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Diversity of Waterbirds in Gegas Lake Musi Rawas District, South Sumatera Province, Indonesia

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Abstract. Lake Gegas is one of the attractive tourist destinations in South Sumatra Province, Indonesia. There are quite a lot of tourists visiting Lake Gegas. This can disturb the life of the fauna there, one of which is waterbirds. In addition, it is feared that land clearing and hunting of waterbirds will reduce waterbirds and loss of habitat in Lake Gegas. The background of this research is the data related to the diversity of aerial bird species in Lake Gegas, so data collection is needed. The purpose of this study was to analyze the height level of birds in Lake Gegas. The research method used is the roaming technique. Cruising is carried out along the shores of Lake Gegas and to the other side by boat. Data collection is done by collecting techniques through collection sheets. Data level analysis using the Shannon Wiener formula. The results found 11 species of waterbirds consisting of 4 families with a contribution value of 2.21 in the "medium" category. "Habitat" by bird habitat. The conclusion of this study is that the results of research on waterbirds in Lake Gegas are included in the "medium" category.

INTRODUCTION

Lake is one of the fresh aquatic ecosystems surrounded by land and formed naturally [1]. Indonesia is one of the countries that have quite a lot of lakes. One of which is located in the province of South Sumatra. Lakes in South Sumatra include Lake Aur, Lake Sukahati, Lake Tingkip and Lake Gegas. Lake Gegas itself is divided into 3 large areas, namely in Sugih Waras Village, Sukakarya District, Suro Village, Muara Beliti District and Muara Kati Village, Tiang Pumpung Kepungut District, Musi Rawas Regency. Lake Gegas has an area of 3,864 hectares, currently used as an irrigation and freshwater fish conservation area. Lake Gegas is one of the tourist destinations that is a mainstay for Musi Rawas Regency, with visitors on holidays around 300 - 600 people. This number will double if the big holiday season. It is feared that the development of tourism in Lake Gegas will disrupt waterbirds' habitat in the lake.

Waterbirds are a type of bird that is highly dependent on wetlands including swamps, marshes, mangrove forests/brackish forests, estuaries/rivers, lakes, rice fields, rivers, and beaches as places to find food, rest and breed [2-4]. The existence of waterbirds in a habitat is influenced by factors of availability, height and water quality, food availability, shelter and nesting, and predators [5]. Waterbirds have the characteristics: long legs and beak, foraging around wetlands, the shape of legs and beaks like this will greatly facilitate waterbirds in foraging around wetlands [6].

Birds are a good indicator of areas rich in biodiversity, including changes and existing environmental problems. The reduced number of birds can indicate a certain impact of environmental degradation [7]. This study aims to analyze the diversity of waterbird species in the Lake Gegas Musi Rawas Regency. The results are used as benchmarks for biological parameters.

EXPERIMENTAL DETAILS

Time and Place of Research

This research was conducted in January - April 2020, in the Lake Gegas area of Musi Rawas Regency, South Sumatra Province. Identification of waterbirds' record results continued at the Biology Laboratory of the Department of Mathematics and Natural Sciences STKIP PGRI Lubuklinggau.

Tools and Materials

The tools used in this study were Canon brand binoculars, Gomu Spotting brand monoculars, hand counters, Sony DSC-H400 DSLR cameras, motorboats, and field observation manuals. The material used in this study was a water bird found in the Lake Gegas area of Musi Rawas Regency, South Sumatra Province.

Research Methods

In this study, we used the encounter rate method [8-11], namely direct observation by exploring and counting every individual found in the Lake Gegas area of Musi Rawas Regency, South Sumatra Province. Observations at each location were done in January - May 2020, which was done by exploring on the shores of the lake and for the island in the middle using a motorboat. Birds found, then photographed and counted. The map of the study area can be seen in Figure 1.

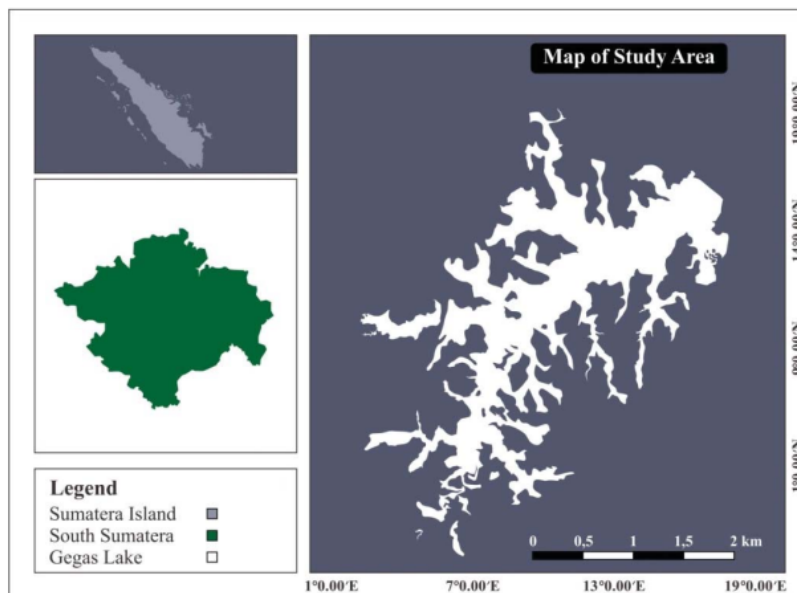


FIGURE 1. Map of Study Area in Gegas Lake

Identification

The identification of waterbirds was carried out directly in the place (lake) or documented for further identification then carried out if the species is unknown. Identification of waterbirds was done by taking into account the special characteristics found in a type, namely: body shape, the appearance of flying (tail, tugging, and wings), the shape and length of the beak, the length of the foot relative to the body, certain markings on feathers (eyebrow lines, crowns, wing line), the striking color of feathers, the striking sound and behavior of birds, concerning the field observation handbook [7,12,13].

Data Analysis

The data analyzed were related to waterbird research in Lake Gegas Musi Rawas Regency, and South Sumatra Province include diversity, dominance, and evenness. The diversity of waterbirds in Lake Gegas Musi Rawas Regency, South Sumatra Province, was calculated using the Shannon Wiener diversity formula [14]. The formula used is stated by Equation 1.

$$H = \sum_{i=1}^S p_i \ln p_i \quad (1)$$

with $p_i = \frac{n_i}{N}$

Information:

H = diversity index
 n_i = number of species i
 N = total number of species
 S = number of species in the sample

The status of community conditions can be determined using the Simpson dominance index [14] (Equation 2).

$$C = \sum_{i=1}^S (P_i)^2 \quad (2)$$

Information:

C = dominance index
 P_i = ratio of species proportions to i
 S = Number of species found

Evenness of waterfowl species was calculated using a species evenness index [14] (Equation 3).

$$E = \frac{H'}{H_{\max}} \quad (3)$$

Information:

E = evenness index
 H' = index of species diversity
 $H_{\max} = \ln s$ and s is the number of species found.

RESULTS AND DISCUSSION

Waterbird Species in Lake Gegas Musi Rawas Regency, South Sumatra Province

Based on the results of research and identification found waterbirds in Lake Gegas with 11 species included in 4 families. The results can be seen in Table 1.

TABLE 1. Waterbird species in Lake Gegas Musi Rawas Regency, South Sumatra Province

Family	Species	Nama Indonesia	IUCN Category	Protection Status
Alcedinidae	<i>Todiramphus chloris</i>	Collared Kingfisher	LC: Decreasing	NP
	<i>Alcedo coerulescens</i>	Cerulean Kingfisher	LC: Stable	NP
	<i>Halcyon smyrnensis</i>	White-breasted Kingfisher	LC: Increasing	NP
	<i>Pelargopsis capensis</i>	Stork-billed Kingfisher	LC: Decreasing	NP
Anatidae	<i>Dendrocygna javanica</i>	Lesser Whistling-duck	LC: Decreasing	NP
Ardeidae	<i>Ixobrychus cinnamomeus</i>	Cinnamon Bittern	LC: Stable	NP
	<i>Ardea purpurea</i>	Purple Heron	LC: Decreasing	NP
	<i>Butorides striata</i>	Green-backed Heron	LC: Decreasing	NP
	<i>Egretta alba</i>	Great White Egret	LC: Unknown	NP
Rallidae	<i>Amaurornis phoenicurus</i>	White-breasted Waterhen	LC: Unknown	NP
	<i>Gallirallus striatus</i>	Slaty-breasted Rail	LC: Increasing	NP

Information: IUCN based on The Red List of Threatened Species and protection status based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.20/MENLHK/SETJEN/KUM.1/6/2018.

The results of taking photos of waterbirds in Gegas Lake, Musi Rawas Regency, South Sumatra Province, Indonesia can be seen in Figure 2.

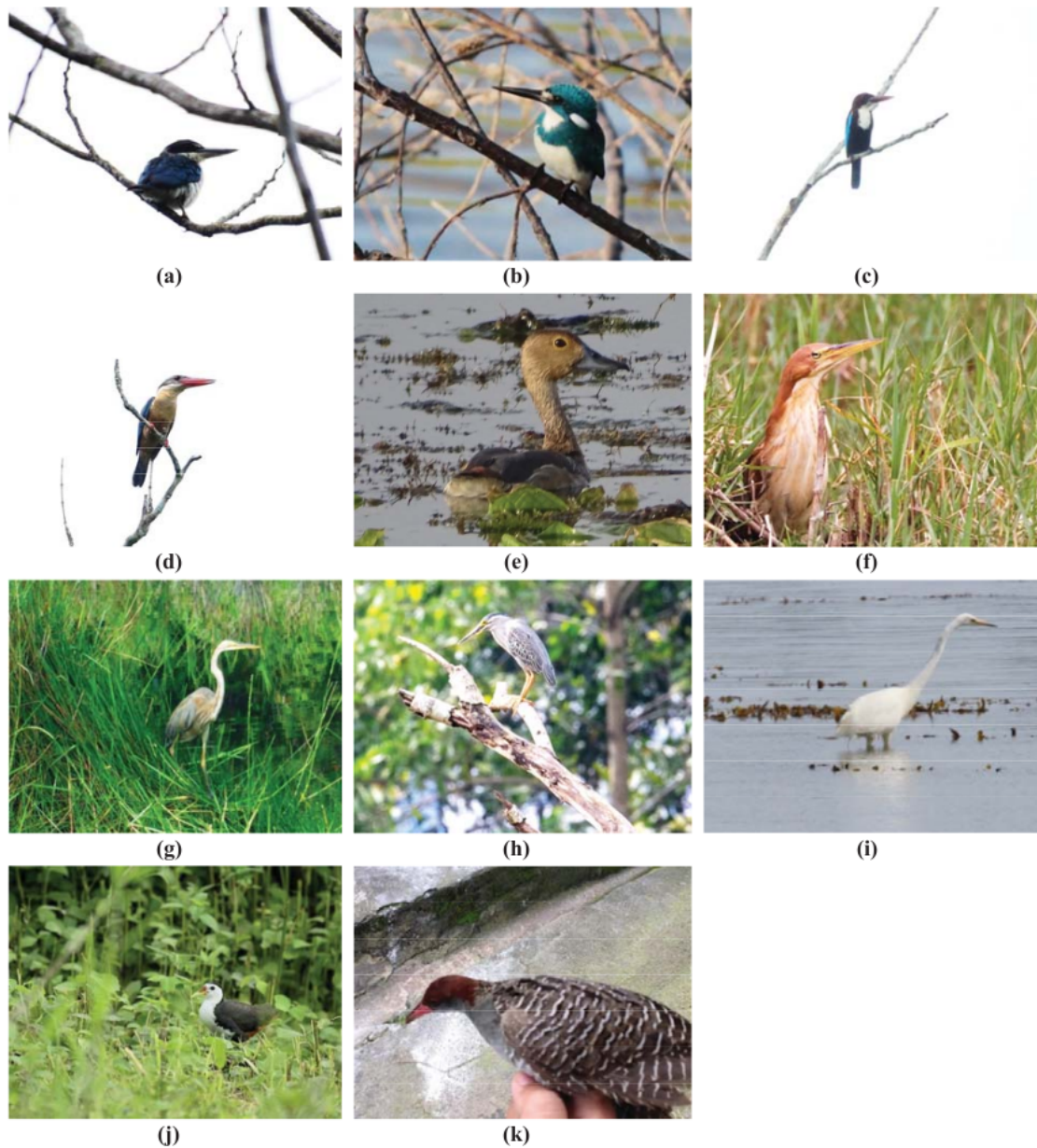


FIGURE 2. Waterbirds in Gegas Lake, Musi Rawas District, South Sumatra Province, Indonesia. (a) *Todiramphus chloris*, (b) *Alcedo coerulescens*, (c) *Halcyon smyrnensis*, (d) *Pelargopsis capensis*, (e) *Dendrocygna javanica*, (f) *Ixobrychus cinnamomeus*, (g) *Ardea purpurea*, (h) *Butorides striata*, (i) *Egretta alba*, (j) *Amaurornis phoenicurus*, and (k) *Gallirallus striatus*

Diversity, Evenness, and Domination of WaterBirds in Lake Gegas Musi Rawas Regency, South Sumatra Province

The results of the analysis of diversity, evenness, and dominance of waterbirds in Lake Gegas Musi Rawas Regency, South Sumatra Province can be seen more clearly in Figure 3. Based on the the analysis, the level of diversity of waterbirds in Lake Gegas is 2.21, which is included in the medium diversity category. The evenness value of waterbirds in Lake Gegas is 0.92, which is included in the stable community category. For the dominance of waterbirds in Gegas Lake, 0.12 is included in the low dominance category. Based on the results of research that has been conducted found 11 species of waterbirds belong to 4 families, namely, Alcedinidae, Anatidae, Ardeidae, and Rallidae. The most waterfowl found in Lake Gegas are from the family of alcedinidae of 28 individuals. Species of alcedinidae family were found as many as 4 species, namely *Todiramphus chloris*, *Alcedo coerulescens*, *Halcyon smyrnensis*, and *Pelargopsis capensis*. This Alcedinidae family water bird is a flesh-eater or predator [15]. Members of the family of Alcedinidae include light-colored birds, short legs and tails, large heads, and strong long beaks. The nests are in holes in the ground, tree trunks, riverbanks, and termite nests [7]. In this study, all species of Alcedinidae were found perched on a tall rubber tree, while *Alcedo coerulescens* were found perched on twigs and jarring pits above water. Indeed this family likes to perch on branches and branches of trees while looking for prey [13,16].

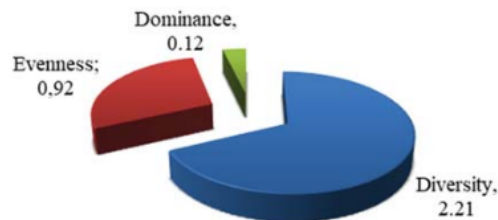


FIGURE 3. Diversity, evenness, and domination of waterbirds in Lake Gegas Musi Rawas Regency, South Sumatra Province

The second most birds are from the Ardeidae family of 19 individuals. There are 4 species of family Ardeidae species, namely *Ixobrychus cinnamomeus*, *Ardea purpurea*, *Butorides striata* and *Egretta alba*. Members of the Ardeidae family at Lake Gegas are found in a variety of different places, for *Ixobrychus cinnamomeus*, *Ardea purpurea*, and *Egretta alba* are found foraging around water grass. *Butorides striata* were found perched on a tree branch that was not too high. Ardeidae is a type of scaffolding, a long-legged and beaked bird that is useful for living near or in wetlands [12]. Ardeidae has an almost evenness distribution in all regions of Indonesia, such as Sumatra, Java, Kalimantan, and Bali [7]. The presence of birds is an important indicator in life so that conservation activities need to be done to protect and preserve birds to maintain the presence of birds in nature. The existence of species from Ardeidae can also be an indicator of environmental ecosystems and aquatic plants that are still maintained [17].

The third-largest waterbird is the family Rallidae with a total of 17 individuals. Members of the Rallidae family found were *Amaurornis phoenicurus* and *Gallirallus striatus*. This type of family is spread throughout the world but is limited to living in swamps, lakes, rice fields, grasslands, and secondary forests [18]. These include shy birds, straight and strong beaks, long legs with very long fingers [7]. The difficulty of meeting these waterbirds is closely related to the presence of aquatic animals as their prey and the time they move [19]. In this study, members of the Rallidae family of both species can only be identified by their voices, because this bird is very shy and runs fast.

The most recent water bird is the family anatidae with a total of 10 individuals consisting of 1 species, namely *Dendrocygna javanica*. Family Anatidae include swimmers with webbed feet and a unique, wide and flat beak. The limbs are short, the wings are narrow-pointed and located somewhat back, the tail is generally short [7]. Found swimming and foraging in the swampy part of Lake Gegas. Open swamp areas such as grass vegetation zones are ideal habitats for bird species belonging to the Anatidae family [20]. Based on IUCN waterbirds found in Lake Gegas, Musi Rawas Regency are all in the LC category (Least concern/Low risk). That is, the population of waterbirds in the wild is still safe and not too worrying. The least concern category is further divided into several categories for waterbirds in Lake Gegas, Musi Rawas Regency.

There are five species of least concern criteria decreasing, namely: *Todiramphus chloris*, *Dendrocygna javanica*, *Ardea purpurea*, *Butorides striata*, and *Pelargopsis capensis*. Least concern criteria for stable (stable) there are two species, namely: *Alcedo coerulescens* and *Ixobrychus cinnamomeus*. Least concern criteria unknown (unknown) there

are 2 species, namely: *Egretta alba* and *Amaurornis phoenicurus* and there are 2 species, namely *Halcyon smyrnensis* and *Gallirallus striatus* included in the Least concern criteria increasing (increase). None of the waterbirds found are included in protected birds [21]. Bird protection and preservation efforts can not only be done in conservation areas that have been determined by the government, but bird conservation activities can also be done in other areas, such as lakes [22].

Based on Shannon Wiener's diversity calculation, the number of 2.21 is included in the "medium" diversity criteria. Diversity index 2-3 is included in the medium category [23]. If the value of the diversity index is higher, it can be interpreted as the more variety of species that exist in the community. The species diversity index can be used to assess the condition of a community [18]. States that the factors that influence the value of H' are environmental conditions, the number of species, and the distribution of individuals in each type. Communities that have a high diversity index value have component relationships in complex communities [24].

In addition to the diversity index, an analysis for the evenness index of waterbirds in Lake Gegas. The result of the evenness index is 0.92, that the waterbird community in Lake Gegas is "stable" with an E value (evenness) close to 1. The higher the evenness index, the higher the evenness of the population. This shows the distribution of each species' individuals is the same so it does not there is a tendency for one biota to dominate. The greater the value of evenness, the number of biota in each species is the same or not much different [25].

Furthermore, the dominance index of waterbirds in Lake Gegas is 0.12, which means that waterbird communities in both locations fall into the "low dominance" category. States that the Simpson dominance index is between 0 - 1, if the C value is close to 0, it means that there is no species that dominates the other types or the community is in a stable condition. In contrast, if the C value is close to 1 means that there is a type that dominates the other types or the community is in an unstable condition due to ecological pressure [26]. Lake Gegas's busy condition of community activities also impacts the existence of the waterbird itself. Some community activities include; visitors/tourists, rubber farmers, and fishermen. Thus, the birds found included in small amounts. Human disturbance, habitat destruction, and loss of foraging locations are factors that cause a reduction in waterbird populations [27]. Waterbirds are very vulnerable to human presence. Humans' presence and activity in an ecosystem will affect the presence, distribution, and abundance of birds [28]. It also requires a longer time for waterbird research activities in Lake Gegas. Many waterbirds will be found if the time needed for observation is longer to conduct observation in large areas with longer observation time [29].

SUMMARY

In summary, the waterbirds found in Lake Gegas consist of 11 species and include four families. Waterbirds found in Lake Gegas based on IUCN are included in the Least Concern category. All waterbirds found in Lake Gegas in the category are not protected under the law under regulations in force in Indonesia. However, it is still necessary for waterbirds to stay in Lake Gegas. The variation of waterbirds in Lake Gegas is in the medium category, and even in the stable category, and dominance in the low category.

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