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ABUNDANCE AND DIVERSITY OF BIRD SPECIES AND THEIR CONSERVATION STATUS IN THE COASTAL AREA AND MARANA RIVER ESTUARY, MAROS REGENCY

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ABSTRACT

Marana river estuary and its surrounding coastal area have been converted into extensive fishpond. This muddy environment with abundant fish in shallow waters, mangroves and *Nypa* palm attracts various species of birds to forage for food. This area also visited by migratory birds. However, avifauna in this area still poorly studied. Based on this, research on abundance, diversity of bird species and its conservation status was conducted. The aim of this study was to determine the abundance, ecological index and conservation status/protection status of bird species in coastal and estuary of Marana River, Maros Regency. Totally, six stations were set up in three different habitat types. Two stations were placed in the mangrove area around the mouth of the river, two stations in the pond area next to the river and two stations in the middle of the river that entered further inland. Data was collected using the point count method, with 3 replicates of different observation points set up randomly at each station. Each point has a circular observation area with a radius of 50m. The distance between observation points is 300m with a bird watching time of 20 minutes at each observation point. Bird species outside the observation area were also recorded but not counted. From the observations, a total of 22 bird species from 14 families were recorded from all stations. Most of the bird species dominated by waterbirds and open country specialized birds i.e: Whiskered Tern (Dara-laut Kumis), Glossy Swiftlet (Walet Sapi) and Little Egret (Kuntul Kecil). From ecological index analysis, bird community in all stations is categorized as stable, with moderate diversity, low dominance and high eveness index except for station 2 which is mostly dominated by Whiskered Tern. All bird species conservation status is categorized as Least Concern (LC) by IUCN. Little Egret (*Kuntul Kecil*), Cattle Egret (*Kuntul Kerbau*) and Great Egret (*Kuntul Besar*) are included in appendix III CITES. Furthermore, four shorebird species: Far Eastern Curlew (Gajahan Timur), Eurasian Whimbrel (*Gajahan Pengala*), Whiskered Tern (*Dara-laut Kumis*) and White-winged Tern (*Dara-laut Sayap Putih*) are protected by the Indonesian Government. It is concluded that bird communities in study sites are stable and Marana estuary can still support bird life, especially for migratory and protected bird species.

Keywords: Abundance, Ecological index, G Status, Marana Estuary, Maros Regency

INTRODUCTION

Coastal areas are transitional areas that are influenced by land and sea, thus forming a very dynamic environment (Christiawan and Gede, 2017). Marannu Village is in Lau District, Maros Regency, South Sulawesi Province, which borders the Makassar Strait to the west. This coastal area is a wetland area consisting of rivers, pond areas and mangroves, which have very important ecological and economic functions, such as as a habitat for various types of aquatic organisms and as a transportation route for boats and small ships. This coastal area also uses the Marana River as a water source for pond cultivation activities (Fitrawahyudi et al., 2019). The more open pond area and the abundance of fish attract various species of fauna to stop by and look for food in the area. One of the animals that is striking and easyly found is birds. This is related to the function of the area, namely providing shelter, foraging for food, breeding and nesting (Master et al., 2016). Based on this, the presence of birds in a habitat can be used as an indicator of whether the environment in the coastal area supports the life of other organisms or not because it has a reciprocal and interdependent relationship with its environment. A specific example from an ecological perspective, birds use mangrove plants as a place to nest, perch, find food and as reciprocity, birds leave their feces as fertilizer or nutrients for mangrove growth (Irwanto, 2006).

Birds act as a balancer for the ecosystem and help in regenerating plants (Ramlah et al., 2017), as well as playing a role in developing tourist attraction areas in coastal areas, which have economic value. The diversity of bird species with their uniqueness and beauty has enriched life and culture, as well as providing various research objects, supporting inner peace and providing satisfaction and pleasure from traveling (Ahmad, 2017).

The coastal area and estuary of the Marana River is an important habitat for various species of birds, including certain speces of shorebirds which are protected by law and migratory birds, however, their management and conservation tend not to be applied, because there are no special reports that clarify the existence of these birds. Based on this reason, this research was carried out with the title Abundance and Diversity of Bird Species and their Conservation Status in the Coastal Area and Marana River Estuary, Maros Regency.

MATERIALS AND METHODS

This research was carried out on 27–29 March 2021. Field data collection was located at the mouth of the Marana River, Lau District, Maros Regency, South Sulawesi Province. This research was carried out at 6 stations with 18 observation points in various different habitats (Estuary area, Mangrove, Tambak area) (Figure 1).

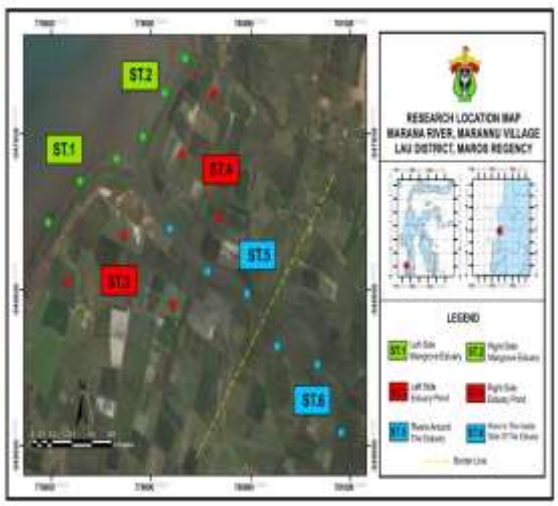

Figure 1. Map of research locations for coastal areas and Marana river estuaries, Maros Regency

The equipments used in this research are a boat as a means of transportation to the research location and also for observing birds, a Global Positioning System (GPS) to determine coordinate points in the field, a Canon camera with Tamron lens 70-300 mm as a bird documentation tool, 50x60 binoculars 9500 meter zoom lens for observing birds, hand counter for counting the number of birds, stationery for recording the data obtained, books for identifying the species of birds found at the research location.

The method used was the point count method, where the calculated points are placed along river flows, mangroves and ponds. Bird watching is carried out in the morning from 7 to 10 am. One observation day, there were three observation points observed from the three types of habitats with a distance between points of ± 300 m with an observation radius of 50 m and an observation time of 20 minutes (Bibby et al., 2000), for the next 40 minutes, it was used as a repetition in observation, along with moving to the next observation point and the results obtained are included outside the observation point and are not included in the calculation.

The observed parameters are the type and number of bird species, their habitat conditions, their activities, and the time the birds were found (Suriansyah et al., 2016), when observing and there are birds outside the observation point, they will still be recorded to be used as supporting data, however not included in the calculation (Fuad, 2019). For birds that cannot be identified in the field, the characteristics of the bird were recorded and sketched in a notebook. Observations include morphological characteristics (body shape and color, beak, feet and feathers) of the birds being observed.

Identification of Bird Species

The bird species was identified using books: Birds of the Wallacea Region (Coates and Bishop, 2000), and Shorebirds: An Identification Guide to the Waders of the World (Hayman et al., 2011). To ensure the validity of the bird's scientific name, it was checked via the integrated taxonomic information system (itis) website: www.itis.gov.

Determination of Bird Conservation Status

The conservation status of birds is determined based on the red list of endangered species (International Union for Conservation of Nature (IUCN) https://www.iucnredlist.org/. Bird trade status (Appendix Cites (convention on international trade in endangered species) via the website: https://cites.org/. Bird protection status (P.106/MENLHK/SETJEN/KUM.1/12/2018 regarding protected plant and animal species.

Index of Bird's Relative Abundance

The relative abundance (Kr) of each bird species was calculated using the following formula (Sarra et al., 2020)

$$KR = \frac{ni}{N} x\ 100\%$$

Where:
KR = Relative Abundance
ni = Individual of a species
N = Number of all species

Shannon-Wienner Diversity Index

The species diversity of an individual can be determined using the Shannon-Wienner diversity index formula (Magurran, 1988).

$$H' = -\sum p_i \, ln \, p_i \; ; \; p_i = \frac{n_i}{N}$$

Where:
H' = Shannon Wiener's diversity index
Pi = The ratio of the number of individuals of the i-th species to the total number of individuals.
ni = Number of individuals in one species
N = Total number of species found

Simpson Dominance Index

The function of determining the dominance index value is to find out or determine which birds are dominant in the area. Simpson Dominance Index Formula (Magurran, 1988).

$$D = \sum p_i^2 \; or \; D = \sum \left(\frac{n_i(n_i-1)}{N(N-1)} \right)$$

Where:
D = Dominance index of a species
Ni = Number of individuals of a species
N = Number of individuals of all species

Shannon Evenness Index

The evenness index is used to determine the evenness of birds in communities found in various habitat types (Supartono et al., 2015). The Shannon Evenness Index formula is as follows (Magurran, 1988).

$$E = \frac{H'}{H_{max}} = \frac{H'}{ln \, (S)}$$

Where:
E = Shannon Evenness Index
H' = Shannon Wiener Index
Hmax = Maximum Species Diversity
S = Number of Types found
ln = Logarithm of Nature

Similarity Index

$$C_S = \frac{2a}{b+c} \; X \; 100 \; \%$$

Where:
Cs = Similarity index
a = Individuals in communities I and II
b = Individuals in community I
c = Number of Individuals in community II

The species similarity index is a change in the composition of bird species in an avifauna community (Tuhumury, 2018). The Sorenson Similarity index formula is as follows (Odum, 1933 in Tarida, 2018).

Data Analysis

All results of bird observations in the field and the results of calculations of bird relative abundance indices, species diversity, dominance, evenness and community similarity indices obtained will be described descriptively and will be presented in the form of tables, histograms and images.

RESULTS AND DISCUSSION

Composition of Bird Species in the Coastal Area and Marana River Estuary, Maros Regency

Based on observations made on 27-29 March 2021 in the coastal area and the mouth of the Marana River, Maros Regency, which is included in the category of bird migration cycles on their way back to their breeding locations. The number of bird species found was 1047 individuals with 22 species from 14 families, including two species of birds found outside the observation point i.e., *Xenus cinereus* (trinil bedaran) and *Phalacrocorax sulcirostris* (black rice cormorant) (Tables 1 and 2), from 22 species of birds found, the highest number of individuals was *Chlidonias hybrida* (whiskered tern) with 574 individuals in the pond area (station 3) while the lowest number of individuals was *Egretta alba* (great egret) only 1 individual was found in the Mangrove area (Station 2).

Based on the results of observations, 1 species of shorebird was also found, namely *Egretta garzetta*, 8 species of migratory birds, namely *Lalage sueurii*, *Todiramphus sanctus, Numenius madagascariensis, Numenius phaeopus, Chlidonias hybrida, Chlidonias leucopteru, Xenerus cinereu, Egretta garzetta* and the rest are included in the coastal bird species. namely 16 species, of which the bird species *Numenius madagascariensis* and *Numenius phaeopus* are included in the coastal birds and migratory birds and *Egretta garzetta* is included in the coastal birds and migratory birds. From observations at six stations, it was found that the average number of bird species and their tribes is shown in Figure 2.

Table 1. Names of Bird Species found in Coastal Areas and Marana River Estuaries, Maros Regency

Number	Family	Scientific/Latin Name	Indonesian Name	Local Name
1	Ardeidae	*Egretta garzetta*	Kuntul Kecil	Kondo Buleng
2		*Ardeola speciose*	Blekok sawah	Kondo Bura
3		*Bubulcus ibis*	Kuntul Kerbau	-
4		*Ardea purpurea*	Cangak Merah	Karro
5		*Egretta alba*	Kuntul Besar	Kondo Kebo
6	Sternidae	*Butorides striata*	Kokoan Laut	Pondang-Pondang
7	Hirundinidae	*Hirundo tahitica*	Layang-Layang Batu	-
8	Apodidae	*Collocalia esculenta*	Walet Sapi	-
9	Estrildidae	*Lonchura atricapilla*	Bondol Kepala Pucat	Bukkuru
10		*Lonchura pallida*	Bondol Cokelat	Bukkuru
11	Aegithinidae	*Aegithina tiphia*	Cipoh Kacat	-
12	Campephagidae	*Lalage sueurii*	Kapasan Sayap Putih	-
13	Alcedinidae	*Todiramphus sanctus*	Cekakak Australia	Maraselang
14	Scolopacidae	*Numenius madagascariensis*	Gajahan Timur	Miong- Miong
15		*Numenius phaeopus*	Gajahan Pengala	Miong-Miong
16	Plocoidae	*Ploceus manyar*	Manyar Jambul	Datte – Datte
17	Laridae	*Chlidonias hybrid*	Dara Laut Kumis	Tarre – Tarre
18		*Chlidonias leucopterus*	Dara Laut Sayap putih	Tarre – Tarre
19	Zosteropidae	*Zosterops chloris*	Kacamata Laut	Cui – Cui
20	Acrocephalidae	*Acrocephalus stentoreus*	Kerakbasi Ramai	Poce

Table 2. Names of Bird Species Found Outside Observation Points in Coastal Areas and Marana River Estuaries, Maros Regency

Number	Family	Scientific/Latin Name	Indonesian Name	Local Name
1	Phalacrocoracidae	*Phalacrocorax sulcirostris*	Pecuk Padi Hitam	-
2	Scolopacidae	*Xenus cinereus*	Trinil Bedaran	Kongkongkong

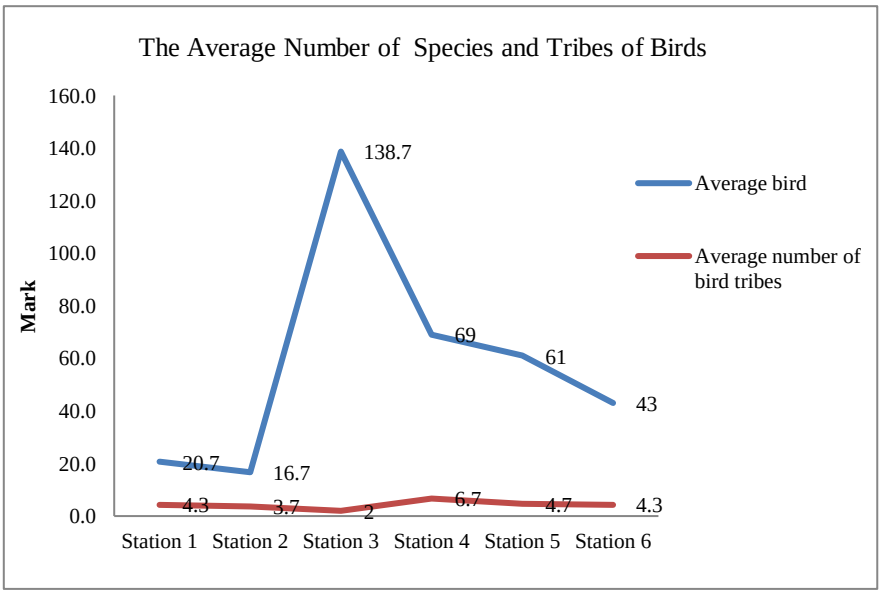

Figure 2. Average number of species and tribes of birds in the coastal and estuary areas of the Marana

The highest average number of bird species was at station 3, 138.7 and the lowest average number of bird species was at station 2, i.e., 16.7, then the highest average number of bird species was at station 4, namely 6.7. The lowest average number of tribes was found at station 3 with a number of 2 (Figure 2), which was found at observation point T. 3.2 where only 1 type of tribe was Laridae which included the *Chlidonias hybrida* and *Chlidonias leucopterus*.

Abundance of Bird Species in the Coastal Area and Marana River Estuary, Maros Regency

Data from observations of the abundance of bird species at the research location are presented in Table 3.

Table 3. Bird Abundance in coastal areas and Marana River Estuaries, Maros Regency

Number	Scientific/Latin Name	Abundance					
		Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
1	*Egretta garzetta*	24	26	0	7	15	33
2	*Ardeola speciose*	2	4	0	0	3	6
3	*Bubulcus ibis*	0	0	0	0	1	1
4	*Ardea purpurea*	0	12	0	0	2	0
5	*Egretta alba*	2	0	0	0	0	0
6	*Butorides striata*	10	10	1	3	2	1
7	*Hirundo tahitica*	6	0	0	0	1	1
8	*Collocalia esculenta*	29	34	0	14	16	16
9	*Lonchura atricapilla*	0	0	3	4	0	0
10	*Lonchura pallida*	0	0	0	6	0	0
11	*Aegithina tiphia*	0	0	0	6	0	0
12	*Lalage sueurii*	2	6	0	0	1	0
13	*Todiramphus chloris*	0	0	0	0	0	2
14	*Numenius madagascariensis*	0	0	0	0	2	0
15	*Numenius phaeopus*	0	0	0	0	1	2
16	*Ploceus manyar*	0	0	0	7	0	0
17	*Chlidonias hybrida*	23	2	90	27	44	38
18	*Chlidonias leucopterus*	0	6	5	0	13	0
19	*Zosterops chloris*	0	0	0	4	0	0
20	*Acrocephalus stentoreus*	3	0	0	25	0	0
21	*Phalacrocorax sulcirostris*	0	0	0	0	0	0
22	*Xenus Cinereus*	0	0	0	0	0	0

The cow swallow (*Collocalia esculenta*) is a species of bird with the highest relative abundance value at station 2 (Mangrove), namely 34%, this is because the cow swallow likes more open areas, when observing this species of bird, it carries out its activities by flying around the mangrove trees at the location. research, in accordance with the statement by Beehler et al., 2001 that cow swallows like open tree and forest habitats by flying low above them which are filled with insects and circling near rivers to bathe and drink water.

Whiskered tern (*Chlidonias hybrida*) is a species of bird with the highest relative abundance value at Station 3 (pond), namely 90%, with a total of 254 individuals. This bird is generally found more often around ponds that are being harvested with muddy soil conditions with a variety of food available such as fish, shrimp, gastropods, molluscs and crabs, in line with Elfidasari (2005) that pond areas with continuously muddy substrates is a suitable habitat for bird species because of the abundance of food sources and generally more in the pond drains.

Whiskered tern (*Chlidonias hybrida*) is a species of bird with the highest relative abundance value at Station 5 (river), namely 44% with a total of 81 individuals, this is because this habitat has an open canopy cover so that birds are more often seen flying and looking for food, Wisnubudi (2009) in Saefullah (2015) states that the openness of the canopy influences the number of bird species found, the more open the canopy cover, the more birds will be found. Food sources are available and it is also flanked by mangrove plants with lots of food resources, making it possible for birds to look for food and nesting places in this area. Along the river flow there are bagang tancap and mangrove plants which birds use to perch and stay still while looking for their prey. This is in line with Siade (2015) in Hardiansyah et al., (2018), that the activity often carried out by sternidae birds is flying behavior, because they have an active nature in searching for food on the surface of the water by remaining silent while stalking, then diving into the water to catch their prey. in the form of fish and crustaceans.

Ecological Index of Bird Species in Coastal Areas and the Marana River Estuary, Maros Regency

Ecological index data for bird species obtained at six observation stations is presented in Figure 3.

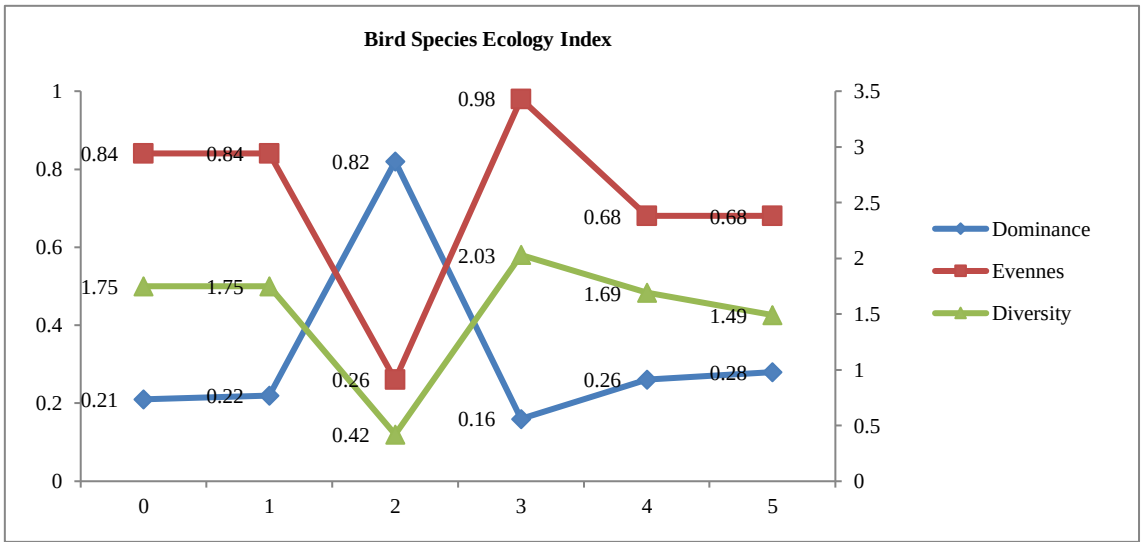

Figure 3. Ecological index at each observation station in the coastal area and the Marana River Estuary, Maros Regency

The overall calculation result of the bird species diversity index value in coastal areas and the Marana River estuary, Maros Regency is 1.73, categorized as moderate because it is in the H' 1-3 range, commensurate with research by Purify et al., 2020 that shows the diversity of water bird communities in Lantebung with an H' value of 1,029 (medium), this is because in general the two research locations have the same habitat (mud beds, ponds, bushes and mangroves), according to Purify et al., 2020 abundance and diversity of bird species Most water is found in mudflats and ponds, because the number of food sources rich in macrozoobenthos is greater than in other habitats and has greater opportunities for finding food than in other habitats.

Species diversity and evenness values are inversely proportional to dominance values, if diversity and evenness are high then dominance will be low and vice versa, if dominance values are high then species diversity and evenness are low, and also the higher the diversity index, the greater the number of species and evenness of the population (Awaluddin et al., 2013).

The pond habitat at station 4 has the highest diversity value among mangrove habitats and river flows, namely 2.03. The high value of species diversity at the pond location indicates the abundance of food availability factors in the coastal area, namely the influence of vegetation such as lots of mixed vegetation and also the presence of shrubs and trees growing on the edge of the pond where birds use them to obtain food sources in the form of insects and seeds. - seeds and as a nesting place, so many types of birds often visit to find food, nest and breed. Based on the statement of Fikriyanti et al. (2018), an important aspect in ensuring the existence of birds in a habitat is the variation in vegetation. The varied vegetation in a habitat can accommodate many types of birds. The pond habitat at station 3 has the lowest diversity value, namely 0.42. This low value indicates that there is a dominant bird species in the area.

Based on observations, the whiskered sea tern (Chlidonias hybrida) was the bird species with the highest level of dominance at station 3 with 254 individuals with a value of 0.82, this was because at the time of observation, the pond farmers were harvesting and cleaning the pond area, and there were also carry out activities to spread fish seeds so that at that time it influences the number of birds that gather and only stop to look for food in the area and do not stay. Beehler et al. (2001), stated that the species Chlidonias hybrida is a wandering animal or is a migratory bird in winter, but some are also often seen in summer. The birds stop to look for food and rest for a while before continuing their long journey. Alikodra (1988) in Kusumahadi (2020), several species of migratory birds each year periodically use parts of Indonesia's coastal areas as temporary habitat and the best months to observe migratory birds are September to March (Howes et al. 2003).

Based on the results obtained, station 4 pond habitat has the highest evenness index value between mangrove and river flow habitats, namely 0.98, this is because the pond habitat has more open land covered with reeds, grass, trees and shrubs so that they are able to provide various types of food for birds, including seeds or grass seeds, small bush fruit and insects so that various types of birds are found in this habitat, therefore the distribution is even and no one dominates, in line with the research of Priosambodo et al . (2020), that open habitats

have a different number and composition of birds from more closed land, where large pond areas with mud beds have more food sources and support many species of birds that visit these habitats.

Station 3 in the pond area with an evenness value of 0.26 is categorized as having a low level of species diversity stability because it is in the range E < 0.3, this is due to competition in utilizing existing resources, if some bird species enter a habitat where they do not belong, usually This bird species will damage the balance of the ecosystem and can eliminate other organisms in the habitat it enters, so that the evenness value in the habitat is low. Hernowo (1985) in Merry et al. (2018) emphasized that the presence of birds in a habitat can be related to the availability of food sources, nesting places and having habitat conditions that are suitable and safe from all kinds of disturbances for the birds themselves.

Similarities in Bird Species Communities in Coastal Areas and the Marana River Estuary, Maros Regency

Based on the results of observations, the level of bird similarity between the three habitats is shown Figure 4.

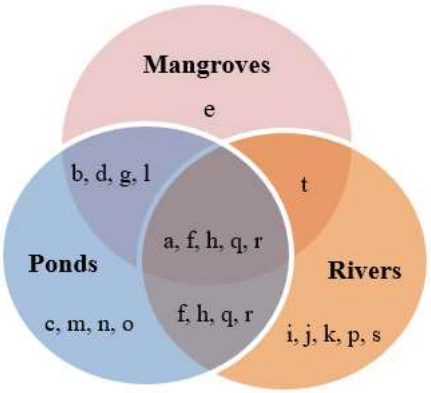

Figure 4. Slices of the level of similarity of bird communities between habitats

The level of similarity of bird species communities between habitats as a whole, from mangrove, pond and river habitats (Figure 4), the same bird species found were *Egretta garzetta*, *Butorides striata*, *Collocalia esculenta*, *Chlidonias hybrida* and *Chlidonias leucopterus*. The highest level of similarity indicates that the bird groups at the two stations are composed of relatively the same or similar types of birds as well as similar habitat structure, close distance between habitats, and the availability of resources that can support the existence of these birds. The highest level of bird community similarity was found at station 2 (mangrove) with station 5 (river flow) with a value of 80%, where only the Australian kingfisher (*Acrocephalus stentoreus*) was found. The Australian kingfisher is a type of migratory bird that is common in open habitats and has a long, large and pointed beak that catches its prey in the form of insects, reptiles, frogs, crabs, shrimp and fish by swooping down from a perch. This bird generally likes to be around waters near rivers because it is close to the food sources it looks for every day. This bird's habit is also to perch in mangrove trees and sometimes it will also descend into mud areas (Beehler et al., 2001).

The level of bird community similarity between Station 4 (pond) and Station 6 (stream) with a value of 31.57% is included in the medium category, this indicates that there are significant differences in the condition of the observed habitat type. Buorides striata, Collocalia esculenta, Chlidonias hybrida and *Chlidonias leucopterus* are the same species of birds found in both habitats. This type of bird, when viewed in terms of habitat, both prefer more open habitats and their prey-seeking behavior involves catching their prey by snatching, staying still or flying low over the water (Beehler, et al., 2001).

Conservation Status of Bird Species in the Coastal Area and Marana River Estuary, Maros Regency

Based on the composition of bird species in the Coastal Area and Marana River Estuary, Maros Regency, the protection status of bird species is grouped into 3 references, namely IUCN Red List, PP. NO.106/MENLHK/SETJEN/KUM.1/12/2018 and CITES. The protection of bird species based on the IUCN Red List is in the LC category, which means that bird species in this area have a relatively low level of threat to extinction, therefore the results of this research show that there is a need for management to maintain the sustainability or stability of their populations so that they do not decline. considering that this habitat is generally quite good for the existence of bird species, this is shown by the existence of various food sources as well as places to live and breed, seen from the statement by Swastikaningrum et al., 2012 that to prevent the reduction or extinction of the animals found in the area can be seen from, by using birds as food, pet birds and so on. the activities of other living creatures that live side by side, the presence of predators, the availability of food, and the availability of a safe and comfortable place to live for these birds so they can breed. Security measures also need to be implemented to prevent people from carrying out illegal activities such as hunting which affect protected bird populations

CONCLUSION

From observations in the coastal areas and estuary of the Marana River, Maros Regency, 22 species of birds from 14 tribes were recorded with a total encounter of 1047 individual of birds. The abundance and ecological index of bird species in this area is greatly influenced by the availability of food, places to rest, reproduce, nest and roost, which is one of the determinants of the abundance of bird species. The values obtained from the three habitat types do not differ significantly, which means that the three habitats are classified as stable and may still be used well and are sufficient as a place for birds to live in that location. Judging from the conservation status which is still at low risk and also that these three habitat types have an adequate level of stability, management is needed to maintain the sustainability or stability of the bird population so that it does not experience a decline.

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