i>	Mandar batu	✓	✓	✓	✓	✓
4	Passeriformes	Cisticolidae	<i>Prinia flaviventris</i>	Perenjak rawa	-	-	✓	-	-
		Sturnidae	<i>Acridotheres javanicus</i>	Jalak kerbau	-	-	✓	-	✓
5	Pelecaniformes	Ardeidae	<i>Bubulcus ibis</i>	Kuntul Kerbau	✓	✓	✓	✓	✓
			<i>Egretta alba</i>	Kuntul besar	✓	✓	✓	✓	✓
			<i>Egretta garetta</i>	Kuntul Kecil	✓	✓	✓	✓	✓
			<i>Nycticorax nycticorax</i>	Kowak Malam Abu	✓	✓	✓	-	✓
			<i>Ixobrychus eurhythmus</i>	Blambangan Cokelat	-	✓	✓	-	-
Species Total					8	7	9	5	7

Information : : ✓ Found - : Not found

Table 1 describes the number of bird species found in the Asam Kumbang Crocodile Captive starting from the 1st data collection to the 5th data collection sequentially as many as 8 species, 7 species, 9 species, 5 species and 7 types of birds. Bird data are grouped by family and order. The most dominating order is the order Pelecaniformes which consists of one family, namely the Ardeidae family of 5 bird species. Ardeidae have an almost even distribution throughout Indonesia, such as Sumatra, Java, Kalimantan and Bali[2].

The number of bird species found in the Asam Kumbang Crocodile Captivity is relatively small compared to the results of research by [10] using the same method. Research by [10] in the Telaga Warna area, Cisarua, Bogor, there were 60 species of birds. The results of this study are different from the results obtained in the Asam Kumbang Crocodile Captivity, which is as many as 12 species of birds. This is influenced by several factors. The first factor is that there are rice fields not far from the research location. Birds have the ability to move, so at the time of observation it is possible for birds to find food in rice fields which is one of the places for birds to find food. Birds usually forage in rice fields [11].

According to [12], birds are a type of animal that has a high ability to move so that its distribution is very wide in the world. Nesting locations and foraging locations for birds are different, different types of birds will fly to look for food and return to the nest at certain times [13]. This is because the research location is a habitat that does not provide food for several bird species, in terms of vegetation type, food availability and environmental factors.

The Acid Bumblebee Crocodile Captive contains a pond as an aquatic habitat that can support the life of water birds. Waterbirds can be interpreted as bird species that depend on wetlands [14]. Waterbirds are one of the groups and classes of birds that forage in the waters [15].

This is why at the time of observation, water bird species were found to be more common than terrestrial bird species. Water bird species also tend to be more visible because they have a larger body size and open land is a place for foraging for water birds. [16] stated that the identified water bird families include Phalacrocoridae, Ardeidae, Anatidae, Rallidae and Alcedinidae. The second factor is the structure of the vegetation that is open and little so that it affects the number of bird species encountered when observing at the research site. [17] suggested that canopy cover, the height of the canopy on the tree determines the diversity of bird species in a place.

According to [18], each type of animal can depend on certain groups of plant species to live. [19] added that the more tree species, the more possibilities of bird species that can live together. According to [20], habitats that have diverse vegetation variations and provide abundant food sources will increase the diversity of bird species.



Figure 3 Types of Trees Used as Nesting Places

The tree that is favored and used as a place for nesting, perching and foraging by birds in the Asam Kumbang Crocodile Farm is the Chinese petai tree (*Leucaena leucocephala*). According to

[21], there are 3 types of plants visited by birds, namely green ki (*Albizia saman*), banyan (*Ficus benjamina*) and Chinese petai (*L. leucocephala*). This plant can provide many food sources for birds such as nectar in flowers, insects, seeds and fruit. Birds are also easy to adapt to the Chinese petai tree (*L. leucocephala*) because it has a transparent canopy structure so that birds are easier to catch insects as prey. Furthermore, by [22] stated that the Chinese petai tree (*L. leucocephala*) is used by birds because it has seeds in the pods which can be used as a food source by seed-eating birds. Chinese petai (*L. leucocephala*) also has strong and elastic stems that birds can use to make nests and are used by birds as perches. This is what causes some species of birds choose the Asam Kumbang Crocodile Breeding as a nesting habitat and some as a place to find food.

The Asam Kumbang Crocodile Farm is a crocodile breeding place in which there are crocodiles. Crocodiles are one of the predators for birds, but in this area birds can still live and coexist with crocodiles. This is because birds and crocodiles do not feel disturbed and threatened. Birds place their nests on trees so that crocodiles cannot reach them. With crocodiles, birds feel protected from other predators such as monitor lizards, snakes and human disturbance. This is in line with [5] research which revealed that birds are more attracted to crocodile areas, because where there are crocodiles, no raccoons or possums (predators that threaten bird nests) are present. In this case there is a reciprocal relationship between birds and crocodiles.

The third factor is that the time of data collection used for research has not been efficient so that the number of bird species encountered is small. Data collection was carried out for only 1 month and in that month there was no rainy season. During 1 month of observation, the types of birds found were constant (neither increasing nor decreasing). According to [7], the recording of bird species is stopped if there are no more additional species, the results obtained already describe the number of bird species in the area. This causes no increase in observation time, even though time and season greatly affect the presence of birds. Changes in weather and seasonal differences can also affect the presence of birds in an area.

Data from bird species diversity observations that have been carried out for 5 times of data collection (Figure 4).

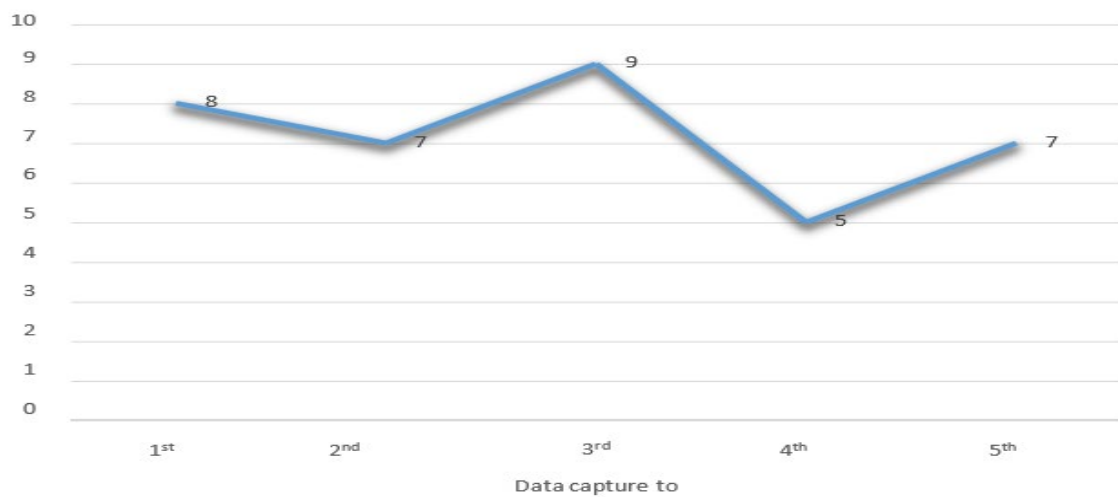


Figure 4 Bird Appearance Data for Five Times Data Collection in Acid Beetle Crocodile Breeding Area

Figure 4 shows the variation in the number of bird species per data collection. The number of bird species that were most frequently found was 9 bird species in the 3rd data collection, this was presumably due to the environmental conditions when the data collection process supported the presence of birds, while the least number of bird species found was in the 4th data collection as many as 5 species of birds, due to the hot weather during the data collection process (Table 2). The number of bird species in the 1st data collection was 8 bird species, 2nd and 3rd each were 7 bird species. The number of bird species found during observations in crocodile breeding areas was slightly compared to the number of bird species in [10] in Cisarua, Bogor, presumably due to the influence of physical factors from the environment, such as temperature, humidity and duration of sunlight. According to [23], the presence of a bird species in an area can be influenced by several factors, including temperature, humidity, availability of food sources, distribution of vegetation and preferred tree species as nesting and resting places. [24] added that the factors that affect the vertical stratification of bird species communities in a place are the availability of food, vegetation structure and physical factors. Physical environmental factors at the time of observation at the Acid Beetle Crocodile Cap are as follows (Table 2).

Table 2 Environmental Physical Factors in the Acid Crocodile Breeding Area Kumbro, Medan Selayang City District Medan

Data Capture to	Temperature (°C)	Air Humidity (%)	Light Intensity (Candela)
1	32,2	62	386
2	33,1	66	479
3	30,7	78	234
4	35,1	59	602
5	32,0	62	457

Table 2 regarding environmental physical factors during 5 observations at the Acid Beetle Crocodile Captivity consisting of temperature, humidity and light intensity. These physical factors can affect the number of bird species encountered. In the third data collection, it can be seen that at a temperature of 30.7°C with a humidity of 78% and a light intensity of 234 candela, there were more bird species found, because the data was collected in a more shady environment, so there were many birds perched on trees. While the least number of birds was found in the 4th data collection with a temperature of 35.1°C, air humidity of 59% and light intensity of 602 candela, due to hotter environmental conditions causing birds to move to find a more shady place. According to [9], the behavioral response of endothermic animals, including birds, is to remove or reduce body heat by moving to a humid environment or entering underground holes in the summer and basking in the hot sun in winter.

Data on environmental physical factors at the time of observation affect the number of bird species encountered during observations. This is in line with the research of [25] who stated that at a temperature of 30°C with 70% humidity, the highest number of birds perched on trees, while at a temperature of 35.5°C with a humidity of 63% and at a temperature of 33°C with 66% humidity, no perching birds were found. This matter This is due to the open vegetation structure in the area so that direct sunlight occurs. Added [26], several environmental factors that dominantly affect animal life, one of which is temperature. Temperature variations in the natural environment and their impacts have a potential role in determining life processes, distribution and abundance of animal populations.

3.2. Species Diversity Index (H') and Equitability Index (E)

The value of the species diversity index (H') of birds in the Asam Kumbang Crocodile Breeding area, Medan Selayang sub-district, Medan city which was carried out in one location was classified as moderate, with the results of the analysis showing H' of 1.171 with E of 0.47. This is presumably due to several factors, including environmental conditions in the Asam Kumbang Crocodile Breeding area that have not been able to support the survival of several bird species and the unavailability of adequate food sources for birds. The diversity index is a value that indicates the high and low diversity of a community. The higher the diversity value indicates that the habitat conditions are good in supporting natural bird life. According to [27], The existence of birds is supported by the suitability of the habitat and the ability of birds to adapt to environmental conditions. [28] argues that birds are one of the wildlife that are found almost everywhere, but for their life it requires certain conditions such as the existence of suitable, good, and safe habitat conditions from all kinds of disturbances. According to [29], habitat is an area that consists of various components, both physically and biotically, which is a unit that is used as a place to live and breed. Added by [30], habitat is a place that is used as a place for nesting and

resting that is protected from various threats from predators. A good habitat should be able to provide food, water, shelter,

The second factor is because during the data collection process there is no access or road to approach the bird, because at the observation location there are crocodile pond that must be passed to be able to approach the birds. Another factor encountered was human disturbance in the form of activities of visitors to the crocodile farm and workers when cleaning the crocodile pond so that the birds felt disturbed and the number of bird species found was less. According to [31], the presence of human disturbance (tourist and worker activity) at the observation site. The index value of bird species diversity found during 5 times of data collection at the observation location fluctuated. The index value was influenced by the number of species and the number of individuals encountered from day 1 to day 5 (Table 3).

Table 3 Species Diversity Index (H'), Number of Species, and Number of Individuals Five Days of Bird Watching at the Acid Crocodile Farm Kumbang

Data Capture to	H'	Number of species (type)	Number of Individuals (tail)
1	0,85	8	396
2	0,89	7	406
3	1,69	9	390
4	0,58	5	239
5	0,78	7	399

The value of diversity obtained from the results of data analysis starting from the 1st data collection to the 5th data collection is not stable, as well as the number of species and the number of individuals obtained. The results of observations in the field for five observations found several patterns of fluctuations in the composition of bird species, namely: 1) the number of species and the number of individual birds and the diversity index obtained varied, 2) the number of species could affect the diversity index value on each day of observation, 3) the diversity index The highest diversity index was obtained on the 3rd day, namely 1.69, 4) the lowest diversity index was obtained on the 4th day, namely 0.58, 5) the most visible species experiencing daily fluctuations was *B. ibis*, 6) the species that did not have a pattern, found only once under observation, namely *Halcyon pileata* and *Prinia flaviventris*. This is related to environmental factors such as temperature, light intensity and humidity on the day of observation. According to [32], the distribution of bird species in a habitat can be influenced by several factors include past habits, geographic barriers, climate (especially temperature, wind, altitude and humidity), behavior and mobility of birds. [33] suggest that the presence of birds in a habitat is closely related to physical factors such as soil, water, temperature, sunlight and biological factors including vegetation and other animals.

3.3 Grouping of Birds by Type of Feed

The availability of natural food at the location affects the number of species and the number of bird species. The Asam Kumbang Crocodile Farm is a location with a low vegetation level. Vegetation can affect feed availability. [11] stated that the distribution of birds is closely related to the availability of food. Furthermore, [34], the diversity of animal species, including birds, is strongly influenced by the level of feed availability.

Birds need food for their survival. Birds have a preference for certain types of feed, so to meet their food needs, birds look for habitats that can provide the appropriate type of feed. According to [35], birds have a preference for a food, if one place does not meet their needs, birds will choose another place that has abundant food sources.

The grouping of birds based on the same pattern of resource use (guild) in the feed category has a relationship with tree species and the availability of food sources. According to [36], each community in different locations can show different patterns in plant species composition, guild structure and bird density. [37] suggests that environmental aspects that can affect bird distribution patterns include the presence and availability of food resources which are influenced by vegetation composition. Data on bird species grouping based on the type of feed guild category can be seen in Table 4.

Table 4 Grouping of birds based on different patterns of resource use Same (guild) according to [23].

Type of Bird		Type of Feed
Scientific Name	Local Name	
<i>Acridotheres javanicus</i>	Jalak kerbau	BGI
<i>Bubulcus ibis</i>	Kuntul kerbau	CI
<i>Egretta alba</i>	Kuntul besar	CI
<i>Egretta garzetta</i>	Kuntul kecil	CI
<i>Ixobrychus eurhythmus</i>	Bambangan coklat	CI
<i>Nycticorax nycticorax</i>	Kowak malam abu	CI
<i>Geopelia striata</i>	Perkutut Jawa	G
<i>Streptopelia chinensis</i>	Tekukur biasa	G
<i>Amaurornis phoenicurus</i>	Kareo padi	GI
<i>Gallinula chloropus</i>	Mandar batu	GI
<i>Halcyon pileata</i>	Cekakak Cina	IN
<i>Prinia flaviventris</i>	Perenjak rawa	LGI

Description : Bark Gleaning Insectivore (BGI) eats insects on branches and twigs, Litter Gleaning Insectivore(LGI) insectivorous on litter or forest floor. Insectivore-Nectarivore (IN) eats insects and nectar, Carnivore-Insectivore (CI) eats other vertebrates and insects, Granivore eats seeds, Granivore-Insectivore (GI) eats seeds and insects.

Table 4 can be seen that the birds that dominate in the Asam Kumbang Crocodile Breeding area are the Carnivore– Insectivore (CI) guilds that eat other vertebrates and insects, followed by the Granivore (G) seed-eating guild categories and the Granivore–Insectivore (GI)

which eat seeds and insects. large insects, as well as the categories of Bark Gleaning Insectivore (BGI) insectivorous, Insectivore-Nectarivore (IN) insectivorous and nectar-eating and Litter Gleaning Insectivore (LGI) insectivorous feeding on litter or forest floor. Insect-eating groups are very common. This is because insects dominate the terrestrial ecosystem. According to [38], most birds are insectivorous or use insects as an alternative food. According to [14].

3.4 Status of Bird Species Found in Crocodile Breeding Area Asam Kumbang, Medan Selayang District, Medan City

Bird data obtained from the results of research at the location, there are two types of birds which are protected birds in Indonesia according to the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.20/MENLHK/SETJEN/KUM.1/6/2018 concerning Types of Plants and Animals the Protected. According to the IUCN Red List Global (2016), one of the number of bird species found is classified as Vulnerable (VU). The status of birds

Table 5 Status of Bird Species Found in Crocodile Breeding Area Asam Beetle District Medan Selayang City Medan species encountered in the field can be seen in Table 5 below.

No	Type of Bird		Protection Status	
	Scientific Name	Local Name	PermenLHK	IUCN
1.	<i>Acridotheres javanicus</i>	Jalak kerbau	-	VU
2.	<i>Amaurornis phoenicurus</i>	Kareo padi	-	LC
3.	<i>Bubulcus ibis</i>	Kuntul kerbau	-	LC
4.	<i>Egretta alba</i>	Kuntul besar	DL	LC
5.	<i>Egretta garzetta</i>	Kuntul kecil	-	LC
6.	<i>Gallinula chloropus</i>	Mandar batu	-	LC
7.	<i>Geopelia striata</i>	Perkutut Jawa	-	LC
8.	<i>Halcyon pileata</i>	Cekakak Cina		LC
9.	<i>Ixobrychus eurhythmus</i>	Bambangan coklat	DL	LC
10.	<i>Nycticorax nycticorax</i>	Kowak malam abu	-	LC
11.	<i>Prinia plaviventris</i>	Perenjak rawa	-	LC
12.	<i>Streptopelia chinensis</i>	Tekukur biasa	-	LC

Description: DL = Protected; LC = Least Concern / low risk ; VU = Vulnerable/vulnerable.

Data in Table 5 on the status of bird species found during observations. From this data, it can be seen that according to Ministerial Regulation Number P.20/MENLHK/SETJEN/KUM.1/6/2018, two of the bird species found were included in the protected bird category in Indonesia, namely the great egret (*Egretta alba*) and cacao tree (*Ixobrychus eurhythmus*). According to the IUCN Red List Global (2016), one of these bird species is classified as Vulnerable and 11 other bird species are included in the Least Concern category, which indicates that this bird species has been evaluated but does not meet the criteria

4. Conclusion

The conclusions of this study are:

- a. Diversity of bird species found as many as 12 bird species, namely *Streptopelia chinensis* (ordinary turtledove), *Geopelia striata* (Javanese turtledove), *Halcyon pileata* (Chinese cockroach), *Amaurornis phoenicurus* (rice kareo), *Gallinula chloropus* (stone palm), *Prinia flaviventris* (swamp prawn), *Acridotheres javanicus* (buffalo starling), *Bubulcus ibis* (buffalo egret), *Egretta alba* (large egret), *Egretta garzetta* (little egret), *Nycticorax nycticorax* (ash night owl) and *Ixobrychus eurhythmus* (chocolate whiskers).
- b. Based on the results of data analysis, the index value of bird species diversity (H') at the observation site was classified into the "medium diversity" category, which was 1.171 with an evenness value (E) of 0.47.
- c. The status of birds according to the Minister of Environment and Forestry Regulation No. P.20, namely 2 birds are included in protected birds in Indonesia, namely the great egret (*Egretta alba*) and the brown bambangan (*Ixobrychus eurhythmus*).

Reference

- [1] Michael P, 1984. Metode Ekologi Untuk Penyelidikan Lapangan Dan Laboratorium. UI Press. Jakarta
- [2] MacKinnon J, Phillipps K, van Balen B, 1998. Seri Panduan Lapangan Burungburung di Sumatera, Jawa, Bali dan Kalimantan. Birdlife International-Indonesia Program – Pusat Penelitian dan Pengembangan Biologi LIPI. Bogor
- [3] Maltby E. 1986. Waterlogged Wealth. An Earthscan Paperback. London. 198h.
- [4] Sukandar et al., 2015. Komunitas Burung di Pulau Tidung Kecil Kepulauan Seribu. Jurnal Biologi, 8: 66-76.
- [5] Nell LA et al., 2016. Presence of Breeding Improves Body Condition for a Crocodylian Nest Protector. Plos ONE. 11 (3).
- [6] Bibby C, Jones M, Marsden S, 2000. Teknik-teknik Ekspedisi Lapangan Survei Burung. Bogor. SMKG Mardi Yuana.
- [7] Mac Kinnon J, Philips K, Balen V, 2010. Birds of Sumatra, Java, Bali, and Kalimantan. Bogor(ID). Indonesian Bird.

- [8] Magurran A. 1988. *Ecological Diversity and Its Measurement*. Croom Helmed Limited. London. PP 1-80.
- [9] Ludwig JA, Reynolds JF. 1998. *Statistical Ecology: A Primer on Methods and computing*. New York (US): John Wiley and Sons Inc..
- [10] Ekowati A, Setiyani AD, Haribowo DR, and Hidayah K. 2016. Diversity Bird Species in Color Lake Area, North Tugu Village, Cisarua, Bogotá. *Journal of Biology*.9 (2) : 87-94.
- [11] Peterson RT, 1980. *The Birds*. Second Edition. Translated by Kamil TW dan T. Jakarta Library. Nature Library.
- [12] Windharti Y, Nurdjali B, Erianto, 2013. Diurnal Bird Species Diversity Landak District Foreman Nature Reserve. *Scientific journals*. 2: 149-155.
- [13] Satriyono A, 2008. *Activities and Habitat Use of Bullying BirdsFlights In Juanda International Airport Area*. [Essay]. Surabaya: ITS. Biology Department.
- [14] Elfidasari D, Junardi. 2006. Diversity of waterbirds in mangrove forest areas Peniti, Pontianak Regency. *Biodiversity* 7 (1): 63-66.
- [15] Gitayana A. 2011. *Book Series on Potential Waterbirds in Alas Purwo National Park*. Banyuwangi (ID): Alas Purwo National Park Hall.
- [16] MacKinnon J, Phillips K, Balen BV. 2000. *Field Guide Series Birds in Sumatra, Java, Bali and Kalimantan*. Rahardjaningtrah W, Adikerana A, Martodiharjo P, Supardiyono EK, Balen BV, translators. Sumadipura S, Kartikasari A, editor. Bogor (ID): Research and Development Center for Biology, LIPI. Translation : *A Field Guide to The Birds of Sumatra, Java, Bali, and Borneo*.
- [17] Welty JC. 1982. *The Life of Birds*. Saunders College Publishing. Philadelphia.
- [18] Euwise JY, 1990. *Introduction to Tropical Ecology*. Bandung Institute Of Technology. Bandung
- [19] Hernowo, JB 1985. *Study of the Effect of Yard Plants on Diversity of Bird Species in Residential Settlement Areas in Bogor Level II Region*. Essay. Department of Forest Resources Conservation, Faculty of Forestry, IPB. Bogor
- [20] Fernandez GJ, Posse G, Ferretti V, Gabelli FM, 2003. Bird-habitat relationship for the declining Pampas meadowlark population in the Southern Pampas Grasslands. *Biological Conservation* 115: 139-148.
- [21] Fadrikal et al., 2005. *Urban Bird Community: Effect of Area and Tree Species on Bird Diversity*. *Pros Sem Nas Masy Biodiv Indonesia*, 1: 1842-1846.
- [22] Sukandar et al., 2015. *Bird Community on Tidung Kecil Island, Thousand Islands*. *Journal of Biology*, 8:66-76.
- [23] MacKinnon J, Phillips K, Balen van B, 1992. *Birds of Sumatra, Java, Bali and Borneo*. Research and Development Center for Biology-LIPI. Bogor
- [24] Walther GR, 2002. *Ecological Responses to Recent Climate Change*. *Nature*. 416: 389-395

- [25] Damanik AN, Patana P, Jumilawaty E, 2014. Identification of Bird Species and Weather Conditions on an Artificial Perch in the Sei Betung Resort Restoration Area, Gunung Leuser National Park: 1-10.
- [26] Sukarsono, 2009. Introduction to Animal Ecology. UMM Press. Poor.
- [27] Sayogo AP, 2009. Diversity of Bird Species in Several Habitat Types in Lore Lindu National Park, Central Sulawesi Province. [Essay]. Bogor (ID). Department of Forest Resources Conservation and Ecotourism, Faculty of Forestry, Bogor Agricultural University.
- [28] Syafrudin D, 2011. Diversity of Bird Species in Several Habitat Types in Tambling Wildlife Nature Conservation (TNWC). [Essay]. Lampung. Bandar Lampung University.
- [29] Alikodra HS, 2002. Wildlife Management. Volume 1. Bogor: Publishing Foundation Faculty of Forestry IPB
- [30] Odum EC, 2004. The Prosperous Way Down, Ecological Modeling. 178: 247-250.
- [31] Linggarjati BD, Dewi NK, Khasanah UN, Yuliana, 2014. Species diversity and abundance of avifauna in the western suburb of Madiun City. Florea 1(2):1-7.
- [32] Pettingill OS, 1970. Ornithology in Laboratory and Field. Minnesota (US). Burgess Publisher.
- [33] Welty JC, Baptista L, 1988. The Life of Birds, Fourth ed. Saunders College Publishing NY 698pp
- [34] Odum EP, 1993. Fundamentals of Ecology Third Edition. Yogyakarta: Gadjah University Mada Press.
- [35] Dewi TS, 2005. A Study on the Diversity of Bird Species in Various Types of Landscapes Pine Plantation Forest. Essay. Bogor: Department of Resource Conservation Forest Faculty of Forestry IPB.
- [36] Ding TS, Lee PF, Lin YS. 1997. Abundance and distribution of bird in four, high elevation plant communities in Yushan National Park, Taiwan. Acta Zoologica Taiwanica 8 (1): 55-64.
- [37] Freifeld HB. 1999. Habitat relationships of forest birds on Tutuila Island, American Samoa. Journal of Biogeography 26:1191-1213.
- [38] Sodhi NS, Soh MCK, Prawiradilaga DM, Darjono, Brook BW, 2005. Persistence of lowland rainforest birds in a recently logged area in Central Java. Bird Conservation International 15:173-191.