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Avifauna Diversity and Conservation Status in PRPM Mengare, Gresik, Indonesia

Agus Satriyono[1*], Citra Fitrie Riany[2], Dian Saptarini[3], Dewi Hidayati[4]
[1,3,4]*Department of Biology, Faculty of Science and Data Analytics, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*
[2]*Agrie Conservation, Gresik, Indonesia*

***Abstract*: Efforts to conserve coastal areas are closely linked to the presence of wildlife, such as birds. By understanding the diversity of bird species in conservation project areas, we can gain insights into how these birds use their habitats. This research focuses on bird species diversity and their conservation status in the PRPM Mengare mangrove rehabilitation area in Gresik, Indonesia. Data was collected through field studies conducted in July 2023, using concentration counts for mudflat areas and point counts for mangrove forests. Birds were identified with the help of field guides, and their conservation statuses were assessed based on the IUCN Red List and local regulations. The study identified 52 bird species across 29 families in the PRPM Mengare area. The bird diversity index was 3.55, indicating a high level of diversity. Of the species recorded, 4 are listed as Near Threatened, and 41 are classified as Least Concern on the IUCN Red List. Additionally, 5 species are protected by government regulations. These findings highlight the high bird diversity in the area and underscore the potential for future conservation initiatives. They also emphasize the importance of ongoing monitoring and targeted conservation strategies, particularly for vulnerable species. Understanding these monitoring patterns is essential for guiding effective conservation and management practices, ensuring the sustainability of mangrove ecosystems and the valuable services they provide.**

***Keywords*: bird diversity, mangrove restoration.**

1. Introduction

Mangrove ecosystems are among the most biologically diverse and economically valuable ecosystems on the planet, providing essential habitats for numerous species and offering vital ecosystem services to coastal communities worldwide [1]-[4]. Among the diverse array of fauna inhabiting mangrove forests, avian species play a particularly significant role as indicators of ecosystem health and functioning [5], [6]. Avian biodiversity in mangrove ecosystems reflects the ecological integrity of these habitats and is influenced by various factors, including habitat quality, food availability, and anthropogenic disturbances [7], [8]. Understanding avian biodiversity patterns in mangrove areas is essential for effective conservation and management strategies aimed at preserving these valuable ecosystems and the services they provide [9], [10].

PRPM (*Pusat Restorasi dan Pembelajaran Mangrove*/ Mangrove restoration and learning center) Mengare, located in Gresik, Indonesia, is a prime example of a mangrove ecosystem facing both conservation challenges and opportunities. Mangrove conservation efforts in PRPM Mengare have been ongoing since 2018, focusing on enhancing mangrove species richness and expanding vegetative cover through extensive mangrove planting initiatives. These efforts aim to restore degraded mangrove areas, mitigate coastal erosion, and promote biodiversity conservation through education. However, avifauna in this area are poorly studied. To support the organization's goals, studies are needed to know diversity of birds around the area as a guide for its educational programs related to bird conservation in mangrove and coastal habitats.

Avian biodiversity assessment serves as a valuable tool for evaluating the effectiveness of mangrove conservation efforts and understanding the ecological dynamics of these ecosystems [11], [12]. Furthermore, avian biodiversity assessments provide crucial data for identifying priority areas for conservation and guiding decision-making processes to ensure the long-term sustainability of mangrove ecosystems [10], [13].

The present study aims to identify species diversity, and conservation status of birds in PRPM Mengare. This study examines avian diversity using the Shannon and Simpson Diversity Indices. The study also explores meteorological factors and their trends, such as precipitation and temperature in PRPM Mengare. By examining these environmental variables, the research aims to uncover potential correlations and causal relationships between climate factors and avian population dynamics.

2. Methodology

A. Study Site and Period

The research was conducted in July 2023 through direct field observations across various sites focused on biodiversity management and community empowerment/CSR programs. Specifically, the study locations included the Mangrove Restoration & Learning Center Mengare Gresik situated in Tanjung Widoro village, Bungah subdistrict, with coordinates at 112°38'39.40" E, 7°1'53.16" S. PRPM Mengare, is characterized by extensive mudflats, mangrove forests, and bamboo forests, reflecting diverse ecological habitats characterized by vast stands of Rhizophora, Avicennia, and Sonneratia species. The mangrove conservation efforts in

*Corresponding author: assatrio@gmail.com

PRPM Mengare have been ongoing since 2018, focusing on habitat restoration and mangrove planting initiatives to enhance biodiversity and ecosystem resilience. These locations were chosen to provide insights into avian biodiversity in PRPM Mengare.

B. Data Collection

Data collection utilized direct observation methods. Equipment included 7x50 binoculars, a Nikon P1000 prosumer camera with 125x optical zoom and 4K UHD video capabilities on a tripod, tally sheets, a wristwatch, a hand counter, and field guides. Bird identification was based on references such as "Birds of Sumatra, Java, Bali, and Borneo" [14], "Birds of the Indonesian Archipelago" [15],"Water Birds of ASEAN" and species names from “Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world”[16] In mangrove forests with dense vegetation, a Point Count method was used [17], conducted on foot with points spaced approximately 150 meters apart to avoid double-counting of the same species. Each point was observed for 20 minutes, recording bird species both seen and heard.

C. Data Analysis

The diversity index and species abundance of terrestrial fauna, particularly avifauna, Shannon-Wiener formula was employed. The Shannon-Wiener Diversity Index (H′) was calculated using the equation $H' = -\sum(ni/N)\ln(ni/N)$, where ni represents the number of individuals of species i, and N denotes the total number of individuals across all species [18]. This index provides a measure of species diversity within the community studied [19]. Additionally, species abundance, referred to as Relative Abundance (RA) in this context, was determined using the formula $RA = (ni/N) \times 100\%$. RA represents the proportion of individuals of a particular species relative to the total population [20].

The Relative Abundance (RA) values were classified into three categories according to Jorgensen's classification: non-dominant (RA 0% – 2%), sub-dominant (RA 2% – 5%), and dominant (RA > 5%). These classifications help to understand the ecological roles and prevalence of different species within the studied community. Furthermore, data on bird species were analyzed for their conservation status based on Ministry of Environment and Forestry Regulation No. P.106/MENLHK/SETJEN/KUM.1/12/2018 and the IUCN Red List criteria. This analysis aids in assessing the conservation priorities and management strategies necessary to protect avifauna populations in the research area.

3. Results and Discussion

A. Bird’s Species Abundance and Diversity in PRPM Mengare

Based on field observations conducted in July 2023 at the PRPM Mangrove area in Gresik, a total of 52 bird species were recorded. The observations revealed 397 individual birds across 29 different families. The Shannon-Wiener Index was calculated to be 3.55, indicating a high level of biodiversity. The most numerous birds observed were water birds, with the *Ardeola speciosa* (Javan Pond-Heron) and *Egretta garzetta* (Little Egret) being the most abundant, totaling 34 and 32 individuals, respectively. The most prominent bird families in the study area were those commonly found in coastal environments, such as Ardeidae, Scolopacidae, and Laridae. The Ardeidae family, which includes species adapted to coastal and wetland habitats, was represented by seven species: Javan Pond-Heron (*Ardeola speciosa*), Little Egret (*Egretta garzetta*), Black-crowned Night-Heron (*Nycticorax nycticorax*), Great Egret (*Ardea alba*), Green-backed Heron (*Butorides striata*), Intermediate Egret (*Ardea intermedia*), and Purple Heron (*Ardea purpurea*) [14]. The Scolopacidae family, which includes shorebirds, was represented by four species: Common Sandpiper (*Actitis hypoleucos*), Whimbrel (*Numenius phaeopus*), Common Redshank (*Tringa tetanus*), and Wood Sandpiper (*Tringa glaerola*). Additionally, the Laridae family, or terns, included Little Tern (*Sterna albifrons*), Common Tern (*Sterna hirundo*), and Whiskered Tern (*Chlidonias hybrida*). The variety and number of species recorded align with the coastal and wetland characteristics of the study area, which includes ponds, mudflats, and mangrove forests.

The high bird diversity index in the Mengare PRPM area indicates that the environment still possesses adequate capacity to support a wide range of bird species. This includes birds that feed on seeds, insects, benthic macrofauna, and other water-dwelling organisms. According to [21] abundance and diversity of bird species in coastal areas are particularly high in mudflats and ponds. This is due to the rich availability of macrozoobenthos, which provides a plentiful food source compared to other habitats. Open environments, such as fish ponds, offer different bird species and compositions compared to more enclosed areas. Large pond areas with mud flats provide ample food resources, supporting a wide variety of bird species that frequent these habitats [22]. Nevertheless, habitat changes can lead to changes in bird composition and abundance components [23]. The conversion of land functions is the main key controlling species diversity currently and in the future [24], [25].

In the study area, birds were categorized based on their relative dominance into three groups: dominant, sub-dominant, and non-dominant. A total of 5 species were classified as dominant, 11 as sub-dominant, and 36 as non-dominant. Dominant species are those with a relative dominance value exceeding 5. The dominant species identified in the study include the Linchi Swiftlet (*Collocalia linchi*), Javan Pond-Heron (*Ardeola speciosa*), Little Egret (*Egretta garzetta*), Pink-necked Green Pigeon (*Treron vernans*), and Javan Munia (*Lonchura leucogastroides*). The Linchi Swiftlet is versatile, inhabiting a range of environments from lowlands to highlands. The Javan Pond-Heron and Little Egret are typically observed in ponds or mudflats during low tide. In contrast, the Pink-necked Green Pigeon and Javan Munia are more commonly found in bamboo forests and areas with various land vegetation. These findings highlight the varied habitats preferred by the dominant bird species and underscore their ecological roles in different environments within the study area.

No	Family	Scientific name	Indonesian Name	English Name
1	Acanthizidae	*Gerygone sulphurea*	Remetuk Laut	Golden-bellied Gerygone
2	Aegithinidae	*Aegithina tiphia*	Cipoh Kacat	Common Iora
3	Alcedinidae	*Alcedo coerulescens*	Raja-udang biru	Cerulean Kingfisher
4		*Todiramphus chloris*	Cekakak Sungai	Collared Kingfisher
5	Anatidae	*Dendrocygna javanica*	Belibis Polos	Lesser Whistling Duck
6		*Anas gibberifrons*	Itik Benjut	Sunda Teal
7	Apodidae	*Collocalia linchi*	Walet Linci	Linchi Swiftlet
8		*Aerodramus fuciphagus*	Walet sarang putih	Edible-nest Swiftlet
9		*Cypsiurus balasiensis*	Walet Palem Asia	Asian Palm Swift
10	Ardeidae	*Ardeola speciosa*	Blekok Sawah	Javan Pond-Heron
11		*Egretta garzetta*	Kuntul Kecil	Little Egret
12		*Nycticorax nycticorax*	Kowak-malam Abu	Black-crowned Night-Her
13		*Ardea alba*	Cangak Besar	Great Egret
14		*Butorides striata*	Kokokan Laut	Green-backed Heron
15		*Ardea intermedia*	Kuntul Perak	Intermediate Egret
16		*Ardea purpurea*	Cangak Merah	Purple Heron
17	Artamidae	*Artamus leucoryn*	Kekep Babi	White-breasted Woodswall
18	Campephagidae	*Pericrocotus cinnamomeus*	Sepah kecil	Small Minivet
19		*Lalage sueurii*	Kapasan sayap-putih	White-shouldered Triller
20	Charadriidae	*Charadrius javanicus*	Cerek Jawa	Javan Plover
21		*Pluvialis fulva*	Cerek Kernyut	Pacific Golden Plover
22	Cisticolidae	*Orthotomus sutorius*	Cinenen Pisang	Common Tailorbird
23		*Prinia familiaris*	Prenjak jawa	Bar-winged Prinia
24	Columbidae	*Treron vernans*	Punai Gading	Pink-necked Green Pigeon
25		*Geopelia striata*	Perkutut	Zebra Dove
26		*Spilopelia chinensis*	Tekukur Biasa	Eastern Spotted Dove
27	Cuculidae	*Cacomantis merulinus*	Wiwik Kelabu	Plaintive Cuckoo
28		*Centropus bengalensis*	Bubut Alang-alang	Lesser Coucal
29	Dicaeidae	*Dicaeum trochileum*	Cabai Jawa	Scarled-headed Flowerpec
30	Dicruridae	*Dicrurus macrocercus*	Srigunting Hitam	Black Drongo
31	Estrildidae	*Lonchura leucogastroides*	Bondol Jawa	Javan Munia
32		*Lonchura punctulata*	Bondol Peking	Scaly-breasted Munia
33	Hirundinidae	*Hirundo javanica*	Layang-layang batu	Pacific Swallow
34	Laridae	*Sterna albifrons*	Dara-laut kecil	Little Tern
35		*Sterna hirundo*	Dara-laut biasa	Common Tern
36		*Chlidonias hybrida*	Dara-laut kumis	Whiskered Tern
37	Meropidae	*Merops leschenaulti*	Kirik-kirik senja	Chesnut-headed Bee-eater
38	Nectariniidae	*Cinnyris jugularis*	Burung Madu Sriganti	Olive-backed Subird
39	Passeridae	*Passer montanus*	Burung-gereja Erasia	Eurasian Tree Sparrow
40	Phalacrocoracidae	*Microcarbo niger*	Pecuk-padi kecil	Little Cormorant
41	Picidae	*Picoides moluccensis*	Caladi tilik	Sunda Pygmy-Woodpecke
42	Pycnonotidae	*Pycnonotus aurigaster*	Cucak Kutilang	Sooty-headed Bulbul
43		*Pycnonotus goiavier*	Merbah Cerukcuk	Sunda Yelloe-vented Bulb
44	Rallidae	*Amaurornis cinerea*	Kareo Padi	White-breasted Waterhen
45	Recurvirostridae	*Himantopus himantopus*	Gagang-bayam Timur	White-headed Stilt
46	Rhipiduridae	*Rhipidura javanica*	Kipasan Belang	Sunda Pied Fantail
47	Scolopacidae	*Actitis hypoleucos*	Trinil Pantai	Common Sandpiper
48		*Numenius phaeopus*	Gajahan Penggala	Whimbrel
49		*Tringa totanus*	Trinil Kaki-merah	Common Redshank
50		*Tringa glareola*	Trinil Semak	Wood Sandpiper
51	Turnicidae	*Turnix suscitator*	Gemak Loreng	Barred Buttonquail
52	Zosteropidae	*Zosterops chloris*	Kacamata laut	Lemon-bellied White-eye

Fig. 1. Bird species in PRPM Mengare

The identification of migratory birds in the study area indicates that PRPM Mengare provides a safe habitat for these species. A total of eight migratory bird species were observed. Among them, the Little Tern (*Sterna albifrons*) and Common Tern (*Sterna hirundo*) are the most frequently seen, while five other species are less common but still significant. These include the Pacific Golden Plover (*Pluvialis fulva*), Whiskered Tern (*Chlidonias hybrida*), Common Sandpiper (*Actitis hypoleucos*), Whimbrel (*Numenius phaeopus*), Common Redshank (*Tringa tetanus*), and Wood Sandpiper (*Tringa glareola*).

B. Conservation Status of Bird Species in PRPM Mengare

In PRPM Mengare, a total of 45 bird species are listed on the IUCN Red List, with 5 species protected by Indonesian government regulations. Among these, 3 species are categorized as Near Threatened, while the remaining 42 are classified as Least Concern. The Javan Pond-Heron (*Ardeola speciosa*) is the most dominant species observed, with 34 individuals and a relative dominance of 8.63%. This species is the only dominant bird listed as Least Concern on the IUCN Red List. Other dominant species, such as the Little Egret (*Egretta garzetta*), Javan Mina (*Lonchura leucogastroides*), Linchi Swiftlet (*Collocalia linchi*), and Pink-necked Green Pigeon (*Treron vernans*), are not listed on the IUCN Red List. The Great Egret (*Ardea alba*) is the only sub-dominant species with a relative dominance of 2.03%. It is included in government regulations and is listed as Least Concern. Additionally, Whiskered Tern (*Chlidonias hybrida*) and Whimbrel (*Numenius phaeopus*) are protected under Indonesian regulations, with relative dominances of 1.52% and 1.02%, respectively. The Sunda Pied Fantail (*Rhipidura javanica*), also protected by government regulations and listed as Least Concern, is a non-dominant species with a relative dominance of 1.27%.

No	Species		IUCN	No 106 Tahun 2018
	English Name	Scientific name		
1	Golden-bellied Gerygone	*Gerygone sulphurea*	LC	-
2	Common Iora	*Aegithina tiphia*	LC	-
3	Cerulean Kingfisher	*Alcedo coerulescens*	LC	-
4	Collared Kingfisher	*Todiramphus chloris*	LC	-
5	Sunda Teal	*Anas gibberifrons*	NT	-
6	Asian Palm Swift	*Cypsiurus balasiensis*	LC	-
7	Javan Pond-Heron	*Ardeola speciosa*	LC	-
8	Black-crowned Night-Heron	*Nycticorax nycticorax*	LC	-
9	Great Egret	*Ardea alba*	LC	v
10	Green-backed Heron	*Butorides striata*	LC	-
11	Intermediate Egret	*Ardea intermedia*	LC	-
12	Purple Heron	*Ardea purpurea*	LC	-
13	White-breasted Woodswallow	*Artamus leucoryn*	LC	-
14	Small Minivet	*Pericrocotus cinnamomeus*	LC	-
15	White-shouldered Triller	*Lalage sueurii*	LC	-
16	Javan Plover	*Charadrius javanicus*	NT	v
17	Pacific Golden Plover	*Pluvialis fulva*	LC	-
18	Common Tailorbird	*Orthotomus sutorius*	LC	-
19	Bar-winged Prinia	*Prinia familiaris*	NT	-
20	Zebra Dove	*Geopelia striata*	LC	-
21	Eastern Spotted Dove	*Spilopelia chinensis*	LC	-
22	Plaintive Cuckoo	*Cacomantis merulinus*	LC	-
23	Lesser Coucal	*Centropus bengalensis*	LC	-
24	Scarled-headed Flowerpecker	*Dicaeum trochileum*	LC	-
25	Javan Munia	*Lonchura leucogastroides*	LC	-
26	Scaly-breasted Munia	*Lonchura punctulata*	LC	-
27	Pacific Swallow	*Hirundo javanica*	LC	-
28	Little Tern	*Sterna albifrons*	LC	-
29	Common Tern	*Sterna hirundo*	LC	-
30	Whiskered Tern	*Chlidonias hybrida*	LC	v
31	Chesnut-headed Bee-eater	*Merops leschenaulti*	LC	-
32	Olive-backed Subird	*Cinnyris jugularis*	LC	-
33	Eurasian Tree Sparrow	*Passer montanus*	LC	-
34	Little Cormorant	*Microcarbo niger*	LC	-
35	Sunda Pygmy-Woodpecker	*Picoides moluccensis*	LC	-
36	Sooty-headed Bulbul	*Pycnonotus aurigaster*	LC	-
37	Sunda Yelloe-vented Bulbul	*Pycnonotus goiavier*	LC	-
38	White-headed Stilt	*Himantopus himantopus*	LC	-
39	Sunda Pied Fantail	*Rhipidura javanica*	LC	v
40	Common Sandpiper	*Actitis hypoleucos*	LC	-
41	Whimbrel	*Numenius phaeopus*	LC	v
42	Common Redshank	*Tringa totanus*	LC	-
43	Barred Buttonquail	*Turnix suscitator*	LC	-
44	Lemon-bellied White-eye	*Zosterops chloris*	LC	-
45	Black Drongo	*Dicrurus macrocercus*	LC	-

Fig. 2. Bird conservation status in PRPM Mengare

Sub-dominant and non-dominant species significantly contribute to the area's bird diversity. Birds' active in mangrove vegetation, such as the Golden-bellied Gerygone (*Gerygone sulphurea*), Common Iora (*Aegithina tiphia*), and Black-crowned Night Heron (*Nycticorax nycticorax*), are listed as Least Concern. Seed-eating birds like the Scaly-breasted Munia (*Lonchura punctulata*), Eurasian Tree Sparrow (*Passer montanus*), insect-eating Small Minivet (*Pericrocotus cinnamomeus*), and fruit-eating Shooty-headed Bulbul (*Pycnonotus aurigaster*) are also classified as Least Concern. Additionally, sea birds such as the Little Tern (*Sterna albifrons*)

and Common Tern (*Sterna hirundo*) are sub-dominant and migratory, also listed as Least Concern. The Adible-nest Swiftlet (*Aerodramus fuciphagus*) is the only sub-dominant species not listed as protected.

The presence of non-dominant species, many listed as Least Concern, suggests a relatively healthy ecosystem where even less common species can maintain viable populations. However, the presence of Near Threatened species, such as the Javan Plover (*Charadrius javanicus*), Bar-winged Prinia (*Prinia familiaris*), and Sunda Teal (*Anas gibberifrons*), highlights areas needing targeted conservation efforts. The Javan Plover inhabits open mudflats, the Bar-winged Prinia is found in fields, bushes, and mangrove forests, and the Sunda Teal frequents open wetlands in Indonesia.

The analysis reveals a diverse bird community in PRPM Mengare, comprising dominant, sub-dominant, and non-dominant species. While species like the Little Egret, Javan Pond-Heron, and Javan Mina, categorized as Least Concern, indicate stable populations, the presence of Near Threatened species underscores the need for continued monitoring and conservation efforts to prevent declines and ensure these populations do not move towards threatened status

4. Conclusion

PRPM Mangrove area in Gresik have documented 52 bird species and 397 individual birds across 29 families. The Shannon-Wiener Index of 3.55 indicates a high level of biodiversity, reflecting a diverse and well-balanced avian community within this mangrove habitat. Continued monitoring is essential to maintain these high biodiversity levels. Ongoing conservation efforts, including mangrove restoration and habitat management, are critical as they can significantly influence the diversity of bird species at the study location. The species dominance analysis using Relative Abundance (RA) highlighted key species such as the Javan Plover (*Charadrius javanicus*), Bar-winged Prinia (*Prinia familiaris*), and Sunda Teal (*Anas griberifrons*). This emphasizes the need for targeted conservation strategies to address specific vulnerabilities within the avian community, including habitat conservation. Moving forward, sustained monitoring and adaptive management practices will be crucial to preserve the observed biodiversity and ensure the long-term resilience of mangrove ecosystems amid environmental changes and anthropogenic pressures. By integrating these findings into conservation policies and practices, stakeholders can enhance the effectiveness of biodiversity conservation efforts in PRPM Mangrove and similar habitats globally.

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