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Diversity of waterbirds in mudflat and fishpond habitats in coastal Wetlands of East Lampung, Indonesia

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The 4th International Conference on Biosciences (The 4th ICoBio)

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Introduction of the 4th ICoBio 2021

The International Conference on Biosciences (ICoBio) is a biennial international conference organized by the Department of Biology, Faculty of Mathematics and Natural Sciences, IPB University, Indonesia, since 2015. For this year, the 4th ICoBio 2021 was held in conjunction with the 17th National Congress of the Indonesian Biological Society (PBI), and it also collaborated with Universiti Putra Malaysia (UPM), Malaysia. The conference was held on 10-12th August 2021. This conference was designed to facilitate academicians, researchers, students, and practitioners related to the field of biosciences worldwide to gather and share information, ideas, knowledge, and research results as well as to strengthen research network and collaboration in a fruitful scientific environment. This year's conference was held virtually due to COVID-19 pandemic and lockdown in several areas around the world that limited the travelling permit issue.

It is beyond doubt that biosciences play a central role in every aspect of life. Bioscience and innovations are closely related with various inter and trans-disciplinary fields, leading to practical solutions which may contribute to Sustainable Development Goals (SDGs) strategic issues occurring in the disruptive era of industrial revolutions 4.0. Indeed, today we are facing serious issues including food and feed security, energy scarcity, healthcare issues, global warming, and others. Integration of biological fields with engineering, information technology, economy, and social sciences may serve as potential strategies to combat such challenging issues. Therefore, this kind of innovation and finding urgently needs to be informed to the science society this year.

The 4th ICoBio 2021 was taking the theme "Bioscience Innovations for Sustainable Development Goals". This conference was intended to gain insight into current trends in research and development related to biology, such as interdisciplinary approaches that are important for understanding biology and its applications. Research topics in this conference were divided into five main groups focusing on (1) Biodiversity, Conservation Biology and Climate Change; (2) Bioprospecting, Health Issues, and Industrial Biology; (3) Omics, Bioinformatics, and Computational Biology; (4) Technology and Bioengineering; and (5) Smart and Sustainable Agro-maritime.

The 4th ICoBio 2021 also served as a place for realizing existing collaboration between the Department of Biology, IPB University with its national and international partners, such as Universiti Putra Malaysia, Malaysia, and Kasetsart University, Thailand, Tottori University, Japan, and also strengthening collaboration with University of Missouri, Columbia, USA; and Iowa State University, USA. We also expect to build partnerships with China Agricultural University, China; Sher-e-Kashmir University of Agricultural Sciences & Technology, Chatha Jammu, India; Mariano Marcos State University, Philippines; and CNRS - Museum National d'Histoire Naturelle, Universite de Paris, France in the near future.

The 4th ICoBio 2021 invited two prominekeynotes and six well known invited speakers related to the theme. The conference was attended by prominent speakers and participants



from several countries, including Malaysia, Thailand, Philippines, India, China, Japan, the USA, France and Indonesia. In total, there were 217 registered participants consisting of 181 oral presenters and 36 participants only. The oral presenter has a 10 minutes presentation and a five minutes discussion with peers in the parallel classroom.

The 4th ICoBio 2021 conference was held virtually in two days using Zoom platform, started with a plenary session, then followed by ten parallel classes based on the five categories. There were 27 state and private universities; 20 Research Centers. The 4th ICoBio's participants come from Indonesia, Malaysia, Thailand, Japan, China, India, Philippines, USA and France.

A total of 124 full papers from the presenters were submitted to The 4th ICoBio 2021 and were peer reviewed from July 19, 2021 until October 15, 2021. The proceedings Editors accepted 90 full papers to be published in *IOP Proceeding Series Earth and Environmental Science* (EES). The core publication editors of The 4th ICoBio 2021 for IOP Proceeding Series EES are Dr Berry Juliandi, Dr Rika Raffiudin, Windra Priawandiputra, PhD.

The 4th ICoBio 2021 was financially supported by (1) Department of Biology, Faculty Mathematics and Natural Sciences, IPB University, and (2) the International Collaboration Office of IPB University under the international conference with international publication program.

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Diversity of waterbirds in mudflat and fishpond habitats in coastal Wetlands of East Lampung, Indonesia

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Abstract. Coastal wetlands provide habitat for waterbirds. However, changes in land use in coastal wetlands in East Lampung, Lampung Province, might affect the use of habitats by waterbirds. The study objective was to identify waterbird species using wetland habitat in coastal areas of East Lampung. Field surveys were conducted in November 2020 in two habitat types, i.e., mudflats and fishponds, employing a concentration method from several vantage points, then calculating Shannon-Wiener diversity indices (H'). A total of 23 species from 9 families of waterbirds were recorded. Mudflat had a higher diversity ($H'=2.21$) than fishpond ($H'=1.74$). Sixteen species were found on mudflats, dominated by shorebirds from the families of Scolopacidae and Charadriidae, which are primarily migratory species. Fishponds were used by 12 species, dominated by the Little Egret (*Egretta garzetta*) and Glossy Ibis (*Plegadis falcinellus*). Two endangered species, i.e., Far Eastern Curlew (*Numenius madagascariensis*) and Milky Stork (*Mycteria cinerea*), and one vulnerable species, Lesser Adjutant (*Leptoptilos javanicus*), were observed using mudflats. This study showed that mudflat in coastal wetlands of East Lampung provides essential habitats for conserving threatened waterbirds and migratory shorebirds.

Keywords: bird diversity, Lampung, waterbirds, wetlands

1. Introduction

Mangroves and other types of coastal wetlands are important habitats for waterbirds. Those habitats provide feeding, roosting, and breeding areas for many kinds of waterbirds, including migratory waterbirds [1-3]. An essential type of habitat for waterbirds in coastal areas is mudflat that serves as a feeding area. Mudflats in the coastal area of East Lampung report to have a high diversity of waterbirds, with at least 23 species consisted of wading birds and shorebirds utilized the habitat for feeding [2].

Changes in land use due to agriculture and fisheries along the coastal area of East Lampung [4] might influence the use of habitat by waterbirds. Understanding habitat use is an essential and fundamental effort in conserving waterbird species and their habitat [5, 6]. This study aimed to identify waterbird species using wetland habitat in coastal areas of East Lampung.



2. Materials and methods

A field survey was conducted in two habitat types, i.e., mudflat in mangrove area and fish/shrimp pond in East Lampung District in November 2020 (figure 1). The study site was a coastal wetland that dominates the coastal areas in East Lampung. Equipment used in this study were a pair of binoculars, notes, and a field guide.

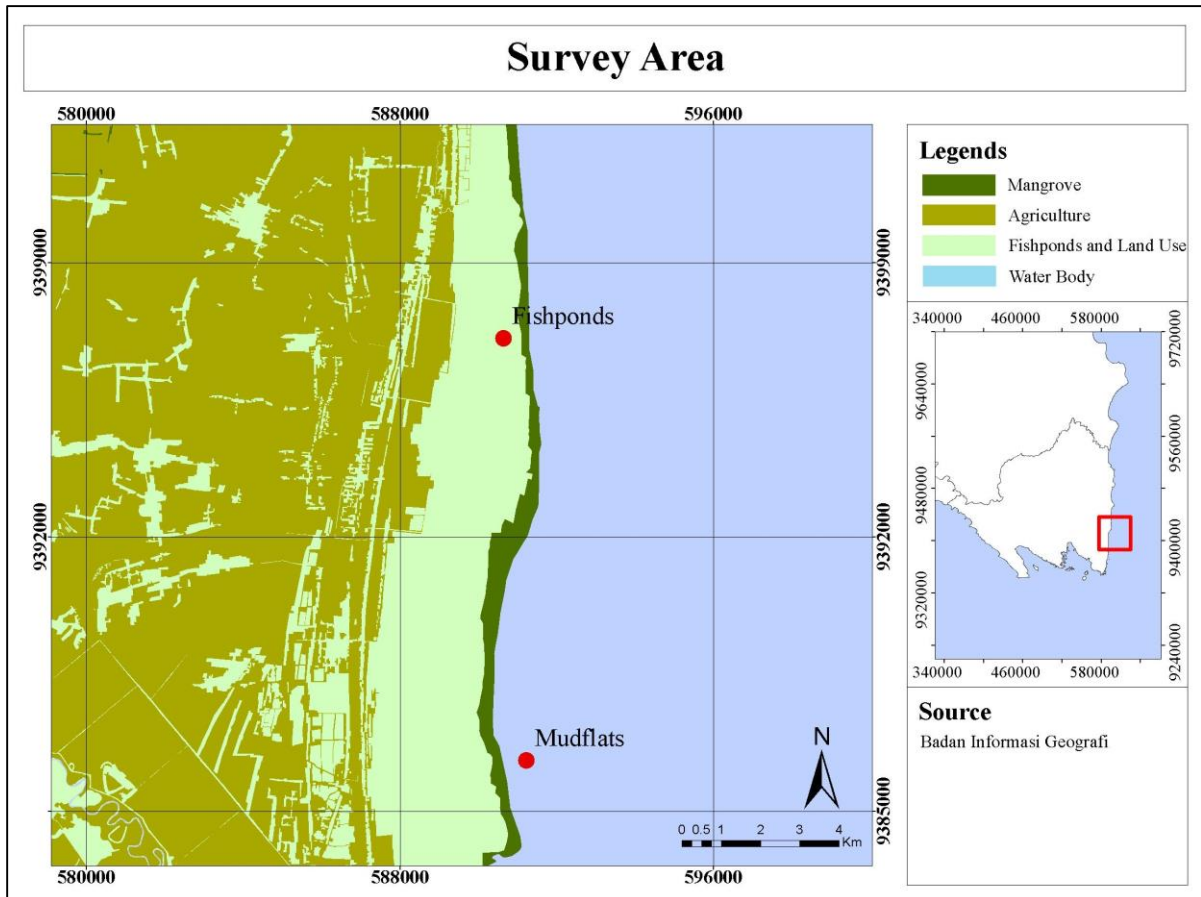


Figure 1. Survey area.

Data was collected using the concentration count method. This method was chosen considering that waterbirds gather in flocks during feeding; therefore, this method is the most suitable [5]. The observation was conducted in mudflats and fishponds with three repetitions in each habitat, following [7]. Data were collected in the morning (6 – 9 am), midday (11 am – 2 pm), and in the afternoon (3 – 6 pm). All waterbirds detected were recorded. Birds were photographed whenever possible to help identification [8]. Bird identification was made by using a bird guidebook [9]. Scientific name follows [10]. Species recorded were categorized based on their conservation status [11, 12] and protection status [13]. Bird diversity was calculated using Shannon-Wiener indices [14], with the following formula.

$$H' = - \sum pi \ln ln pi$$

where:

H' : Diversity index.

n : Number of birds per species.

N : Number of total birds.

3. Results

3.1. Waterbird species and conservation status

The survey recorded 16 species of 6 families in the mudflat area with an average number of 176 individuals, while there were 12 species of 8 families in fishponds with an average number of 184.33 (table 1). Families of Ardeidae, Charadriidae and Phalacrocoracidae occupied both habitats. Ciconiidae family or stork was found only in mudflats, while Rallidae, Recurvirostridae, and Threskiornithidae were found in the fishpond. Based on the threat status according to IUCN, there are two endangered species (EN) those are *Numenius madagascariensis* or eastern curlew and *Mycteria cinerea* or milky stork. Both species are also under protection by Indonesian law.

Table 1. List of waterbirds in each habitat and their conservation status.

Family	Species		Habitat		Conservation Status		
	English Name	Scientific Name	M	P	IUCN	CITES	P106/2018
Ardeidae	Grey Heron	<i>Ardea cinerea</i>	+	-	LC	-	-
	Great Egret	<i>Ardea alba</i>	+	-	LC	-	D
	Javan Pond Heron	<i>Ardeola speciosa</i>	+	+	LC	-	-
	Little Egret	<i>Egretta garzetta</i>	+	+	LC	-	-
	Purple Heron	<i>Ardea purpurea</i>	-	+	LC	-	-
Charadriidae	Grey Plover	<i>Pluvialis squatarola</i>	+	+	LC	-	-
	Javan Plover	<i>Charadrius javanicus</i>	+	+	NT	-	D
Ciconiidae	Milky Stork	<i>Mycteria cinerea</i>	+	-	EN	AI	D
	Lesser Adjutant	<i>Leptoptilos javanicus</i>	+	-	VU	-	D
	Swift Tern	<i>Thalasseus bergii</i>	+	-	LC	-	D
Laridae	Lesser Crested Tern	<i>Thalasseus bengalensis</i>	+	-	LC	-	D
	Common Tern	<i>Sterna hirundo</i>	+	-	LC	-	D
Phalacrocoracidae	Gull-billed Tern	<i>Gelochelidon nilotica</i>	-	+	LC	-	D
	Little Cormorant	<i>Phalacrocorax niger</i>	+	+	LC	-	-
Rallidae	Slaty-breasted Rail	<i>Gallirallus striatus</i>	-	+	LC	-	-
Recurvirostridae	White-headed Stilt	<i>Himantopus leucocephalus</i>	-	+	LC	-	D
	Eastern Curlew	<i>Numenius madagascariensis</i>	+	-	EN	-	D
Scolopacidae	Whimbrel	<i>Numenius phaeopus</i>	+	-	LC	-	D
	Bar-tailed Godwit	<i>Limosa lapponica</i>	+	-	NT	-	-
	Terek Sandpiper	<i>Xenus cinereus</i>	+	+	LC	-	-
	Common Redshank	<i>Tringa tetanus</i>	-	+	LC	-	-
Threskiornithidae	Glossy Ibis	<i>Plegadis falcinellus</i>	-	+	LC	-	D

M = Mudflat, P = Fishpond, + = Found, - = Not Found, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, AI = Appendix I, D = Protected

3.2. Species composition and diversity

Ten species were only found in a mudflat habitat. Those are *Numenius madagascariensis*, *Numenius phaeopus*, *Limosa lapponica*, *Mycteria cinerea*, *Leptoptilos javanicus*, *Thalasseus bergii*, *Thalasseus bengalensis*, *Sterna hirundo*, *Ardea cinerea*, and *Ardea alba*. The dominant species was Javan Plover (*Charadrius Javanicus*) (29.55%) (figure 2). Six species were only found in the fishpond. Those are

Plegadis falcinellus, *Himantopus leucocephalus*, *Gallirallus striatus*, *Gelochelidon nilotica*, *Ardea purpurea*, and *Tringa tetanus*. In the fishpond habitat, the dominant species was Little Egret (*Egretta garzetta*) (47,74%). The Shannon-Wiener diversity index was higher in mudflats compared to that in fishponds (figure 3). Although more species were found/ the waterbird species in this habitat had fewer individuals than the fishponds.

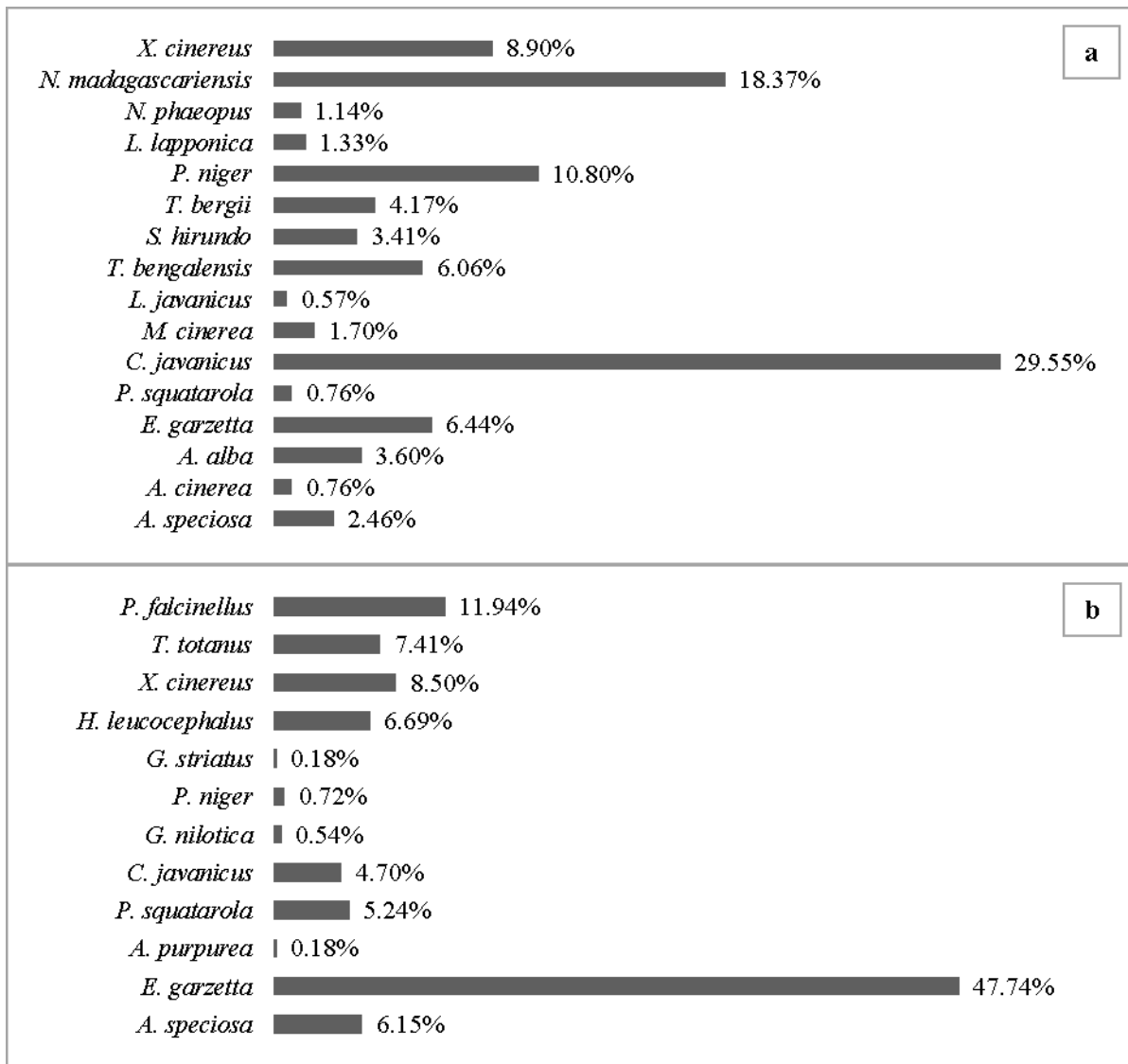


Figure 2. a) Percentage of waterbirds at mudflat habitat, b) Percentage of waterbirds at fishpond habitat.

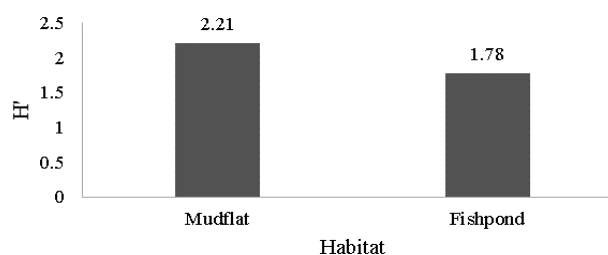


Figure 3. Shannon Diversity Index.

4. Discussion

The result showed a decrease in the number of species and population compared to the study reported by [2] that found 27 species with number 671 individuals of waterbirds. The difference might be due to different methods applied, such as the number of observation points (concentration) and time of the study. However, it might also be caused by environmental factors that affect habitat quality in the area, such as vegetation cover. Waterbirds usually concentrate in areas rich in food. Therefore, they are good indicators of coastal area quality [15].

This study showed that most species found were members of the Ardeidae family. This family has a wide distribution and can be found in a variety of wetland habitats [16, 9]. The occurrence of the Ardeidae family can be an indicator of wetland habitat [17]. Meanwhile, shorebirds such as Scolopacidae and Charadriidae are commonly found in mudflat habitats. Shorebirds utilize puddles in the coastal areas or humid soil to search for invertebrates [18, 1]. In addition to shorebirds, some seabirds of the family Laridae were also recorded in mudflats. Most waterbirds use mudflats for foraging, while sea birds use mudflats only to rest. Shorebirds used to flock while foraging in mudflat [15], making mudflat an essential habitat for the conservation of shorebirds [16]. Meanwhile, the fishpond habitat has shallow water with muddy spots preferred by waterbirds such as Ardeidae [2]. Little Egret (*Egretta garzetta*) prefers shallow water because that condition supported habitat from small fish as a food source for Little Egret [3].

The value of bird diversity in the mudflat habitat was higher due to the more significant number of species found in this habitat. Although more species were found, the waterbird species in this habitat had fewer individuals than the fishpond habitat. Both of these values can be categorized as ecosystem conditions that can support the existence of birds [14]. It can be said that the two ecosystems are relatively good and do not experience significant pressure to support the survival of waterbirds.

During the observation, the dominant activity of waterbirds was foraging, while few were resting or flying. Several factors affect bird diversity in habitat, including the stability of habitat carrying capacity, which in turn are affected by food resources, nesting resources, and roosting sites [2]. The flocking of foraging waterbirds might indicate the amount of food available in that location and the degree of disturbance, which in the coastal areas are agriculture and fisheries [1, 19].

Bird migration can also influence the diversity of waterbirds. Many shorebirds utilize mudflats in coastal mangroves during migration [19] because mudflats can support both migrant and resident waterbirds [20]. The external factors that influence species richness are, among others, dispersal, emigration and immigration, size of the area, landscape, distance between habitats, and human disturbance [1, 21].

Coastal wetlands East Lampung, Lampung Province provide habitat for waterbirds. The habitat held important species based on their conservation status. Three threatened species were recorded using the mudflat habitat, i.e., the endangered Milky Stork (*Mycteria cinerea*) and Eastern Curlew (*Numenius madagascariensis*), and the vulnerable Lesser Adjutant (*Leptoptilos javanicus*). The occurrence of those species showed the importance of mangroves in Eastern Lampung. Additionally, there are also Near Threatened species such as *Limosa lapponica* and *Calidris javanicus*. Milky Stork is listed in CITES Appendix I and is protected by law in Indonesia, which means they are a conservation priority in Indonesia and need to be protected from illegal hunting and habitat destruction [2].

5. Conclusion

Mudflat habitat held a higher diversity of waterbirds compared to fishpond habitat. That might be due to the higher food availability in the mudflat habitats. The occurrence of high conservation of priority species in the coastal area of East Lampung showed the importance of the area for conservation, including for migratory species.

Acknowledgments

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