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Composition and Diversity of Avifauna Species in the Angke-Kapuk Protected Forest Area, North Jakarta

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Abstract

Birds are a good indicator for identifying areas rich in biodiversity, including environmental changes and problems. The reduced number of birds also indicates environmental degradation. Birds play an important role in an ecosystem in maintaining biological balance. These roles include pollinating plants, controlling insect populations and playing a role in the dispersal of plant seeds. In fact, several species of birds are considered key species where their presence in an ecosystem can indirectly influence the existence of other species. Birds need a habitat that acts as a source of food, a place to socialize, reproduce, take shelter, rest and nest. The mangrove area in the Angke-Kapuk Muara Angke Protected Forest is an important bird area or Import Bird Area. The method used is the Visual Encounter Survey (VES). Each species of avifauna found at the observation location was recorded and counted. Bird watching is carried out in the morning at 06.30 – 09.30 WIB. Observations are carried out using a transect route, that is, the observer will walk along the existing observation route. This research will be carried out in the Pantai Indah Kapuk area, namely in the Angke-Kapuk Muara Angke Protected Forest, North Jakarta. This research was conducted in November 2023. This research aims to determine the species composition and diversity of avifauna species at Pantai Indah Kapuk, North Jakarta. Based on the results of research conducted at 11 locations in the Pantai Indah Kapuk area, it was found that there were 62 species of birds from 31 families. The highest number of bird species was found in plot 1, namely 44 species belonging to 24 families and plot 9, namely 36 species belonging to 23 families.

***Keywords**: Birds, Indicators, Mangroves, North Jakarta*

INTRODUCTION

Biodiversity in Indonesia is one of the highest in the world, one of which is bird diversity. Indonesia has a high level of bird diversity with various native endemic and migrant species. According to Burung Indonesia (2023), Indonesia has a total of 1.826 bird species as of early 2023, an increase from 1.812 species in the previous year. There are a recorded number of endemic bird species in Indonesia of 532 species as of 2021. An increase in the recorded number of endemic species occurred in 2020, namely 16 species. Based on their threat status, there are 179 bird species in Indonesia that are included in the list of globally threatened bird species. There are 31 bird species in the critical category, 52 species are declared Endangered. According to MacKinnon (2010), birds are a good indicator for identifying areas rich in biodiversity, including environmental changes and

problems. It is also related to the reciprocal relationships and dependencies therein. The reduced number of birds also indicates environmental degradation.

Birds play an important role in an ecosystem in maintaining biological balance. These roles include pollinating plants, controlling insect populations and playing a role in the dispersal of plant seeds (MacKinnon, 1990). In fact, several species of birds are considered key species where their presence in an ecosystem can indirectly influence the existence of other species. Birds need habitats that act as providers of food sources, places to socialize, reproduce, take shelter, rest and nest (Hadianto et al., 2012).

The existence of a particular bird population usually depends on the habitat preferred by that bird population, for example mangrove forests as bird habitat (Swastikaningrum et al., 2012). Mangrove forests are a transitional area between terrestrial and marine areas where they are generally covered with typical vegetation in the form of plants that can tolerate changes in salinity. In general, mangrove forests have an important role as a habitat for various species of aquatic biota and a source of nutrients for animal food. Mangrove forests are very important from biological and ecological aspects. Viewed from an ecological aspect, mangrove forests are a habitat for shorebirds and several species of forest birds. This is because the availability of food for shorebirds and predatory birds is abundant, while from an economic aspect it can increase the income of the surrounding community.

The mangrove area in the Angke-Kapuk Muara Angke Protected Forest, North Jakarta has an area of 44.76 Ha. The geographical location of this area is located at 106043'- 106048 East Longitude and 606'-6010' South Latitude, included in the Kapuk Muara Village area, Penjaringan District, North Jakarta. Its status as a protected forest with absolute cover along the coastline with a width of 100 – 150 meters is determined based on the Decree of the Governor of DKI Jakarta No. Ea 15/1/13/70 (Atmawidjaja and Romimohtarto, 1998).

The existence of mangrove forests or mangroves in Jakarta Bay is very important, in the coastal area of the North Coast of Jakarta, supporting the sustainable development of DKI Jakarta. Mangrove areas are areas that are very vulnerable to land conversion and exploitation due to the high number and needs of the population. The decline in the quality of mangrove areas can have a direct or indirect impact on the level of bird species diversity.

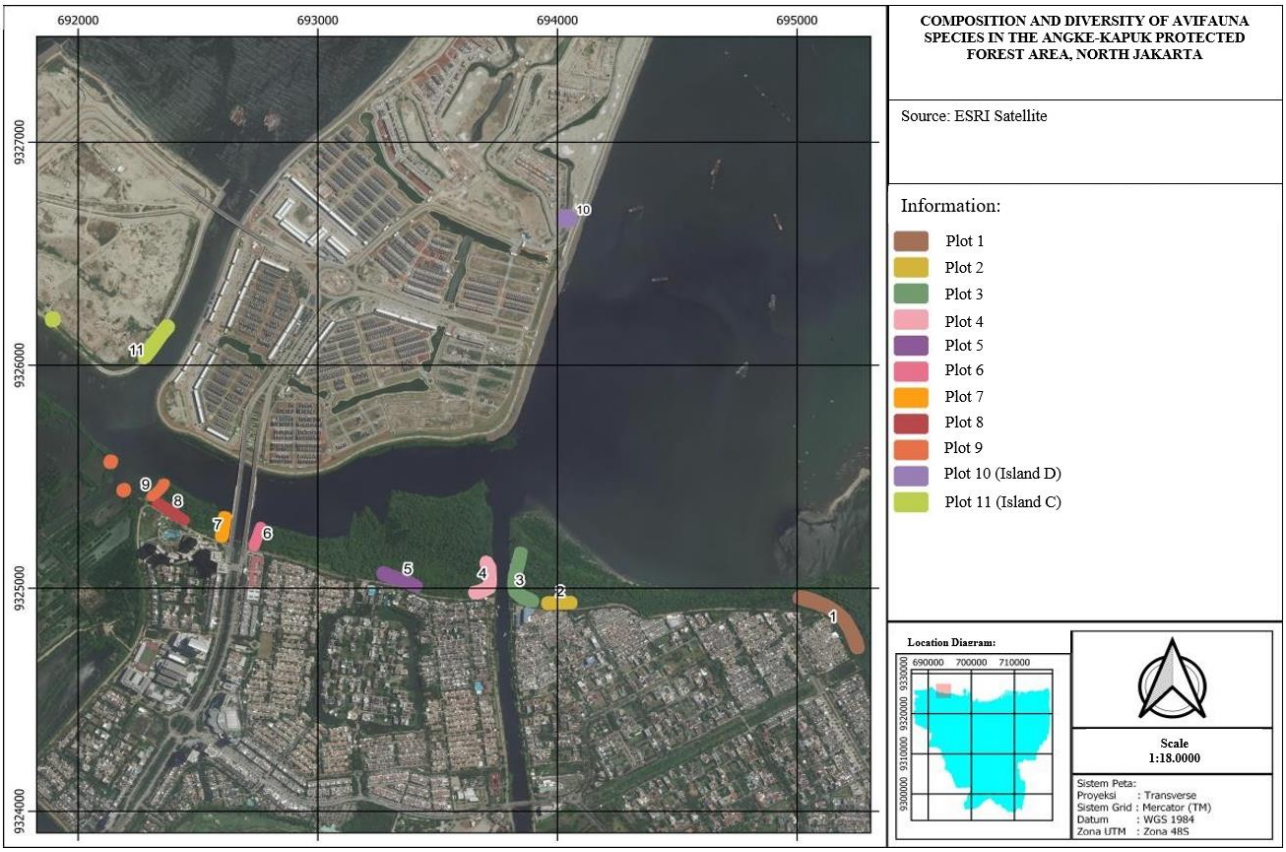
Based on this background, this research aims to determine and analyze the species composition, species diversity and abundance of bird species in the Pantai Indah Kapuk area. This research can be useful as information and input to related agencies to maintain the existence of bird species in the Pantai Indah Kapuk area.

METHOD

1. Time and Location of Sampling

This research was located at 11 points in the Pantai Indah Kapuk (PIK) area, North Jakarta. The location of the 11 observation points consists of plots 1 – 9 which are protected forest areas, while the other 2 plots, namely Islands C and D, are reclaimed island areas (Figure 1). The research was carried out on 6 November 2023 - 12 November 2023. Determining the location of the observation points in the Pantai Indah Kapuk area was based on representatives of each area's conditions so that the data taken could represent all conditions that exist in the PIK area (Figure 1).

Figure 1. Sampling location



2. Research Equipment

The equipment used in this research was stationery, pocket book, field guide book "Birds in Sumatra, Kalimantan, Java and Bali", digital camera, GPS, binoculars, digital clock and counter.

3. Data Collection Method

Before making observations, first make an observation of the area. To see and get to know the area that will be used as an observation location, apart from looking for information about birds in the local location and getting to know them as well as searching for locations and determining observation points.

The method used is the Visual Encounter Survey (VES). Each species of avifauna found at the observation location was recorded and counted. Bird observations are carried out in the morning at 06.30 – 09.30 WIB. Observations are carried out using the Transect route, that is, the observer will walk along the existing observation route. In this method, observations run along a predetermined path/road with a right and left observation radius of 25 meters. Every time they meet a bird (observation target), the observer will stop for ±15-20 minutes to identify it. The parameters observed are the observer's encounter time with each species of bird, identifying the species of bird that is on each observation route and counting the number of individuals of each species of bird.

4. Data Analysis

1. Species composition

Species composition is the arrangement and number of species in an area, to determine the underlying composition of whether there is a relationship between the number of species

commonly found in two community areas and the total species (Rusmendro, 2004).

2. Shannon-Wiener species diversity index
   To find out the bird species diversity index according to Magurran (1988), you can use the formula:

   $$H' = -\sum Pi \, . \ln Pi$$

   Information:
   H' = Species Diversity Index
   Pi = ni/N
   ni = number of individuals in species 1
   N = number of individuals of all species
   According to Krebs (1985), the criteria used to determine the value of the species diversity index (H'), namely:

   H' $\leq$ 1 = Low diversity
   1 < H' < 3 = Medium diversity
   H' > 3 = High diversity

3. 3. Relative Frequency (RF), Relative Abundance (RK) and Importance Value Index (IVI).
   Frequency is a quantity that expresses the level of encounter in a community. Relative Frequency (RF) is obtained from the comparison between the frequency value of one species and the frequency value of all species. Frequency values and relative frequency can be calculated using the formula (Fachrul, 2012):

$$F = \frac{\text{Number of paths containing species i}}{\text{Number of lanes}}$$

$$RF = \frac{\text{Individual frequency of a bird species}}{\text{Total frequency of all bird species}} \text{ X } 100\%$$

Abundance shows the number of individuals of certain species that are members of a community. Relative abundance is calculated by dividing the abundance of one species by the abundance of all species. The abundance (A) and Relative Abundance (RA) values of each bird species at each observation location can be calculated using the formula (Fachrul, 2012) as follows:

$$A = \frac{\text{The number of individuals of a species at each location}}{\text{Total number of individuals}}$$

$$RA = \frac{\text{The abundance of individuals of a species}}{\text{Total abundance of all species}} \text{ x } 100\%$$

The Importance Value Index (IVI) is a quantitative parameter that can be used to express the level of species dominance in a bird community. To get the important value, it can be calculated using the formula (Fachrul, 2012):

IVI = RF + RA
Information:
RF = Relative Frequency
RA = Relative Abundance

4. Species evenness index
The Species Evenness Index functions to determine the evenness of each species of bird in each community. The evenness of bird species can be calculated using the formula (Fachrul, 2012), namely:

$$E = \frac{H}{Ln\ (S)}\ x\ 100\ \%$$

Information:
E = Species evenness index
H' = Species diversity index
S = Number of species found

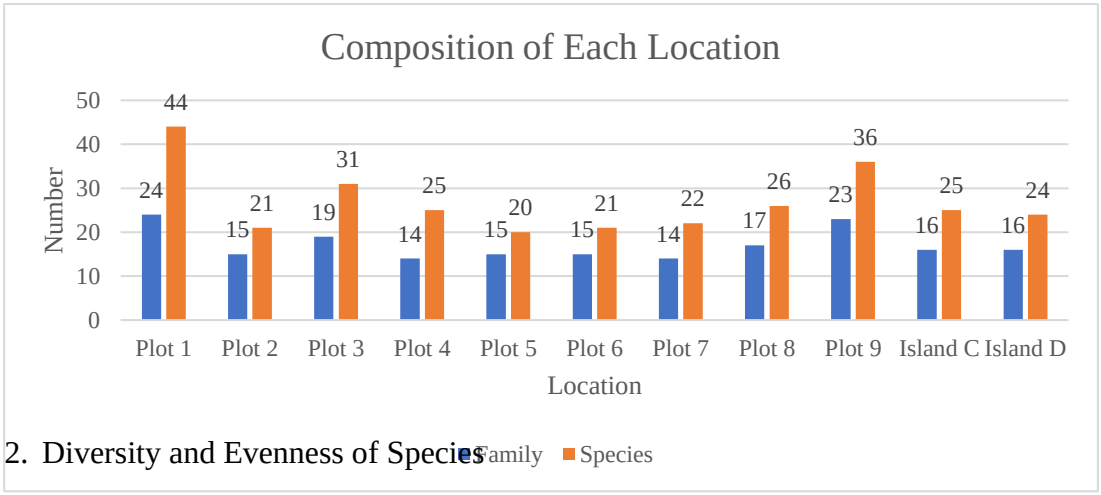
If the species evenness index value is close to one, then the bird species found in the community are more evenly distributed and if the evenness index value is close to zero, it indicates that there is an unequal distribution of bird species in a community (Fachrul, 2012).

RESULT

1. Species Composition

Based on the results of research conducted at 11 locations in the Pantai Indah Kapuk area, it was found that there were 62 species of birds from 31 families. Based on Figure 2, the highest number of bird species was found in plot 1, namely 44 species belonging to 24 families and plot 9, namely 36 species belonging to 23 families. Meanwhile, the lowest number of bird species in plot 5 was 20 species of 15 families, plot 2 and plot 6 were 21 species of 15 families (Figure 2).

Figure 2. Comparison graph of the number of families and species of birds

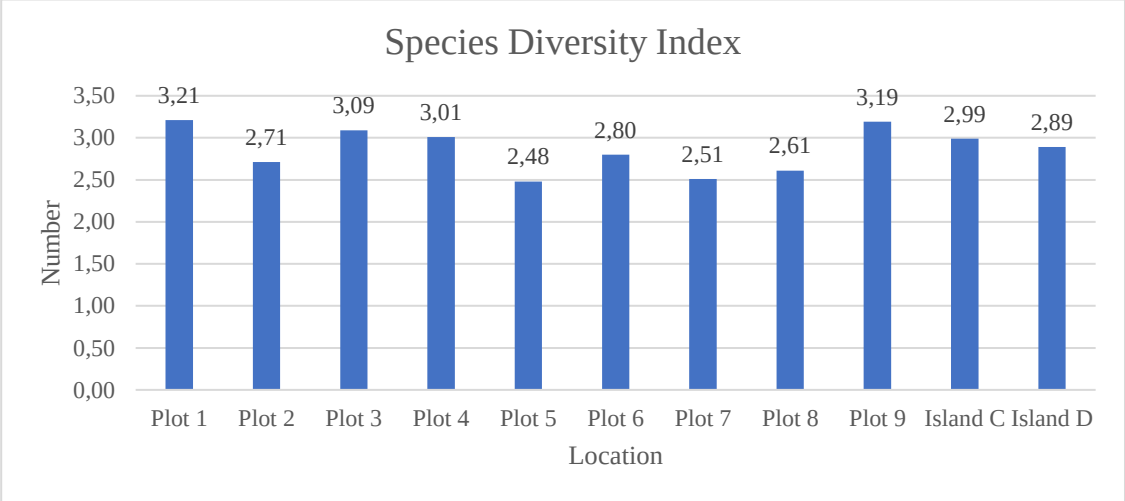


2. Diversity and Evenness of Species

Based on the results of the survey that was carried out, it was found that the diversity index (H) of bird species in the Pantai Indah Kapuk area can be seen in the image below (Figure 3).

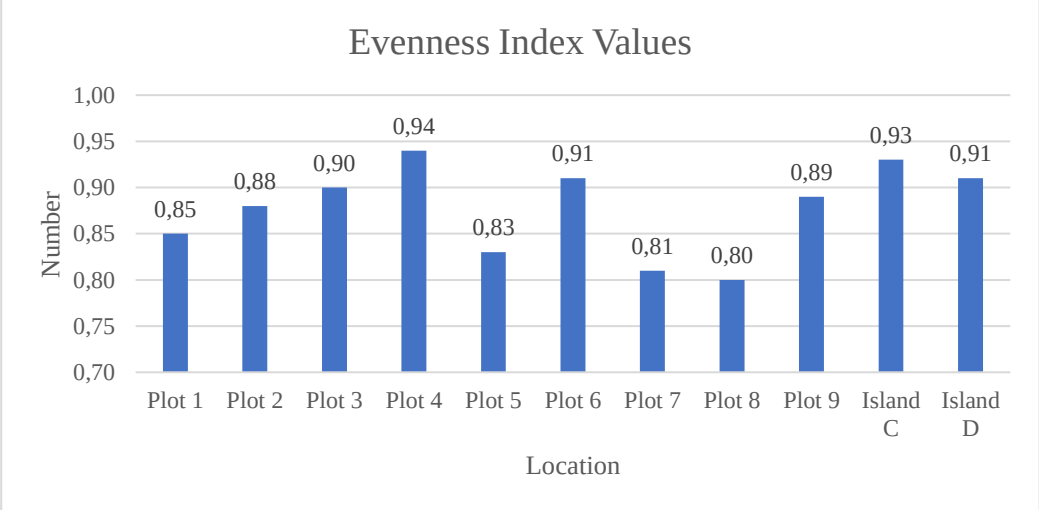
Comparison of the highest diversity values in plot 1 (3.21) and plot 9 (3.19), this value is classified in the high diversity category (Krebs, 1985). The survey results show that the category of bird species diversity at the Pantai Indah Kapuk location is still stable and even tends to increase with the discovery of several new bird species that were not previously found.

Figure 3. Comparison graph of the Shanon Wiener Species Diversity Index (H)



From the results of the evenness index, the bird species found in several areas of Pantai Indah Kapuk have an evenness that is not much different between the plots. This value can ensure that the habitat in each plot has the capacity to meet the availability of food for a species so that there is no high competition between species. In the 2023 study, the evenness value ranged from 0.80 to 0.94). According to Novarino (2010), the value of species diversity and evenness will be evenly distributed if at the observation location the bird species found are evenly distributed with the same number of individuals. At each location, several different species of birds and different bird characters were found, one example being on Island D, we found migratory terns, whiskered terns, which generally move in small or large groups.

Figure 4. Comparison graph of Evenness Index Values (E)



3. Species Encounter Rate
   High frequency values for a number of bird species are related to the bird's ability to adapt to the environment. Frequency values are used to see the spatial distribution of birds in the observation section. Based on the survey results obtained for frequency levels in the Pantai Indah Kapuk area, the relative frequency values for each bird can be seen in the table below.

Table 1. RA (Relative Abundance) and RF (Relative Frequency) Values

RA and RF Values			
Plot 1			
Scientific Name	**Indonesian Name**	**RA**	**RF**
Himantopus leucocephalus	Gagang bayam belang	13,6	2,273
Gelochelidon nilotica	Dara-laut tiram	10,4	2,273
Chlidonias hybrida	Dara-laut kumis	9,2	2,273
Plot 2			
Scientific Name	**Indonesian Name**	**RA**	**RF**
Collocalia linchi	Walet linci	20,909	4,762
Passer montanus	Burung gereja erasia	12,727	4,762
Ardeola speciosa	Blekok sawah	7,273	4,762
Plot 3			
Scientific Name	**Indonesian Name**	**RA**	**RF**
Passer montanus	Burung gereja erasia	12,805	3,226
Collocalia linchi	Walet linci	9,756	3,226
Lonchura punctulata	Bondol peking	9,756	3,226
Plot 4			
Scientific Name	**Indonesian Name**	**RA**	**RF**
Collocalia linchi	Walet linci	12,403	4
Passer montanus	Burung gereja erasia	11,628	4
Lonchura punctulata	Bondol peking	8,527	4
Plot 5			
Scientific Name	**Indonesian Name**	**RA**	**RF**
Passer montanus	Burung gereja erasia	28	5
Lonchura punctulata	Bondol peking	16	5
Collocalia linchi	Walet linci	11	5

RA and RF Values			
Plot 6			
Scientific Name	**Indonesian Name**	**KR**	**RF**
Passer montanus	Burung gereja erasia	15,625	4,545
Collocalia linchi	Walet linci	11,458	4,545
Pycnonotus aurigaster	Cucak kutilang	9,375	4,545
Plot 7			
Scientific Name	**Indonesian Name**	**RA**	**RF**
Collocalia linchi	Walet linci	30,088	4,545
Lonchura punctulata	Bondol peking	10,619	4,545
Passer montanus	Burung gereja erasia	9,735	4,545
Plot 8			
Scientific Name	**Indonesian Name**	**RA**	**RF**
Passer montanus	Burung gereja erasia	25,714	3,846
Lonchura punctulata	Bondol peking	16,429	3,846
Collocalia linchi	Walet linci	10,000	3,846
Plot 9			
Scientific Name	**Indonesian Name**	**RA**	**RF**
Passer montanus	Burung gereja erasia	13,974	2,778
Collocalia linchi	Walet linci	9,607	2,778
Lonchura punctulata	Bondol peking	7,860	2,778
Island C			
Scientific Name	**Indonesian Name**	**RA**	**RF**
Passer montanus	Burung gereja erasia	12,234	4,000
Anas gibberifrons	Itik benjut	10,638	4,000
Ardeola speciosa	Blekok sawah	10,106	4,000
Island D			
Scientific Name	**Indonesian Name**	**RA**	**RF**
Sterna hirundo	Dara-laut biasa	10,900	4,167
Anas gibberifrons	Itik benjut	10,427	4,167
Cisticola juncidis	Cici padi	8,057	4,167

The density and frequency values can then be used to calculate important index values, the calculation results of which are presented in the table below.

Table 4. Highest Importance Value Index (IVI) at Each Location

Importance Value Index		
Plot 1		
Scientific Name	**Indonesian Name**	**IVI**
Himantopus leucocephalus	Gagang bayam belang	15,873
Gelochelidon nilotica	Dara-laut tiram	12,673
Chlidonias hybrida	Dara-laut kumis	11,473
Plot 2		
Scientific Name	**Indonesian Name**	**IVI**
Collocalia linchi	Walet linci	25,671
Passer montanus	Burung gereja erasia	17,489
Ardeola speciosa	Blekok sawah	12,035
Plot 3		
Scientific Name	**Indonesian Name**	**IVI**
Passer montanus	Burung gereja erasia	16,031
Collocalia linchi	Walet linci	12,982
Lonchura punctulata	Bondol peking	12,982
Indeks Nilai Penting		
Plot 4		
Scientific Name	**Indonesian Name**	**IVI**
Collocalia linchi	Walet linci	16,403
Passer montanus	Burung gereja erasia	15,628
Lonchura punctulata	Bondol peking	12,527
Plot 5		
Scientific Name	**Indonesian Name**	**IVI**
Passer montanus	Burung gereja erasia	33
Lonchura punctulata	Bondol peking	21
Collocalia linchi	Walet linci	16

Importance Value Index		
Plot 6		
Scientific Name	**Indonesian Name**	**IVI**
Passer montanus	Burung gereja erasia	20,170
Collocalia linchi	Walet linci	16,004
Pycnonotus aurigaster	Cucak kutilang	13,920
Plot 7		
Scientific Name	**Indonesian Name**	**IVI**
Collocalia linchi	Walet linci	34,634
Lonchura punctulata	Bondol peking	15,165
Passer montanus	Burung gereja erasia	14,280
Plot 8		
Scientific Name	**Indonesian Name**	**IVI**
Passer montanus	Burung gereja erasia	29,560
Lonchura punctulata	Bondol peking	20,275
Collocalia linchi	Walet linci	13,846
Indeks Nilai Penting		
Plot 9		
Scientific Name	**Indonesian Name**	**IVI**
Passer montanus	Burung gereja erasia	16,752
Collocalia linchi	Walet linci	12,385
Lonchura punctulata	Bondol peking	10,638
Island C		
Scientific Name	**Indonesian Name**	**IVI**
Passer montanus	Burung gereja erasia	16,234
Anas gibberifrons	Itik benjut	14,638
Ardeola speciosa	Blekok sawah	14,106
Island D		
Scientific Name	**Indonesian Name**	**IVI**
Sterna hirundo	Dara-laut biasa	15,067
Anas gibberifrons	Itik benjut	14,593
Cisticola juncidis	Cici padi	12,224

High relative abundance and relative frequency values for a particular bird species are used to determine the Importance Value Index or dominance in a habitat. The bird that has the highest dominance at the research location is the Gereja Erasia (*Passer montanus*). This species of bird dominates in Plots 3, 5, 6, 8, 9 and Island C in the Pantai Indah Kapuk area. The Gereja Erasia (*Passer montanus*) is a very common species of city bird. Lives in colonies and is associated with humans, so it is always found at every observation location.

4. Migratory birds in the Pantai Indah Kapuk area

Bird migration is the movement of bird populations from the northern hemisphere to the southern hemisphere. This occurs every year, birds move from breeding places to foraging places as long as the climate in the northern hemisphere does not allow them to find food. When migrating birds do not breed and will breed when they return to their original habitat when the breeding season arrives (Campbell, 1985 in Howes et al., 2003). Based on the time used by migratory birds, it is return migration. Return migration is a movement carried out by birds from a certain destination and then returning to their starting location regularly. This migration is carried out by various species of birds when the northern hemisphere enters winter to the southern hemisphere where it is summer (Howes et al, 2003). Several species of waterbirds are species of birds that often migrate regularly every year or annually. Hayman et al (1988) stated that the group of waterbirds are shorebirds that regularly migrate.

In 2023 observations, 9 species of migratory birds were found in several observation locations, namely Kicuit Kerbau (*Motacilla flava*), Trinil Semak (*Tringa glareola*), Trinil Pantai (*Actitis hypoleucos*), Dara Laut Kumis (*Chlidonias hybrid*), Dara Laut Tiram (*Sterna nilotica*), Dara Laut Biasa (*Sterna hirundo*), Gagang Bayam Belang (*Himantopus leucocephalus*), Gagang Bayam Timur (*Himantopus himantopus*) and Alap-Alap Kawah (*Falco peregrinus*).

DISCUSSION

The *Ardeidae* family is the family that has the largest number of bird species in the Pantai Indah Kapuk (PIK) area. There are 11 species of birds belonging to the *Ardeidae* family in the Pantai Indah Kapuk area, namely the Cangak Abu (*Ardea cinerea*), Cangak Merah (*Ardea purpurea*), Kuntul Kerbau (*Bubulcus ibis*), Kuntul Besar (*Egretta alba*), Kuntul Kecil (*Egretta garzetta*), Kokokan Laut (*Butorides striata*), Blekok Sawah (*Ardeola speciosa*), Bambangan Merah (*Ixobrychus cynnamomeus*), Kuntul Karang (*Egretta sacra*), Kuntul Perak (*Ardea intermedia*) and Kowak-Malam Kelabu (*Nycticorax nycticorax*) which are common families found in mangrove areas. Almost all species and families of birds were found at 11 observation points except for the red Bambangan which was only found in Plot 1.

The existence of the *Ardeidae* family which is generally distributed in the PIK area is due to the type of habitat which is suitable for making nests and breeding as well as the availability of a lot of food. The abundance of required resources will influence the rare or non-discovery of species in an area. An area that is often visited by birds because it can provide food and drink needs and function as a place to hide or hide, a place to rest, a place to sleep and a place to breed (Al Haq et al., 2011).

Based on a survey conducted in 2023, 30 species of birds were found which were classified as waterbirds. Waterbirds are a species of bird that depends almost entirely on wetland areas (natural and artificial) including mangrove forests, swamps, mudflats, lakes, ponds, rice fields and others (Noor et al., 1999). Some examples of water bird families include *Ardeidae* (Kuntul, Cangak, Kokokan), *Phalacrococidae* (Pecuk), *Ciconiidae* (Bangau) and *Rallidae* (Kareo). Apart from waterbirds in the Pantai Indah Kapuk area, several groups of shorebirds (shorebirds or waders) were also found, a group of waterbirds that are very dependent on coastal areas to find food and breed as well as a place to stop during migration (Howes et al, 2003). According to Tirtaningtyas and Febrianto (2013), there are several species of shorebirds which are migrant birds from the northern hemisphere. This happens because the northern hemisphere is experiencing winter so this is one way to survive during the season. extreme cold. There are 65 species of shorebirds found in Indonesia. Several examples of shorebird tribes such as *Charadriidae* (Cerek) and *Scolopacidae* (Trinil) are found in the Pantai Indah Kapuk area.

Based on Figure 3, the lowest diversity value is found in Plot 5, namely 2.48 and Plot 7, namely 2.51. There are several factors that cause the low diversity value in Plot 5 and Plot 7, one of which is

that there are not many certain food trees that provide shelter and breeding for birds and also quite high human activity because these two locations are very close to the main road. lots of vehicles pass by. Meanwhile, the survey location in Plot 9 has a wider coverage so that birds can be observed (including flying birds).

According to Wiens and Rotenberry (1981), more diverse birds will be found in habitats that have an abundance of the required resources, and conversely birds will be difficult to find in environments that are less favorable for them. The diversity of bird species differs from one place to another depending on environmental conditions and factors that influence animal life such as biotic factors (food, predators, migration, vegetation composition) and abiotic factors (temperature, water, climate and oxygen).

The location of Plot 1 coincides with Protected Forest, close to community settlements and the Angke Wildlife Reserve. Apart from that, opposite SM Angke there is a Gosong Island which is visited by many migratory birds so you can still find many different species of birds and there are still large populations of various species of birds there. , while Plot 9 has a wide view with mangrove habitat and estuaries, apart from that, the location of Plot 9 is close to the Angke Kapuk Nature Tourism Park, which is one of the factors for the many species found in Plot 9.

The diversity of species in an area is determined by various factors. Species diversity has a number of components that can react differently to geographic factors and physical development, one of the main components is species richness (Odum, 1993).

The diversity of bird species in one habitat and another depends greatly on the diversity of vegetation, abundance of food, shelter and water sources. Vegetation diversity can provide a diversity of bird species (Alikodra, 1990). There are several factors that cause the high H value in Plot 1 and Plot 9, namely the lack of human activity and the distance from residential areas.

Based on the calculation results (Table 1), the highest relative abundance value in 2023 is the Gereja Erasia (*Passer montanus*) which we can find in 9 observation locations with the highest RA value in Plot 5. The species of Walet Linchi (*Collocalia linchi*) is almost present. in all, namely with the highest RA value in Plot 7. Apart from that, there are also species of migratory birds that have high RA values, namely the Gagang Bayam (*Himantopus leucocephalus*) in Plot 1.

The Gereja Erasia (*Passermontanus*) and Walet Linci (*Collocalia linchi*) are birds that have high relative abundance values in several research locations. This is due to the bird's ability to live in various habitats and adapt very quickly, this bird also usually lives in small to large groups. Meanwhile, water birds that have a fairly high species encounter rate compared to other species of water birds are the Blekok Sawah (*Ardeola speciosa*) and Itik Benjut (*Anas gibberifrons*). Both birds are from the same family, namely *Ardeidae*, which is widespread in the world and consists of birds with long legs, long necks, long and straight beaks which are used to catch fish, small vertebrates or invertebrates.

CONCLUSION

Based on the results of the research that has been carried out, the following conclusions can be drawn:

a. Komposisi The bird species at 11 observation locations in the Pantai Indah Kapuk area were 62 bird species from 31 families. The most species of birds come from the *Ardeidae* family, this family is widespread throughout the world and is characterized by long legs, long necks, long straight beaks which are used to find fish, small crustaceans or other invertebrates.
b. The highest diversity of bird species is in Plot 1 and Plot 9. The high diversity index value at this location compared to other locations is thought to be due to the presence of a number of vegetation that shelters birds and is a source of food. Apart from that, in Plot 1 there is also a sandbar island which is a stopover place for migratory birds to look for food. Another factor is that the location is not very close to human settlements and activities.

c. The encounter rate at the 11 observation locations was dominated by the Gereja Erasia (*Passer montanus*) and Walet Linci (*Collocalia linchi)*.
d. There are 9 recorded species of migratory birds, namely Kicuit Kerbau (*Motacilla flava*), Trinil Semak (*Tringa glareola*), Trinil Pantai (*Actitis hypoleucos*), Dara Laut Kumis (*Chlidonias hybrid*), Dara Laut Tiram (*Sterna nilotica*), Dara Laut Biasa (*Sterna hirundo*), Gagang Bayam Belang (*Himantopus leucocephalus*), Gagang Bayam Timur (*Himantopus himantopus*), and Alap-Alap Kawah (*Falco peregrinus*).

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