

## DIVERSITY OF MIGRATORY BIRDS IN SEVERAL TYPES OF WETLANDS (CASE STUDY IN SUMBERNADI VILLAGE, SOUTH LAMPUNG REGENCY)

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### ABSTRACT

*Bird migration is a natural phenomenon that plays a crucial role in maintaining global ecosystem balance. One of the most notable groups involved in this phenomenon is migratory waterbirds, which depend on wetlands as resting, feeding, and breeding sites during their migration period. This study aims to analyze the ecological indices of migratory birds, including species diversity, richness, evenness, abundance, and dominance, across various wetland types in Sumbernadi Village, South Lampung Regency. Data were collected from November to December 2024 using the point count method at six observation points representing four wetland types: mangrove, mudflat, fishpond, and rice field. The results recorded nine migratory bird species from three families, with the highest diversity observed in mudflats ( $H' = 1.958$ ) and the lowest in mangroves ( $H' = 0.637$ ). The Scolopacidae family dominated in terms of both abundance and distribution. Environmental factors, including food availability, vegetation structure, and human disturbance, influenced differences in diversity among habitats. These findings suggest that the wetlands in Sumbernadi Village provide vital ecological habitats for migratory birds. Therefore, sustainable management and conservation efforts are crucial for preserving the environmental functions of these wetlands and supporting the continuity of migratory bird populations in the region.*

*Keywords: Migratory bird, Wetlands, Species Diversity*

### I. INTRODUCTION

Bird migration is a natural phenomenon that attracts the attention of scientists and nature observers. Approximately 1,855 bird species, or 19% of all existing species, are migratory, undertaking cyclical movements beyond their breeding grounds with regular patterns of timing and destination (Somveille et al., 2013; Runge et al., 2015). A critical group in this phenomenon is migratory birds, which naturally depend on aquatic environments for resting, foraging, and breeding (Eren et al., 2024; Siregar and Jumilawaty, 2019). Migratory birds have physical adaptations such as waterproof feathers, long or webbed feet, and beaks suitable for foraging in aquatic environments (Fayogi et al., 2019; Siregar et al., 2018). These species generally inhabit wetland habitats such as mangroves, mudflats, fishponds, and rice fields due to the availability of food, protection from predators, and safe

nesting locations (Woghomugu and Warmetan, 2017; Tambunan et al., 2016). In addition to their high ecological value, migratory birds also play a crucial role in maintaining the balance of cross-regional ecosystems.

Wetlands are ecosystems that play a crucial role in maintaining environmental balance. These ecosystems serve as water reservoirs, flood control mechanisms, water quality buffers, and habitats for various plant and wildlife species (Wiranda et al., 2020). Therefore, the presence and diversity of migratory birds can be used as a significant indicator to assess the health of a wetland. As a country with high biodiversity, Indonesia has many wetland areas, both natural and artificial (Meidita et al., 2018). The province of Lampung, particularly the district of South Lampung, features a diverse range of wetlands, including mangroves, mudflats, fishponds, and rice fields. The diversity of these wetland types

has the potential to become habitats for various kinds of migratory birds with different ecological needs (Dima et al., 2022).

Sumbernadi Village is one of the villages in South Lampung Regency that features a fairly diverse landscape, characterized by a mix of agricultural land, mangrove forests, fishponds, and mudflats. The variety of wetland types can affect the composition and abundance of migratory birds in this area (Malindu et al., 2016). Each land type offers distinct environmental conditions, including water depth, vegetation availability, and the level of human disturbance, which can influence the habitat preferences of migratory birds (Sesser et al., 2016). Despite their high potential as habitats for migratory birds, the wetlands in Sumbernadi Village also face pressure from human activities, such as land conversion for intensive agriculture, residential development, and environmental pollution (Makkatenni et al., 2020). This can lead to a decline in habitat quality and threaten the existence of migratory birds (Angga et al., 2015). Therefore, data on the diversity of migratory birds in each type of wetland is needed to support environmental conservation efforts and sustainable habitat management.

The diversity of migratory bird species includes various types of birds that inhabit and depend on wetland habitats (Dima et al., 2022). Factors such as climate, environmental conditions, and resource availability can affect the diversity of migratory bird species in a wetland area (Kusumahadi, 2020). Additionally, the migration season plays a crucial role in increasing the diversity of migratory bird species, as many species travel long distances each year to forage or breed in various types of wetlands (Lestari and Kurnia, 2023). The greater the diversity of wetland types in an area, the more migratory bird species can be found (Lasantu et al., 2020). Research on the diversity of migratory bird species in Sumbernadi Village, South Lampung Regency, has never been conducted, so

information and data on the diversity of migratory birds in several types of wetlands in Sumbernadi Village, South Lampung Regency, are still limited. Therefore, research is needed on the diversity and abundance of migratory bird species in several types of wetlands as one of the potential to support natural resource management in Sumbernadi Village, South Lampung Regency, which aims to obtain data on the diversity, species richness, species evenness, species abundance, and species dominance of migratory birds.

## II. MATERIALS AND METHOD

This study was conducted from November to December 2024 in Sumbernadi Village, Ketapang Subdistrict, South Lampung Regency, Lampung Province. The mangrove ecosystem in South Lampung spans an area of 524.8 hectares, comprising 14 species (Kuncahyo et al., 2020; Simanjuntak et al., 2025). In Sumbernadi Village, the mangrove species found include *Rhizophora* sp. Sumbernadi Village is situated in a coastal area that is part of a wetland ecosystem, which provides for mangroves, mudflats, fishponds, and rice fields. Species diversity is related to environmental factors and land management that affect the distribution and diversity of migratory bird species in the area. The method used in collecting data on migratory birds was the point count method (Kiros, 2018). The point count method involves observing specific points in an area and recording all migratory birds seen or heard within a specified time period (Fikriyanti et al., 2018). In this study, six observation points were determined in each type of wetland (mangrove, mudflat, fishpond, and rice field) with a distance of 200 meters between each point and a time interval of 15 minutes. These observation points were used to avoid overlap when counting individual migratory birds in each type of wetland (Nurdin et al., 2021). Migratory bird observations were conducted in several types of wetlands, including mangroves, mudflats, fishponds, and

rice fields, with two repetitions: in the morning from 06:00 to 09:00 a.m. and from 3:00 to 6:00 p.m. The analysis of the research data consisted of examining the species diversity index,

species richness, species evenness, species abundance, and species dominance of migratory birds. The data analysis is as follows.

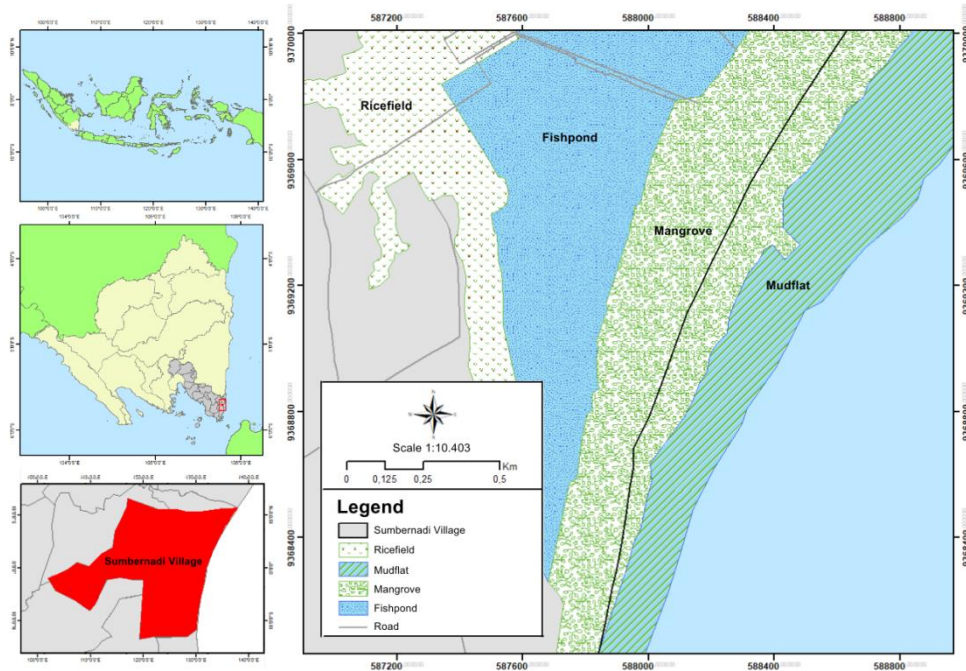


Figure 1. Research location: Wetlands area in Sumbernadi Village, South Lampung Regency

### Species Diversity (H')

The species diversity index is the relationship between species abundance and species richness of migratory birds found in several types of wetlands (Meidita et al., 2018). The species diversity index can be calculated using the Shannon-Weiner formula with the following equation (Magurran, 1988):

$$H' = - \sum P_i \ln(P_i), P_i = \frac{n_i}{N}$$

Description:

H' = Shannon-Wiener diversity index

n<sub>i</sub> = Number of individuals of type i

N = Total number of individuals of all types

P<sub>i</sub> = Proportion of individuals of type i

Criteria for Shannon-Wiener diversity index (H') values:

H' ≤ 1 = Low diversity

1 ≤ H' ≤ 3 = Moderate diversity

H' ≥ 3 = High diversity

### Species Richness (R)

The species richness index provides an overview of species diversity in an ecosystem (Baderan et al., 2021). The species richness index for migratory birds can be calculated using Margalef's species richness index formula with the following equation (Magurran, 1988):

$$R = \frac{S - 1}{\ln(N)}$$

Description:

R = Richness index

S = Number of species found

n = Total number of individuals

Species richness criteria (R):

R < 2.5 = Low species richness

2.5 < R < 4 = Medium species richness

R > 4 = High species richness

### Species Evenness (E)

The species evenness index is used to determine the uniformity of the number of migratory birds that form communities in various types of wetlands, such as mangrove forests, mudflats, fishponds, and rice fields (Nurdin et al., 2021). The species evenness index is formulated using the following equation (Ludwig and Reynolds, 1988):

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

Description:

E = Species evenness index

H' = Species diversity index

S = Number of species.

If the E value <0.20, it can be said that the species distribution condition is unstable, while if the E value is 0.21 <E <1, it can be said that the species distribution condition is stable (Pertiwi, 2021).

### Species Dominance (C)

The dominance index of waterbird species in several types of wetlands, such as mangroves, mudflats, fishponds, and rice fields, can be determined using the Simpson Index formula equation as follows (Kurniawan and Prayogo, 2018).

$$C = \sum \left( \frac{ni}{N} \right)^2$$

Description:

C = Dominance index

ni = Number of individuals of a species

N = Number of individuals of all species

Criteria:

$C \leq 0.5$  = No species can dominate other species

$C \geq 0.8$  = There are species that dominate other species

### III. RESULTS AND DISCUSSION

The study identified 12 species of migratory birds, comprising a total of 95 individuals, belonging to three families: Charadriidae, Scolopacidae, and Sternidae (Table 1). The use of the point count method at each point yielded differences in the number of migratory bird species observed. This is because Sumbernadi Village has various types of wetlands, including mangrove habitats, mudflats, fishponds, and rice fields, indicating that each species has distinct habitat preferences compared to other species (Iswandaru et al., 2023).

**Table 1.** Species Composition of Migratory Birds in Several Types of Wetlands in Sumbernadi Village, South Lampung Regency

No.	Common Name	Scientific Name	Family	Wetland Types				IUCN
				A	B	C	D	
1	Kentish plover	<i>Charadrius alexandrinus</i>	Charadriidae		7	20		LC
2	Marsh sandpiper	<i>Tringa stagnatilis</i>	Scolopacidae		2	3		LC
3	Common sandpiper	<i>Actitis hypoleucos</i>	Scolopacidae	7	5	13	2	LC
4	Terek sandpiper	<i>Xenus cinereus</i>	Scolopacidae	2	2	2	1	LC
5	Wood sandpiper	<i>Tringa glareola</i>	Scolopacidae	1	6	4		LC
6	Common tern	<i>Sterna hirundo</i>	Sternidae		1	2		LC
7	Grey plover	<i>Pluvialis squatarola</i>	Charadriidae		1	3		LC
8	Pacific Golden-plover	<i>Pluvialis fulva</i>	Charadriidae	1	3	4		LC
9	Common greenshank	<i>Tringa nebularia</i>	Scolopacidae		1	2		LC
Amount				11	28	53	3	

Information:

A : Mangrove; B: Mudflat; C : Fishpond; D : Rice field; LC : Least Concern

Results of observations on these four types of wetlands show that the Scolopacidae family is the most frequently encountered

(Table 1). Migratory birds belonging to the Scolopacidae family include the marsh sandpiper (*Tringa stagnatilis*), Common

sandpiper (*Actitis hypoleucos*), Terek sandpiper (*Xenus cinereus*), Wood sandpiper (*Tringa glareola*), and Common greenshank (*Tringa nebularia*). The abundant food supply in wetlands tends to make migratory bird species more dominant in these areas, especially those belonging to the Scolopacidae family (Indrayanti et al., 2015). The greater abundance of bird species in mudflat and fishpond compared to other locations is due to the abundant availability of food sources, such as invertebrates in the mud and fish in the ponds, which attract aquatic and migratory birds of prey. These habitats provide ideal open and semi-aquatic areas for resting, nesting, and hunting, supporting greater species diversity. Migratory birds utilize mudflats in mangrove forests to search for food (Iswandaru et al., 2020). Additionally, the presence of trees as perching and nesting sites supports the existence of migratory birds (Mahrudin and Arsyad, 2019). Wetlands such as mangroves, mudflats, fishponds, and rice fields in Sumbernadi Village are ideal habitats for migratory birds due to the abundant food supply, as well as allowing migratory birds to carry out various other activities, such as foraging, building or having nests, incubating eggs, and caring for their young. It can also be influenced by vegetation diversity (Suparjo, 2010).

According to the conservation status classification of the International Union for

Conservation of Nature (IUCN), 12 species of migratory birds are identified as being in the lowest category (LC). Several activities that can threaten the survival of migratory birds in wetland areas include poaching, land use change, and habitat destruction. This environmental damage can result in habitat loss, forcing migratory birds to relocate to other regions (Riefani and Soendjoto, 2015). In addition, the distance between the observation site and residential areas also affects the difference in the number of migratory bird species found in the four wetland locations, which may be due to the activities of residents around the settlements that disturb or threaten migratory birds (Angga et al., 2015). Therefore, the conservation and management of wetlands in mangrove forests, mudflats, fishponds, and rice fields are crucial for maintaining biodiversity and the sustainability of ecosystems that support the lives of various species, including migratory birds (Charalambous et al., 2024). One of the key steps in this conservation effort is the restoration of mangrove habitats, the implementation of sustainable management in mudflat areas, the application of environmentally friendly cultivation techniques, and the reduction of pesticide and chemical fertilizer use in rice field management (Paulino et al., 2024).

**Table 2.** Ecological Index of Migratory birds in Several Types of Wetlands

Wetland Types	H'	R	E	C
Mangrove	1,034**	1,251*	0,746***	0,455***
Mudflat	1,958**	2,401*	0,891***	0,166***
Fishpond	1,799**	2,015*	0,819***	0,225***
Rice field	0,637*	0,910*	0,918***	0,556***

Description: \*Low; \*\*Moderate; \*\*\*Stable

Similar ecological index (H') of migratory birds values across all wetland types except rice paddies indicate that habitats such as mudflats

and fishponds have similar food sources and attract aquatic birds with balanced species diversity. However, rice paddies differ because

intensive human management, such as irrigation and pesticides, reduces native species or attracts tolerant species, resulting in more variable  $H'$ . The ecological index of migratory birds in mangrove wetland types shows a species diversity index ( $H'$ ) of 1.034 (Table 2). This value indicates that the species diversity of migratory birds in mangroves is in the moderate category, as the  $H'$  value is in the range of  $1 \leq H' \leq 3$  (Khalil et al., 2021). In addition, the species richness value ( $R$ ) of 1.251 also indicates that the species richness of migratory birds in mangrove wetland types falls into the low category, as the  $R$  value is within the range of  $R < 2.5$  (Kamal, 2017). The species evenness value ( $E$ ) of 0.746 indicates that the species evenness of migratory birds in mangrove wetlands is stable, as the  $E$  value falls within the range of  $0.21 < E < 1$  (Nurdin et al., 2021). Meanwhile, the species dominance value ( $C$ ) of 0.455 indicates that no migratory bird species dominate significantly in mangrove wetland types, as the  $C$  value is within the range  $C \leq 0.5$ .

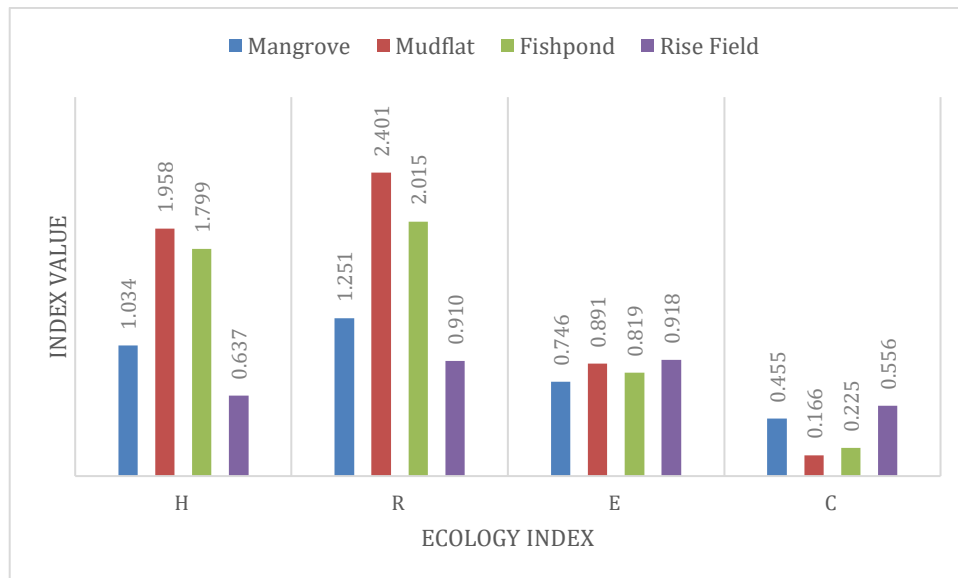
The ecological index of migratory birds in mudflat wetland types shows a species diversity value ( $H'$ ) of 1.958. This value indicates that the diversity of migratory birds in mudflat wetland types is in the moderate category, as the  $H'$  value is in the range of  $1 \leq H' \leq 3$ . In addition, the species richness value ( $R$ ) of 2.401 also indicates that the species richness of migratory birds in mudflat wetland types is in the moderate category, as the  $R$  value is in the range of  $2.5 < R < 4$  (Asrianny et al., 2018). The species evenness value ( $E$ ) of 0.891 indicates that the species evenness of migratory birds in mudflat wetland types is in the stable category, as the  $E$  value is in the range of  $0.21 < E < 1$ . This high  $E$  value indicates that the distribution of migratory bird species in mudflat wetland types is relatively even. Meanwhile, the species dominance value ( $C$ ) of 0.166 indicates that no migratory bird species dominate significantly in mudflat wetland types, because the  $C$  value is within the range of  $C \leq 0.5$  (Kurniawan and Prayogo, 2018).

Based on Table 2, the ecological index of migratory birds in the wetland fishpond type shows a species diversity index ( $H'$ ) of 1.799. This value indicates that the diversity of migratory birds in the wetland fishpond type is in the moderate category, because the  $H'$  value is in the range of  $1 \leq H' \leq 3$ . In addition, the species richness value ( $R$ ) of 2.015 also indicates that the species richness of migratory birds in the wetland type of fishponds is in the moderate category, because the  $R$  value falls within the range of  $2.5 < R < 4$  (Baderan et al., 2021). However, this relatively low  $R$  value suggests that the species richness of migratory birds in the wetland-type fishponds remains limited. The species evenness value ( $E$ ) of 0.819 indicates that the evenness of migratory bird species in the wetland type of fishponds is in the stable category, as the  $E$  value is in the range of  $0.21 < E < 1$ . This relatively high  $E$  value indicates that the distribution of migratory bird species in the wetland type of fishponds is relatively even. Meanwhile, the species' dominance value ( $C$ ) of 0.225 indicates that no migratory bird species dominate significantly in the wetland type of fishponds, as the  $C$  value is within the range of  $C \leq 0.5$ .

Based on Table 2, the ecological index of migratory birds in rice paddy wetland types shows a species diversity index ( $H'$ ) of 0.637. This value indicates that the species diversity of migratory birds in wet rice field habitats is low, as the  $H'$  value falls within the range of  $H' \leq 1$ . The migratory bird community in wet rice field habitats has relatively low species diversity (Bai et al., 2018). Environmental factors such as intensive land use, pesticide use, and climate change may contribute to the low species diversity of migratory birds in wet rice field habitats (Choi et al., 2022). In addition, the species richness value ( $R$ ) of 0.910 also indicates that the species richness of migratory birds in rice paddy wetland types is classified as low, as the  $R$  value falls within the range of  $R < 2.5$ . Indicates that the migratory bird community in rice paddy wetland types has

relatively low species richness. However, the species evenness value (E) of 0.918 indicates that the distribution of migratory bird species in wet rice field habitats is relatively stable, as the E value falls within the range of  $0.21 < E < 1$ . It indicates that the migratory bird community in

wet rice field habitats has a balanced community structure. Meanwhile, the dominance species (C) of 0.556 indicates that there are dominant migratory bird species. Still, they are not significant in wet rice field habitats, as the C value is within the range  $C \leq 0.5$ .

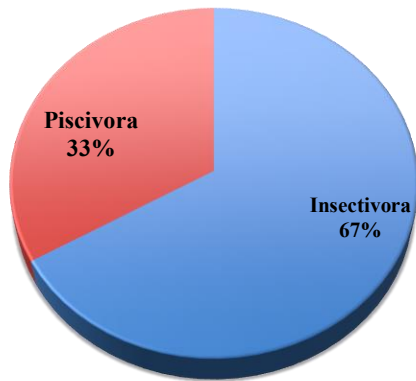


**Figure 2.** Ecological Index of Migratory birds in Several Types of Wetlands

The mangrove shows that the migrant bird community in this wetland type has low species diversity, low species richness, stable species evenness, and insignificant species dominance (Paulino et al., 2024). Indicates that mangrove wetland types have ecological conditions that are less supportive of migratory bird life (Chanate et al., 2020). Mudflats show that the migratory bird community in this type of wetland has moderate species diversity, moderate species richness, stable species evenness, and insignificant species dominance. It suggests that mudflat wetland types have ecological conditions that are conducive to the survival of migratory birds (Schéré et al., 2023). The environmental index of migratory birds in fishpond wetland types shows that the migratory bird community in this type of wetland has moderate species diversity, moderate species richness, stable species evenness, and insignificant species dominance

(Herdiawan et al., 2018). Suggesting that the fishpond wetland type has ecological conditions that support the survival of migratory birds; however, there is still room for improvement in terms of species richness and abundance (Kaur et al., 2018). The wetland rice field type indicates that the migrant bird community in this type of wetland has low species diversity, low species richness, stable species evenness, and insignificant species dominance. Suggests that the wetland rice field type has ecological conditions that are less supportive of migrant bird life (Paulino et al., 2024). In wetland ecosystems, migratory birds play a crucial role in maintaining ecosystem balance through their interactions with various natural resources, including food (Artika et al., 2019). A feeding guild is a group of species that have similar feeding methods or sources (Taylor et al., 2010). Based on the study's results, migratory birds found in wetland

habitats, such as mangroves, mudflats, fishponds, and rice fields, exhibit feeding guild types that are categorized into two main groups: insectivores and piscivores (Figure 4).



**Figure 3.** Migratory Bird Feed Guild Diagram

The feeding guilds of migratory birds in this area are dominated by insectivores (67%) and piscivores (33%). The study reveals that migratory birds in this area exhibit diverse food preferences, with a predominance of insectivores. The distribution of insectivore and piscivore species is generally influenced by variations in wetland type. In areas with dense vegetation such as swamps, wet meadows, and riverbanks, insectivore species are more dominant due to the high insect availability and diverse microhabitats that support foraging activities. Meanwhile, wetlands consisting of open water bodies such as lakes, large rivers, and especially fish ponds tend to attract piscivore species because they provide a food source of fish and other aquatic organisms. The dominance of insectivorous birds may be attributed to the abundant availability of food resources in wetland ecosystems, including insects and other invertebrates. The insectivorous guild is a group of migratory birds that feed on small invertebrates such as insects (Ramadhani et al., 2023). The Charadriidae and Scolopacidae families are the dominant groups in this category. Species included in this group are the Kentish plover (*Charadrius alexandrinus*), Marsh sandpiper (*Tringa stagnatilis*), the Common sandpiper

(*Actitis hypoleucos*), the Terek plover (*Xenus cinereus*), the Wood sandpiper (*Tringa glareola*), the Grey plover (*Pluvialis squatarola*), the Pasific Golden-plover (*Pluvialis fulva*), and the Common greenshank (*Tringa nebularia*). This group plays a vital role in controlling the population of insects and other invertebrates in wetland ecosystems. The existence of this group is essential for maintaining the balance of wetland ecosystems. Additionally, this group plays a crucial role in preserving water and soil quality in wetland ecosystems, as it helps control the population of insects and other invertebrates that can harm water and soil quality (Rumblat et al., 2016). Wetland diversity plays a fundamental role in attracting migratory bird species because different types of wetlands provide varied resources and habitat functions needed during migration. Heterogeneous wetlands create a mosaic of feeding grounds, shelter, and resting areas that support birds with different dietary needs and behavioral strategies. Insect-rich vegetated wetlands attract insectivorous species by offering abundant invertebrates and safe foraging microhabitats, while open-water wetlands and fishponds attract piscivorous species that rely on fish and aquatic organisms. This habitat variety ensures that migratory birds can meet their energetic demands during long-distance travel. Moreover, diverse wetlands help maintain ecological balance by supporting complex food webs and regulating water quality, which further enhances their capacity to sustain bird populations. In summary, the higher the diversity of wetland types, the greater the ability of the landscape to support, attract, and retain a wide range of migratory bird species.

#### IV. CONCLUSION

The composition of migratory bird species in several types of wetlands in Sumbernadi Village, South Lampung Regency, consists of nine species belonging to three families, namely Charadriidae, Scolopacidae,

and Sternidae. The species diversity of migratory birds in several types of wetlands in Sumbernadi Village shows that mangrove wetlands have moderate species diversity with a species diversity index ( $H'$ ) value of 1.034, mudflat wetlands have moderate species diversity with an  $H'$  value of 1.958, fishpond wetland types have moderate species diversity with an  $H'$  value of 1.799, and rice field wetland types have low species diversity with an  $H'$  value of 0.637. Additionally, the species richness value ( $R$ ) for each type of wetland indicates that mangrove wetlands have low species richness, with an  $R$  value of 1.251. Mudflat wetland types have moderate species richness with an  $R$  value of 2.401, fishpond wetland types have moderate species richness with an  $R$  value of 2.015, and rice field wetland types have low species richness with an  $R$  value of 0.910. The species evenness ( $E$ ) and species dominance ( $C$ ) values indicate that the communities are in a stable condition. Therefore, conservation and management of wetlands in Sumbernadi Village, South Lampung Regency, are critical to maintain biodiversity and the sustainability of ecosystems that support the lives of various species, including migratory birds, through mangrove habitat restoration, implementation of sustainable management in mudflat areas, application of environmentally friendly cultivation techniques, and reduction of pesticide and chemical fertilizer use in rice field management.

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