Species composition of birds in converted coastal area of Barru Regency, South Sulawesi, Indonesia

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Abstract. Sulawesi, the largest island in Wallacea region is well-known for its avifauna diversity and endemism. The island is mountainous and surrounded by long coastline with mangrove and wetland ecosystems. To date, most of coastal area converted into fishpond, rice field and settlement. As a result, many species are seriously threatened by land conversion. Nevertheless, species composition of birds in the converted coastal area has poorly studied. To fill in the information gaps, we conducted research in Universitas Hasanuddin fishpond. The fishpond situated in Tanjung Kupa, a small peninsula in Mallusetasi subdistrict, Barru regency, South Sulawesi. This research aimed to figure out the species composition, ecological niche, conservation status and feeding guild of the bird at converted coastal area. Data were collected using MacKinnon list method in the morning at 06.30-09.30 and in the afternoon at 15.30-17.30 from August to September 2020. From the observations, we recorded 37 bird species from 25 families consist of 29 resident, 4 migratory, 3 introduce and 1 endemic species. Most of common birds species dominated by open-country specialist which indicates a change in the composition of bird species in the converted coastal areas of Barru Regency.

1. Introduction
Sulawesi is one of the main bird habitats in the Wallacea Region. In contrast to the more fertile northern regions, southern Sulawesi has a drier climate. The inland area is mountainous, while the coastal area has a long coastline. Important area for bird in North Sulawesi consist of Tangkoko-Dua Sudara, Sangihe-Talaud islands, Mount Ambang, Lake Limboto and Bogani-Nani Wartabone national park. Central Sulawesi also have many important bird area i.e., Lore-Lindu National Park, Morowali Nature Reserve and Banggai-Sula islands where many new endemic bird species discovered recently.
Some important bird habitats in South Sulawesi situated in the interior of the peninsula include Mount Bawakaraeng-Lompobattang and Maros-Pangkep limestones [1]. Meanwhile, the coastal area which is an important habitat for birds is the Lampuko-Mampie mangrove area (2000 Ha), the Lantebung-Kuri coast around Makassar-Maros border, mangrove area in Pallime river estuary in Bone district (200 Ha) and estuary in the north of Bone Bay which consist of 5000 hectares mangrove along Palopo-east Luwu coastline. For lowland areas, lake Tempe is an important habitat for various species of water birds and migratory birds [2]. The areas in general have been researched a lot, but other coastal areas which is highly converted such as the coast of Pangkep-Barru, Pare-Pare-Pinrang, Gowa-Bulukumba and Bone-Sinjai have rarely received attention. Based on this, we conducted bird research in the converted coastal area of Barru regency, which has the longest coastline in western part of South Sulawesi.

2. Material and Method

2.1. Study Site

One of the sites in Barru Regency that is known to be visited by many bird species and has not been studied is Universitas Hasanuddin fishpond. This 21.25 Ha education fishpond is located in Tanjung Kupa, a small peninsula in Bojo', Mallusetasi District, Barru Regency, 10 km before Pare-pare, a small port city in South Sulawesi. Most of the landscape of Universitas Hasanuddin fishpond is dominated by ponds and embankments with shrubs grow on several parts. The fishpond surrounded by thin mangrove belts which is formed a barrier between the foreshore and the fishponds. Settlement with small yard and garden are in the middle. On the south side, there are extensive local community ponds surrounded by large mangrove area and in the eastern part, the pond bordered with the main road. Ornithological observations conducted at four stations (station A: fishpond near main road, Station B: settlement grounds, Station C: fishpond near mangrove and Station D: mangrove area that surrounding the fishpond) during August-September 2020. This research aimed to figure out the species composition, relative abundance, habitat use and conservation status of the bird at Universitas Hasanuddin fishpond.

2.2. Data Collection

Birds were recorded with MacKinnon list method [3] combined with opportunistically observation [4], and their abundance was assessed from twelve-species lists which contain of 20 species for each list as described in [5], the first twenty bird species encountered in a station in one observation were listed, then a new list was started when more than 20 species found, and so on until 12 lists had been completed. There is not allowed to write a bird name species twice in a list. Observation conducted in certain point for covered all different type of habitat that exist in a station. Photo of the bird taken using a Canon 550D DSLR camera with a 150-300 mm telephoto lens for identification purposes. Identification of bird species based on [1, 5, 6, 7]. Informal discussions about birds in study site were also carried out with local people. Relative abundance determined based on percentage records of each bird species from totally 12 observation list on each station. This method was chosen because it does not depend on the area, duration of observation, the weather [5], provides a greater opportunity to record more bird species, makes easier to observe small and hard-to-identify birds and also easier to observe birds in flock and to observe birds that like to hide in grass, shrubs and trees [3].

3. Result and Discussion

From the observed, we recorded 37 bird species from 25 families consist of 29 resident, 4 migratory, 3 introduce and 1 endemic species. Little Egret, Pacific Swallow, Tree Sparrow, Pink-necked Green Pigeon, Lemon-bellied White-eye and Rainbow Bee-eater are the most abundant species. While Brahminy Kite, Great-billed Heron, Sunda Teal, Ruby-cheeked Sunbird and Slaty-breasted Rail are among the rarest species which is only recorded once during observation. Sulawesi Pygmy Woodpecker is the only endemic bird recorded at the study site (Table 1). Glossy Ibis and
Little Black Cormorant also abundant, however both species only found flying low across the pond from Batukalasi Island as roosting area to the feeding site at the waters around study site.

**Table 1.** Interval abundance of bird species from twelve observations on each station at Universitas Hasanuddin fishpond. Station A: fishpond near the main road, Station B: settlement ground, Station C: fishpond near the mangrove belt and Station D: mangrove belt.

| Bird Species                  | Common/English Name                  | Families            | Interval abundance of birds in each station |
|-------------------------------|--------------------------------------|---------------------|---------------------------------------------|
| **Resident**                  |                                      |                     | A   | B   | C   | D   |
| Amadornis phoenicurus         | White-breasted Waterhen              | Rallidae            | 1-3 | 0   | 1-2 | 0   |
| Anas gibberifrons             | Sunda Teal                           | Anatidae            | 0   | 0   | 1-5 | 0   |
| Anthreps malacensis           | Brown-throated Sunbird               | Nectaridae          | 0   | 0-1 | 1-3 | 1-2 |
| Ardea sumatranana             | Great-billed Heron                   | Ardeidae            | 0   | 0   | 0-1 | 0   |
| Ardeola speciosa              | Javan-fishpond Heron                 | Ardeidae            | 1-7 | 0   | 1-5 | 0   |
| Artamus leucorynchus          | White-breasted Woodswallow           | Artamidae           | 4   | 1   | 1-4 | 1-8 |
| Butorides striatus            | Striated Heron                       | Ardeidae            | 0   | 0   | 1-6 | 1-11|
| Caprimulgus affinis           | Savannah Nightjar                    | Caprimulgidae       | 1-2 | 0   | 1-3 | 1-2 |
| Chalcoparia singalensis       | Ruby-cheeked Sunbird                 | Nectaridae          | 0   | 0-1 | 0   | 0   |
| Charadrius javanicus          | Javan Plover                         | Charadriidae        | 1-4 | 0   | 1-7 | 0   |
| Corvus enca                   | Slender-billed Crow                  | Corvidae            | 0   | 1-4 | 0   | 0   |
| Cynnis jugularis              | Olive-backed Sunbird                 | Nectaridae          | 1-4 | 1-6 | 1-4 | 1-7 |
| Egreta garzetta nigripes      | Little Egret                         | Ardeidae            | 3-51| 0   | 1-23| 1-9 |
| Gallirallus striatus          | Slaty-breasted Rail                  | Rallidae            | 0   | 0   | 0-1 | 0   |
| Gerygone sulphurea            | Flyeater                             | Acanthizidae        | 0   | 1-4 | 0   | 1-4 |
| Halcyon chloris               | Collared Kingfisher                  | Alcedinidae         | 1-2 | 1-4 | 1-2 | 1-3 |
| Halistaur indus               | Brahmyri Kite                        | Accipitridae        | 0   | 0   | 0   | 0-1 |
| Himantopus leucocephalus      | Pied Stilt                           | Recurvirostridae    | 1-3 | 0   | 1-4 | 0   |
| Hirundo tahitica              | Pacific Swallow                      | Hirundinidae        | 6-21| 4-16| 7-25| 8-36|
| Lagalea sueuri                | White-shouldered Triller             | Camphephagidae      | 1-2 | 1-2 | 1-2 | 1-2 |
| Leptocoma aspasia             | Black Sunbird                        | Nectaridae          | 0   | 1-2 | 0   | 1-4 |
| Lonchura atricapilla          | Chestnut Munia                       | Estrildidae         | 0   | 1-5 | 1-2 | 0   |
| Lonchura pallida              | Pale-headed Munia                    | Estrildidae         | 0   | 2-17| 2-12| 0   |
| Lonchura punctulata           | Scaly-breasted Munia                 | Estrildidae         | 0   | 2-9 | 2-12| 0   |
| Phalacrocoryx sulcirostris    | Little Black Cormorant               | Phalacrocoracidae   | 6-14| 0   | 2-20| 0   |
| Plegadis falcinellus          | Glossy Ibis                          | Threskiornithidae   | 4-19| 0   | 4-29| 0   |
| Sterna albitrons              | Little Tern                          | Sturnidae           | 0   | 1-4 | 0   | 0   |
| Treron vernans                | Pink-necked Green pigeon            | Columbidae          | 5-14| 1-4 | 4-8 | 8-23|
| Zosterops chloris             | Lemon-bellied White-eye              | Zosteropidae        | 3-9 | 4-15| 5-22| 9-31|
| **Migratory**                 |                                      |                     |     |     |     |     |
| Actitis hypoleucus            | Common Sandpiper                     | Scolopacidae        | 1-4 | 0   | 1-6 | 1-3 |
| Nettapus pulchellus           | Green Pygmy Goose                    | Anatidae            | 0   | 0   | 2-8 | 0   |
| Heteroscelus brevipes         | Grey-tailed tattler                  | Scolopacidae        | 0   | 0   | 1-7 | 0   |
| Merops ornatus                | Rainbow Bee-eater                    | Meropidae           | 1-9 | 0   | 0   | 7-61|
| **Introduce**                 |                                      |                     |     |     |     |     |
| Passer montanus               | Tree Sparrow                         | Passeridae          | 1-4 | 7-29| 1-4 | 0   |
| Pycnonotus aurigaster         | Sooty-headed Bulbul                  | Pycnonotidae        | 1-4 | 2-6 | 1-2 | 1-4 |
| Streptopelia tranquebarica    | Red Collared Dove                    | Columbidae          | 0   | 0   | 1-4 | 0   |
| **Endemic**                   |                                      |                     |     |     |     |     |
| Dendrocopos temminckii        | Sulawesi Woodpecker                  | Picidae             | 0   | 0   | 0   | 1-4 |
3.1. Species Composition

The coastal area of Sulawesi was once overgrown by mangroves and dense coastal forests. However, currently only a small portion of those communities remains [8, 9, 10]. Most of the vegetation have been logged for timber, charcoal and converted into fishponds, settlements, rice fields and cultivated area [8, 11, 12]. Mangroves are defined by the presence of trees that mainly occur in the intertidal zone, between land and sea, in the tropics and subtropics region [13]. The intertidal zone is characterized by fluctuate and dynamic environment. The complex structure of mangroves root has important role in trapping sediment, stabilize the environment and formed substratum on which many species of plants live. The plants than provide food source and sheltered habitat for animals including birds, insects, mammals and reptiles [13]. Mangroves also increase connectivity among coastal habitats, and may be preferentially used as corridors for movement and as protected roosting or breeding sites [14]. Despite poor in number of floral species, avian species richness in mangroves area is surprisingly high in tropical regions [14].

Bintuni Bay in West Papua for instance have the most extensive (450,000 Ha) and least disturbed mangrove area in Indonesia. On this almost pristine mangrove forest, more than 90 species of bird has been recorded [15]. Avifauna that mostly spent their time in mangrove forest included the Darter, Fruit-Dove, Frogmouth, Kingfisher, Dollarbird, Cuckoo-Shrike, Gerygone, Fantail, Flycatcher, Robin, Whistler, Flowerpecker, Sunbird and the Drongo. All these species might be considered as characteristic of mangrove bird species [15]. Water birds, migratory birds and bird from surrounding non-mangrove forest i.e rapters, cockatoo, parrots, swallows, swiftlets, flycatcher, starling, imperial pigeons, friarbird, Rainbow bee-eater, crow, hornbill, bird of Paradise also observed frequently in Bintuni Bay mangrove.

In contrast, coastal area of Lampoko-Mampie in West Sulawesi has drastically lost its mangrove and coastal forest due to land conversion. This coastal area formerly was designated as a Wildlife Reserve base on the Decree of Minister of Agriculture No. 699/Kpts /Um/11/1978 covering an area of 2000 Ha to protect migratory birds especially from Australia or east Asia. However, recently only 237 hectares of mangrove areas remain as a result of land conversion into fishponds, cultivated area and settlements [16]. From 50 species avifauna reported at Lampoko-Mampie, the birds nowadays dominated by Little Egret, Pied Stilt and Pacific Swallow. Most of the birds derived from Ardeidae, Nectarinidae, Anatidae, Estrildidae and Rallidae followed by Sylviidae, Apodidae, Meropidae and Scolopacidae [17].

![Rainbow Bee-eater, Common Sandpiper, Grey-tailed Tattler](Photo: Dody Priosambodo)

Composition of bird species in Universitas Hasanuddin fishpond somewhat similar to the bird at coastal of Lampoko-Mampie especially in family structure. We recorded 37 bird species during observation consist of 29 resident, 4 migratory, 3 introduced and 1 endemic species. Mostly derived from the family Ardeidae, Nectarinidae, Estrildidae, Scolopacidae, Anatidae, Rallidae and Columbidae (Table 1). Some of the most common bird in Universitas Hasanuddin fishpond also consist of waterbirds including Little Egret, Striated Heron and Collared Kingfisher (Table 2). Four migratory bird were also observed from the study site i.e., Common Sandpiper, Green Pygmy Goose, Grey-tailed...
Tattler and Rainbow Bee-eater (Figure 1). The latter is migratory from Australia and formed large flock roosting in mangrove around the fishpond and flying noisily in the air to catch the insects above the fishpond.

Table 2. Percentage Occurrence of Bird Species in Twelve Observation List. A: fishpond near the main road, B: settlement and yard, C: fishpond near the mangrove belt and D: mangrove belt

| Bird Species                  | Common/English Name          | Category | Percentage Occurrence in 12 Observation List (%) |
|-------------------------------|------------------------------|----------|-----------------------------------------------|
| Resident                      |                              |          | A         | B         | C         | D         |
| *Amaurornis phoenicus*        | White-breasted Waterhen      | Rare     | 8.33 0.00 | 16.67 0.00 | 0.00 0.00 |
| *Anas gibberifrons*           | Sunda Teal                   | Rare     | 8.33 0.00 | 8.33 0.00  |
| *Anthreptes malacensis*       | Brown-throated Sunbird       | Uncommon | 0.00 25.00 | 25.00 16.67| 0.00 0.00 |
| *Ardea sumatrana*             | Great-billed Heron           | Rare     | 0.00 0.00  | 8.33 0.00  | 0.00 0.00 |
| *Ardeola speciosa*            | Javan-fishpond Heron         | Occasional| 41.67 0.00 | 25.00 16.67| 0.00 0.00 |
| *Artamus leucorynchus*        | White-breasted Wood-swallow  | Common   | 100.00 100.00 100.00 100.00 |
| *Butorides striatus*          | Striated Heron               | Common   | 100.00 0.00 100.00 50.00 |
| *Caprimulgus affinis*         | Savana Nightjar              | Frequently| 41.67 0.00 100.00 33.33 |
| *Chalcoparia singalensis*     | Ruby-checked Sunbird         | Rare     | 0.00 8.33 0.00 0.00 |
| *Charadrius javanicus*        | Javan Plover                 | Occasional| 33.33 0.00 50.00 0.00 |
| *Corvus enca*                 | Slender-billed Crow          | Occasional| 25.00 41.67 8.33 0.00 |
| *Cynnis jugularis*            | Olive-backed Sunbird         | Common   | 100.00 100.00 100.00 100.00 |
| *Egretta garzetta nigripes*   | Little Egret                 | Abundant | 100.00 0.00 100.00 33.33 |
| *Gallirallus striatus*        | Slaty-breasted Rail          | Rare     | 0.00 0.00 8.33 0.00 |
| *Gerygone sulphurea*          | Flyeater                     | Frequently| 33.33 50.00 50.00 33.33 |
| *Halcyon chloris*             | Collared Kingfisher          | Common   | 100.00 100.00 100.00 33.33 |
| *Haliastur indus*             | Brahminy Kite                | Rare     | 8.33 0.00 8.33 8.33 |
| *Himantopus leucocephalus*    | Pied Stilt                   | Frequently| 58.33 0.00 58.33 0.00 |
| *Hirundo tahitica*            | Pacific Swallow              | Abundant | 100.00 100.00 100.00 100.00 |
| *Lalage sueuri*               | White-shouldered Triller     | Common   | 0.00 0.00 100.00 58.33 |
| *Leptocoma aspasia*           | Black Sunbird                | Frequently| 83.33 100.00 66.67 66.67 |
| *Lonchura atricapilla*        | Chestnut Munia               | Frequently| 25.00 33.33 25.00 0.00 |
| *Lonchura pallida*            | Headed Munia                 | Abundant | 75.00 100.00 100.00 0.00 |
| *Lonchura punctulata*         | Scaly-breasted Munia         | Abundant | 83.33 100.00 100.00 0.00 |
| *Phalacrocorax sulcicristis*  | Little Black Cormorant       | Abundant | 91.67 0.00 100.00 0.00 |
| *Plegadis falcinellus*        | Glossy Ibis                  | Common   | 91.67 0.00 100.00 0.00 |
| *Stermula albifrons*          | Little Tern                  | Frequently| 41.67 0.00 58.33 0.00 |
| *Tremon vernans*              | Pink-necked Green pigeon     | Abundant | 75.00 0.00 100.00 100.00 |
| *Zosterops chloris*           | Lemon-bellied White-eye      | Abundant | 100.00 100.00 100.00 100.00 |

Migratory

| Bird Species                  | Common/English Name          | Category | Percentage Occurrence in 12 Observation List (%) |
|-------------------------------|------------------------------|----------|-----------------------------------------------|
| *Actitis hypoleucus*          | Common Sandpiper             | Common   | 100.00 0.00 100.00 0.00 |
| *Nettapus pulchellus*         | Green Pygmy Goose            | Uncommon | 0.00 0.00 33.33 0.00 |
| *Tringa brevipes*             | Grey-tailed tattler          | Frequently| 0.00 0.00 75.00 0.00 |
| *Merops ornatus*              | Rainbow Bee-eater            | Abundant | 100.00 0.00 100.00 100.00 |

Introduce

| Bird Species                  | Common/English Name          | Category | Percentage Occurrence in 12 Observation List (%) |
|-------------------------------|------------------------------|----------|-----------------------------------------------|
| *Passer montanus*             | Tree Sparrow                 | Abundant | 100.00 100.00 100.00 0.00 |
| *Pycnonotus aurigaster*       | Sooty-headed Bulbul          | Common   | 91.67 100.00 100.00 75.00 |
| *Streptopelia tranquebarica*  | Red Collared Dove            | Frequently| 0.00 0.00 0.00 50.00 |

Endemic

| Bird Species                  | Common/English Name          | Category | Percentage Occurrence in 12 Observation List (%) |
|-------------------------------|------------------------------|----------|-----------------------------------------------|
| *Dendrocopos temminckii*      | Sulawesi Woodpecker          | Occasional| 0.00 0.00 0.00 50.00 |
Abundant: recorded 10-12 times in large population  
Common: recorded 10-12 times solitary or in small flock  
Frequently: recorded 7-9 times in 12 list  
Occasional: recorded 5-6 times in 12 list  
Uncommon: recorded 3-4 times in 12 list  
Rare: only recorded once or twice during observation

3.2. Ecological Niche

The conversion of mangroves and coastal forests into ponds has resulted in habitat changes. Mangrove forests generally play an important role in the ecosystem as a source of food, shelter, roosting and nesting [14]. Mangroves lack seed resources to attract rice field dwelling granivorous birds, and very few mangroves produce fleshy fruits that attract rain forest frugivores [14]. However, mangrove provide nectar that will attract the insects. The presence of these nectar source and insect population will attract insectivore and nectarivore birds to visit the mangrove area. The bottom of the mangrove forest which are rich in polychaeta worms, shellfish, crabs and other types of animals will be exposed during low tide [18,19]. This will attract many waterbirds such as Great Egret, Little Egret, Striated Heron, Pied Stilt and migratory shorebird to explore and forage for food in muddy mangroves floor.

The cutting down of mangrove areas into ponds has reduced mangrove stands and created extensive open areas. The decline in mangrove trees is causing the loss of flowers and insects that provide food for insectivore and nectarivore birds. As a result, the population of insectivore and nectarivore birds will decrease. Ponds which has been made in a former mangrove forest area will develop into new habitats for birds and other animals. Some of the embankments will be overgrown with grass and shrubs, a vegetation previously not found in the mangrove ecosystem. This new habitat provides a distinct food source consist of grass seeds, small bush fruit and insects. Thus, the new habitat, supporting avifauna species which is different from the previous when the area is still in the form of mangrove forest. Therefore, the composition of avifauna species will change with changing types of food available due to changes in habitat.

Figure 2. Most abundant avifauna in study site dominated by open-country specialist bird. a. Pacific Swallow, b. Lemon-bellied White-eye, c. Pink-necked Green Pigeon (Photo: Dody Prio Sambodo)

The composition of birds in a certain area is influenced by many factors, i.e habitat diversity, flora and fauna diversity, topography, climate and anthropogenic influences such as: land use change, and poaching. Clearing land in coastal areas into settlements, fishpond and cultivation areas has an impact on the avifauna species composition [20]. This can be seen from the dominance of open-country specialist birds at Universitas Hasanuddin fishpond. From 37 species that we observed at study site, 24 bird species classified as open-country specialist, 11 bird species grouped into mangrove specialist and only 2 bird species belong to forest specialist (Table 3). Anthropogenic factors through urbanization, shrimp pond, garbage disposal, as well as oil palm plantation in Malaysia also causes the high abundance of open country birds such as Treron vernans, Hirundo tahitica and Merops philippinus, compared to the mangrove-dependent birds [18]. Our observations also show similar results where the most abundant spesies bird were found in Treron vernans, Hirundo tahitica, Merops ornatus, Passer montanus, Lonchura pallida, Lonchura punctulate and Zosterops chloris (Figure 2). Species composition also influenced by surrounding different habitat type [14, 21]. The low number of forest specialist birds is probably due to the absence of nearby forests or lack of food sources needed by
forest birds at the study site. The absence of a vegetation corridor connecting the forest to the study site may also be the reason for the leastwise of forest birds at Universitas Hasanuddin Fishpond. Extensive rice fields are likely to be the cause of the difficulty of forest specialist bird species to reach the coastal areas.

Table 3. Feeding Guild, Ecological Niche, Conservation Status and Protected Bird at Study Site.

| Bird Species                  | Common/English Name          | Feeding Guild | Eco. Niche | IUCN Status | Regulation No.106/2018 |
|-------------------------------|------------------------------|---------------|------------|-------------|------------------------|
| **Resident**                  |                              |               |            |             |                        |
| *Amaurornis phoenicurus*      | White-breasted Waterhen      | OM            | O          | LC          | Not Protected          |
| *Anas gibberifrons*           | Sunda Teal                   | OM            | O          | NT          | Not Protected          |
| *Anthreptes malacensis*       | Brown-throated Sunbird       | NE            | M          | LC          | Not Protected          |
| *Ardea sumatrapa*             | Great-billed Heron           | CA            | M          | LC          | Protected              |
| *Ardea speciosa*              | Javan-fishpond Heron         | CA            | M          | LC          | Not Protected          |
| *Artamus leucorynchus*        | White-breasted Wood-swallow  | IN            | O          | LC          | Not Protected          |
| *Butorides striatus*          | Striated Heron               | CA            | M          | LC          | Not Protected          |
| *Caprimulgus affinis*         | Savana Nightjar              | IN            | O          | LC          | Not Protected          |
| *Chalcoparia singalensis*     | Ruby-cheeked Sunbird         | IN            | F          | LC          | Not Protected          |
| *Charadrius javanicus*        | Javan Plover                 | CA            | O          | NT          | Not Protected          |
| *Corvus enca*                 | Slender-billed Crow          | OM            | O          | LC          | Not Protected          |
| *Cynthis jugularis*           | Olive-backed Sunbird         | IN            | M          | LC          | Not Protected          |
| *Egretta garzetta nigripes*   | Little Egret                 | CA            | O          | LC          | Not Protected          |
| *Gallirallus striatus*        | Slaty-breasted Rail          | CA            | O          | LC          | Not Protected          |
| *Gerygone sulphurea*           | Flyeater                     | OM            | O          | LC          | Not Protected          |
| *Halcyon chloris*             | Collared Kingfisher          | CA            | M          | LC          | Not Protected          |
| *Haliaeetus leucocephalus*    | Brahminy Kite                | CA            | O          | LC          | Protected              |
| *Himantopus leucocephalus*    | Pied Stilt                   | CA            | O          | LC          | Protected              |
| *Hirundo tahitica*            | Pacific Swallow              | IN            | O          | LC          | Not Protected          |
| *Lalage sueurii*              | White-shouldered Triller     | OM            | M          | LC          | Not Protected          |
| *Leptocoma aspasia*           | Black Sunbird                | NE            | M          | LC          | Not Protected          |
| *Lonchura atricapilla*        | Chestnut Munia               | GR            | O          | LC          | Not Protected          |
| *Lonchura pallida*            | Pale-headed Munia            | GR            | O          | LC          | Not Protected          |
| *Lonchura punctulata*         | Scaly-breasted Munia         | GR            | O          | LC          | Not Protected          |
| *Phalacrocorax sulcirostris*  | Little Black Cormorant       | CA            | M          | LC          | Not Protected          |
| *Plegadis falcinellus*        | Glossy Ibis                  | CA            | M          | LC          | Protected              |
| *Sterna albifrons*            | Little Tern                  | CA            | O          | LC          | Protected              |
| *Treron vernans*              | Pink-necked Green pigeon     | FR            | O          | LC          | Not Protected          |
| **Migratory**                 |                              |               |            |             |                        |
| *Actitis hypoleucos*          | Common Sandpiper             | CA            | O          | LC          | Not Protected          |
| *Nettapus pulchellus*         | Green Pygmy Goose            | OM            | O          | LC          | Not Protected          |
| *Tringa brevipes*             | Grey-tailed tattler          | CA            | O          | NT          | Not Protected          |
| *Merops ornatus*              | Rainbow Bee-eater            | IN            | O          | LC          | Not Protected          |
| **Introduce**                 |                              |               |            |             |                        |
| *Passer montanus*             | Tree Sparrow                 | OM            | O          | LC          | Not Protected          |
| *Pycnonotus aurigaster*       | Sooty-headed Bulbul          | OM            | O          | LC          | Not Protected          |
| *Streptopelia tranquebarica*  | Red Collared Dove            | GR            | O          | LC          | Not Protected          |
| **Endemic**                   |                              |               |            |             |                        |
| *Dendrocopos temminckii*      | Sulawesi Woodpecker          | IN            | F          | LC          | Not Protected          |
Feeding Guild:
CA (Carnivore); FR (Frugivore); GR (Graminivore); IN (Insectivore); NE (Nectarivore); OM (Omnivore). Conservation Status: LC (Least Concern); NT (Near Threatened).
Ecological Niche:
O (Open-country specialist); M (Mangrove specialist); F (Forest specialist).

3.3. Feeding Guild
Six functional feeding guild consist of carnivore, frugivore, granivore, insectivore, nectarivore and omnivore were found in study site during observation (Table 3). Most of bird in Universitas Hasanuddin fishpond classified as Carnivore (14 species) which prey on fish, worms, crabs, shellfish, reptiles, amphibians and other animals. Omnivore that feeds on plants and animal also dominated with 9 species. This category including generalist birds that eat fruit and insect or nectar and insect. In the next position there are birds that only eat insects (insectivore) with 6 species. We also found four seed eater species (granivore) which is mostly dominated by Munias, three nectarivore species and one frugivore species.
The composition of feeding guild in Universitas Hasanuddin fishpond was similar to those in Lampoko-Mampie [17] and Rawa Aopa Watumohai [22] but slightly different with Pallime Estuary and Tempe Lake which is consists of less species in granivore and nectarivore [23].

Figure 3. Waterbirds attracted to visit dried fishpond at study site for foraging food. a. Little Egret and Javan Pond Heron, b. Pied Stilt, c. Striated Heron (Photo: Dody Priosambodo)

Most of study site landscape dominated by extensive open area consist of pond and embarkments. Waterbirds such as Little Egret, Striated Heron, Javan-pond Heron and other piscivore (fish eater) has the largest proportion in this carnivore feeding guild (Figure 3). Brahminy Kite is the only bird of prey (raptor) that found during observation. The bird encountered when grabbing and catching a needlefish around mangroves. Carnivore which are dominated by water birds are also reported to be found in Pallime estuary, an extensive fishpond surrounded with patchy mangroves in the coastal of eastern Bone Regency, South Sulawesi [23]. The vast mudflats which is absent at study site also found and support many migratory bird species. The long distance from the rice fields may cause the absence of seed eater species in this area which is abundant at study site. This shows that the diversity of habitat, flora and fauna affects the species composition and feeding guild of the bird [14]. Drained pond areas also attract more shorebirds and wetland birds to visit. These carnivore birds mainly forage for fish, shellfish, crabs, worms and other animals on muddy beaches at low tide. Shallow water surface causes the fish in the dried pond to gather at certain points so that they are easier to catch [24]. Research on small egrets at the commercial fishpond in Hong Kong shows that these birds spend more time in dried fishponds than other habitat types because they find it easier to catch fish trapped in shallow water in ponds [24].
The omnivore at the study site mostly consists of generalist species such as frugivore-nectarivore and frugivore-insectivore. Waterhen, Teal and Pygmy Goose were omnivore that observed when foraging for food in the fishpond. Although there are quite a lot of species, most of these birds are solitary or form small flocks. Omnivore bird which is encounter in large groups is Lemon-bellied
White-Eye. This bird is common and widespread in lowland and coastal forest, feed on nectar, fruit and insects. Common introduced species at study site i.e Sooty-headed Bulbul and Tree Sparrow. Both of species derived from feral species that spread successfully in Sulawesi. Small flock of Slender-billed Crow encountered when eating ripe papaya fruit on a tree. Many food choices cause omnivore species to have a high adaptability to different habitat conditions.

Settlements and gardens only cover a small portion of the entire study site. However, most of the large trees are concentrated in this area. Granivore are easily found at surrounding settlement. Even, this seed eaters, which are dominated by Munias, build nests in these trees (Figure 4). The presence of large number of granivore at the study site may be due to several reasons. Lack of trees around the ponds and rice fields makes the large trees in the yards an ideal place for nesting. The birds also visit the study site forage for grass seed that overgrown on the embankments due to the dried of rice field after harvest. The large trees also served as shelter from the predators. From this information, we know that composition of bird species can describe the type of flora, fauna and availability of food sources [24]. However, the availability of food is not the only reason to describe the presence of a bird species at study site [14].

**Figure 4.** Seed eater birds (granivore) collecting nest material around settlement (Station C). a. Scaly-breasted Munia. b. Chesnut Munia. c. Pale-headed Munia (Photo: Dody Priosambodo)

In least disturbed mangrove at Northern Territory, Australia, avian assemblage structure in mangroves is determined by the type and diversity of mangrove zones, the timing of mangrove flowering and the nature of the matrix surrounding mangroves. Insectivore and nectarivore reported as the most abundant bird. The species mostly derived from Gerygone, Myzomela, Lichmera and Zosterops [14]. In contrast, our result in heavily converted mangrove showed that carnivore and omnivore has many more species compared to previous habitat. Common insectivore at study site mostly prefer to hunt in open areas.

**Figure 5.** Introduced bird in Universitas Hasanuddin fishpond. a. Sooty-headed Bulbul. b. Eurasian Tree Sparrow. c. Red Collared Dove (Photo: Dody Priosambodo)

Pink-necked Green Pigeon is the only frugivore bird encountered at study site during observation. The bird diet mainly consists of fruit especially fig (Ficus spp). It is unclear whether the bird foraging
for food in mangrove forest due to only few mangrove species that produce edible flesh fruit. It is possible that the Green Pigeon uses the mangrove habitat as roosting area. Lack of edible flesh fruit causes less frugivore bird species presence in study site. Frugivore is a forest specialist bird that is mostly found in primary and secondary forests such as Bantimurung-Bulusaraung National Park [25] or forest around limestone hills at Barru Regency. These habitats are generally found in the interior of Sulawesi, far from the study site and separated by extensive rice fields.

3.4. Conservation Status
Birds in Indonesia are currently facing threat of extinction due to habitat loss, climate change, poaching, small populations and limited distribution areas [26]. Therefore, the government issued a regulation to protect the remaining. From totally 37 bird species recorded at Universitas Hasanuddin fishpond, six species are protected according to Minister of Environment and Forestry Regulation No. P.106 of 2018 [29]. The protected bird species consists of Javan Plover, Little Tern, Pied Stilt, Glossy Ibis, Great-billed Heron and Brahminy Kite. According to IUCN redlist [30], most of bird species at Universitas Hasanuddin fishpond classified as Least Concern. However, the status of three species i.e: Sunda Teal, Javan Plover and Grey-tailed Tattler fall into Near Threatened [7].

Three individuals of Javan Plovers were recorded during observation in Universitas Hasanuddin fishpond. This small birds forage for food in the middle of fishpond along with Little Tern. Javan Plover was once considered an endemic species of Java. However, in recent years, Javan Plover bird has also been reported to be present in Sumatra, Sulawesi, Nusa Tenggara and Timor Leste [26]. Javan Plover has been recorded in coastal lowlands, sandy beaches, intertidal, saline lagoons, feeding and breeding near dry aquaculture ponds. They have also been recorded breeding on dry saline land in Sape Sumbawa [1]. It has also been recorded feeding and breeding in dry cleared rice-fields before seeding or after harvesting. Javan Plovers prefer beaches or dry land above the shoreline in coastal habitats. However, the bird sometimes forages on sandy tidal flats. This bird also observed hunting crabs on beach at low tide. Population of Javan Plover was declined due to habitat pressure and limited population [26].

Figure 6. Protected bird at study site based on Minister of Environment and Forestry Regulation No. P.106 of 2018. a. Javan Plover. b. Little Tern. c. Brahminy Kite (Photo: Dody Priosambodo)

A pair of Little Tern was observed resting on the rocks in the middle of a shallow water fishpond at study site (Figure 6). Little tern is recorded to breed locally (racsinensis), but in certain months (September-May), there is a population of migrants from the northern hemisphere visiting large lakes and marshes in the interior, lagoons, fishponds and fishponds, estuaries rivers to small islands [1].

Another waterbird that has striking appearance is the Pied Stilt. This very long leg bird often visit dried fishpond in the morning, afternoon and evening in small flock consist of 1-4 individuals. The Pied Stilt explore the inside of the pond area, feeds in shallow water, probing into the sediment with its beak. It feeds largely on aquatic insects and on small molluscs. When foraging for food, a common Sandpiper observed follow along beside. Pied Stilt can be found on shallow wetlands, breeding in lake edges, marshes, swamps, riverbeds, dried fishponds and freshwater sites. This bird is resident and breeding in southern Sumatra, Java, Sulawesi, Papua New Guinea, Australia and New Zealand [1].
Large populations of Glossy Ibis and Little black cormorant were found on the island of Batukalasi, a roosting area near to the study site. These birds observed every morning passing over the fishponds, flying to feeding area in large flocks consist of 15-50 birds. Glossy Ibis reported occurs in fairly large numbers in both lowland and upland localities in Sulawesi, but breeding sites are unknown [27]. One survey recorded flocks of up to 1000 individuals travelling across Lake Tempe or feeding in the short grass and along the muddy shoreline. Small flocks of up to 20 individuals were observed at Lake Sidenreng [27]. In the Mampie Nature Reserve, the presence of the species is small numbers was confirmed, but local people reported large flocks. This bird are resident in Java, Sulawesi and Papua but considered as visitor in Sumatera, Borneo, Lesser Sunda and other part of Indonesia [27].

The only bird of prey found during the observation was the Brahminy Kite. This raptor was recorded once while hunting needlefish around the mangrove. Brahminy Kite is generally found in coastal areas and freshwater wetlands. Its diet mainly consists of fish, birds, bats, lizard and other animals. Sometimes these birds eat the carcasses of fish that have died. Brahminy Kite is widespread in India, Southeast Asia, to Papua New Guinea and Australia [28].

Several bird species found in Universitas Hasanuddin fishpond are relatively rare. The Great-billed Heron, for instance, was only encountered once during observation. The bird perched in the highest treetops around the fishpond. When approached, this bird emitted several very loud warning tones before flying away. Great-billed Heron is a shy, very alert solitary bird which is hard to approached. This bird specializes in catching large fish in intertidal area near mangrove. Feeding site in shallow water that visited by large fish is specific habitat that probably scarce and difficult to find [27]. This may explain why this bird is rare.

Rails such as the White-breasted Waterhen and the Slaty-breasted Rail are among the rarest species in study site for different reasons. Both include crepuscular birds which are more active in exploring the fishponds in the early morning or late afternoon. On one occasion, Slaty-breasted Rail was observed crossing the embankment of the fishpond in study site as the sun was almost setting. This bird passed quickly and immediately disappeared behind the thick grass that grew on the embankment. Slaty-breasted Rail are notorious for their skulking habits and are rarely flushed, and are thus comparatively little known [31]. This bird is resident but rarely found in Wallacea region [1].

Sulawesi Woodpecker is the only endemic bird species found at study site during observation (Figure 7). This bird often seen alone or in groups of 2-3 in the morning, perched on dry mangrove bark in search of caterpillars, larvae and insects. Sulawesi Woodpecker is quite common in high primary and secondary forest, forest edges, cultivated land with few trees, to urban areas with a lot of trees from sea level to 2,400 m [1].

Grey-tailed Tattler is migratory birds that found resting, alone or in pairs, in the early morning and late afternoon on the rocks in the fishpond. When the observation was made until sunset, 7 individuals were found resting on a rock in the middle of the fishpond. Most likely, this bird spent the night in the fishpond. Lightly streaked and barred underparts showed that the bird still in breeding plumage. This indicates that this bird had just arrived from the northern hemisphere. The Gray-tailed Tattler breeds in
Siberia and the Kamchatka Peninsula (far eastern Russia) and carries out regular annual migrations to Malaysia, the Philippines, Indonesia, Papua New Guinea and Australia [6]. The global population is currently estimated at 44,000 individuals [2].

4. Conclusion

From the observations at Universitas Hasanuddin fishpond, we recorded 37 bird species from 25 families consist of 29 resident, 4 migratory, 3 introduce and 1 endemic species. All bird species are scattered in six functional feeding guild categories (14 species carnivore, 9 species omnivore, 6 species insectivore, 4 species granivore, 3 species nectarivore and 1 species frugivore). Based on IUCN red list, three species consist of Sunda Teal, Javan Plover and Grey-tailed Tattler classified as near threatened. Furthermore, six species i.e., Glossy Ibis, Great-billed Heron, Pied Stilt, Little Tern, Javan Plover and Brahminy Kite including protected species based on Minister of Environment and Forestry Regulation No.P.106 of 2018. Sulawesi Woodpecker is the only endemic bird species found at study site during observation. The dominance of carnivore and omnivore bird species shows that the study site experienced significant habitat changes. This is indicated by the lack of nectarivores and insectivores which is characterize mangrove specialist bird.

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