Biodiversity of Freshwater Fish in Kelekar Floodplain Ogan Ilir Regency in Indonesia

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Abstract

The purpose of this study is to investigate fish biodiversity in the Kelekar floodplain. The study is explorative, with the determination of observation stations with purposive sampling methods. Fishes were captured approximately 1.509 individuals consisting of 17 families and 24 species. The Shannon-Weiner diversity index was 2.394; 2.691; and 2.183 for station 1, 2, and 3, respectively. The Evenness index was 0.764; 0.871; and 0.806 for station 1, 2, and 3, respectively. The highest value of Simpson's dominance index was 0.045. The biodiversity index of the three stations is in the medium category.

Keywords: aquatic biodiversity; lebak lebung; swamp; Kelekar River

Floodplains are major, seasonal wetlands habitat that is formed by the overspill of flooding from the rivers with which they are connected. The biodiversity in these systems is very high and riverine faunas depend on the intimate linkage between the flowing water (riverine) component and the static water (floodplain) (Welcomme, 2000). One of the floodplain areas is called "lebak lebung", known only in South Sumatra, is a habitat of various fish species, which are feeding, growing, spawning, and nursery ground (Muslim 2012). In South Sumatra Province, the area of open waters is approximately 2.5 million ha, where 43% is "lebak lebung" (Muslim 2013, 2012), consists of swamps, oxbow lakes, and rivers. This area is highly fertile because it contains a lot of nutrients and also natural feed, especially from the decomposition process of flooded forest vegetation (Ajai et al. 2020). The ecological function of these waters is as a feeding ground, spawning, nursery (Ammar et al. 2014; Haryono 2007; Nurdawati & Prasetyo 2007). However, Welcomme (2000) stated that living aquatic resources in floodplain are extremely intense in their response to natural climatic variability and flood strength variations.

The "lebak lebung" distribution area is in the districts of Ogan Ilir, Ogan Komering Ilir, Musi Banyuasin, Banyuasin, Muara Enim, Penukal Abab Lematang Ilir, and Palembang. One of the “lebak lebung” areas in the Ogan Ilir regency is the Kelekar floodplain area, which is located on the riverbank of the Kelekar River. The upper stream of the river is in the Prabumulih and Muara Enim districts, meanwhile the middle stream, and downstream in the Ogan Ilir districts. The river is a source of clean water, transportation, food (fish), as well as the daily activities of the people who live on the banks. The purpose of this study is to make an inventory of the diversity of fish species captured in the Kelekar floodplain. The results of this study are beneficial for the government and other stakeholders to design management strategies of aquatic resources in Ogan Ilir Regency and selecting candidates for aquaculture local species.

Fish samples were collected as many as 1.509 individuals (representing 24 species) from six local fishermen in the Kelekar floodplain, Ogan Ilir regency, South Sumatra, Indonesia (Figure 1). The specimens were collected from three sampling stations: (S1) Tanjung Pring (3°14’36.2” S 104°38’58.8” E), (S2) Tanjung Raya (3°14’41.0” S 104°39’28.4” E), and (S3) Indralaya Mulya (3°23’89.8” S 104°64’94.8” E). The fish samples were periodically collected from January to December 2020 (January, April and June represented the dry season, while September, October, and December represented the rainy season).

Fishes were caught with traditional fishing gears such as square lift net (*jaring angkat*), monofilament fixed gill net (*jaring insang*), cast net (*jala*), fish barrier (*empang*), and seine net (*arat waring*). Samples were collected, photographed and refrigerated. The samples were then transferred to the lab for taxonomic identification. The specimens were identified using the keys of Kottelat et al.1993; Kottelat & Whitten, 1996; Saanin, 1984.

Water quality observed were water temperature, dissolved oxygen, and water acidity (pH), carried out in situ.

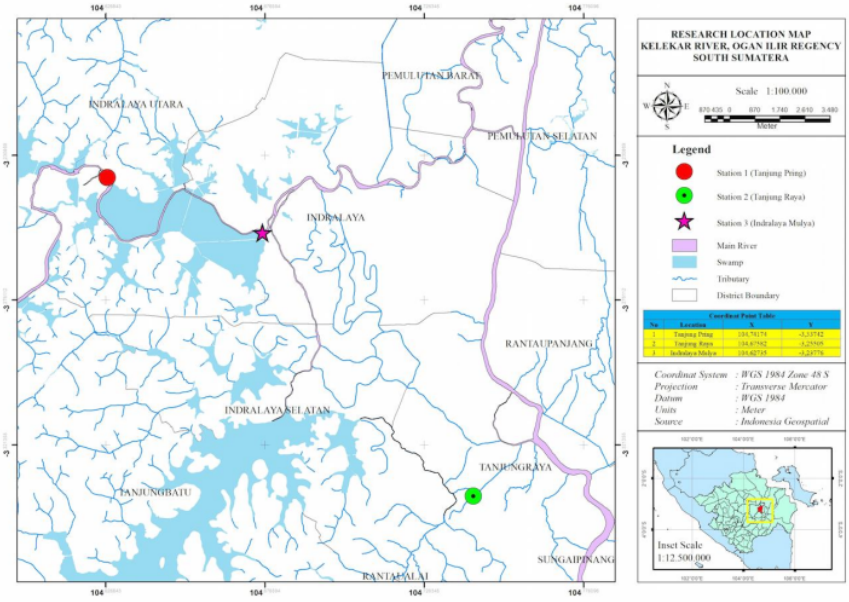


Figure 1. Map of sampling site in the Kelekar River. (S1), Tanjung Pring, (S2) Tanjung Raya, (S3) Indralaya Mulya of Ogan Ilir Regency, South Sumatra Province, Indonesia.

Data on fish number and species were tabulated and computed in the Microsoft Excell. The diversity for fish species was calculated using the Shannon-Wiener diversity index (Sweke et al. 2013):

$$H' = \sum_{i=1}^{S} Pi.\ln Pi \quad (2)$$

Where *S* is the number of species in the sample, and *Pi* is relative importance values obtained as the squared ratio of the important values of *S* individual value for all species to N the total importance. Determination of criteria: H' < 1.0 (low diversity); H' = 1.0 – 3.0 (medium); H' > 3.0 (high)

The evenness index is calculated by a formula Magurran (1988):

$$E = \frac{H'}{H'max}$$

Where, H' is Shannon-Wiener diversity index, E (Evennes index (value 0-1), H' maks (Maximum diversity index), S (Number of species). Determination of criteria: E < 0.4 (low); E = 0.4-0.6 (medium); E > 0.6 (high).

The dominant fish species is determined using the following formula:

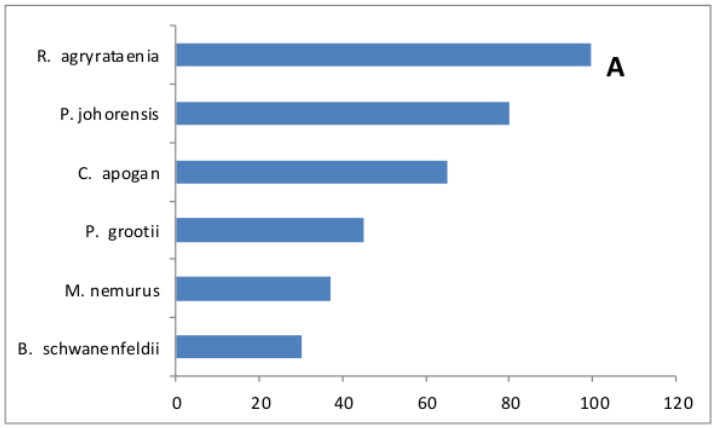
$$C = \sum_{i=1}^{S} (Pi)^2$$

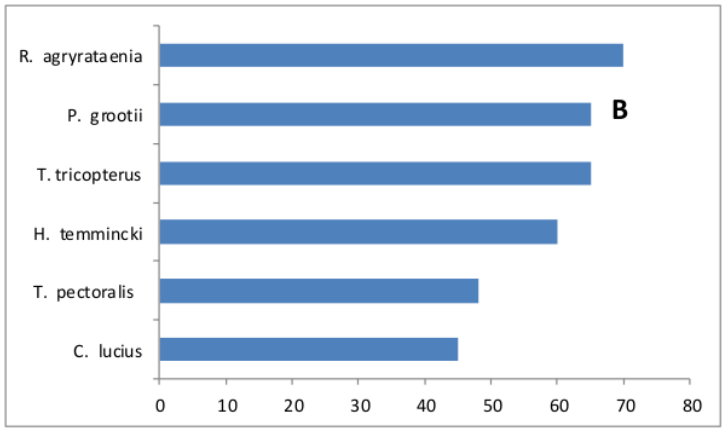
Where, C is Simpson's dominance index, □□ is relative importance values obtained as the squared ratio of the important value, □ is individual value for all species.

This study indicated a wide distribution of fishes in the Kelekar river floodplain. A total of 1509 individuals that were identified can be classified into 12 families and 17 genera. Five hundred twenty-nine (529) individuals were dominated by members of Cyprinidae, followed by Osphronemidae (276), Channidae (196), Helostomatidae (163), Pristolepidae (145), Anabantidae (100), Bagridae (42), Notopteridae (26), Claridae (17), Tetraodontidae (9), Pangasidae (5), and Mastocembelidae (2) (Table 1). The five most species of total individuals found were *R. agryrataenia* (185), followed by *H. temmincki* (165), *T. pectoralis* (146), *P. johorensis* (112), *Anabas testudineus* (100), and the least number of individuls are *M. maculatus* (2), *N. chitala* (3), *O. schlegeli* (5), *P. polyuranodon* (5), and *T. palembangensis* (7). During the dry season, the dominant fish obtained were from groups of black fishes, which included *T. tricopterus*, *H. temmincki*, *P. pectoralis*, *C. striata*, and *A. testudineus*, while in the rainy season dominated by groups of white fishes, namely *R. agrirataenia*, *P. johorensis*, and *C. apogan*. The six species with the largest number of individuals found at each station were presented in Figure 2.

Tabel 1. Fish diversity of Kelekar floodplain in Ogan Ilir regency

Family	Genus	Species	Station			Total	Body weight (g)	Total length (cm)
			1	2	3			
Anabantidae	Anabas	*Anabas testudineus*	2	30	68	100	10-90	3-12
Bagridae	Hemibagrus	*Hemibagrus nemurus*	37	6	-	42	100-250	20-30
Channidae	Channa	1. *Channa pleuropthalma*	-	10	30	40	37-150	15-26
		2. *Channa striata*	3	20	70	93	50-250	10-28
		3. *Channa lucius*	5	45	13	63	20-150	8-20
Claridae	Clarias	*Clarias batrachus*	1	4	12	17	30-160	20-30
Cyprinidae	Puntius	1. *Puntius johorensis*	80	30	2	112	0.2-0.4	3-6
		2. *Puntioplites bulu*	30	12	-	42	10-20	8-11
	Osteochilus	1. *Osteochilus hasselti*	25	15	-	40	10-25	7-12
		2. *Osteochilus schlegelii*	5	-	-	5	10-30	7-14
	Cycloheilichthys	*Cycloheilichthys apogan*	65	10	2	77	15-20	8-13
	Hampala	*Hampala macrolepidota*	2	15	1	18	20-200	14-20
	Barbonymus	*Barbonymus schwanenfeldii*	30	10	-	40	100-200	15-20
	Rasbora	*Rasbora argyrotaenia*	100	70	15	185	0.2-5	5-7
Helostomatidae	Helostoma	*Helostoma temmincki*	5	60	98	163	20-120	10-18
Mastocembelidae	Mastocembelus	*Mastocembelus maculatus*	2	-	-	2	100-250	20-30
Notopteridae	Notopterus	1. *Notopterus chitala*	2	1	-	3	200-500	20-30
		2. *Notopterus notopterus*	7	12	4	23	50-150	10-18
Osphronemidae	Trichogaster	1. *Trichogaster trichopterus*	6	65	60	130	6-12	3-9
		2. *Trichogaster pectoralis*	12	48	86	146	10-25	8-12
Pangasidae	Pangasius	1. *Pangasius pangasius*	2	5	-	9	200-800	25-35
		2. *Pangasius polyuranodon*	2	3	-	5	130-300	15-30
Pristolepidae	Pristolepis	1. *Pristolepis grootii*	45	65	35	145	20-80	5-12
Tetraodontidae	Tetraodon	1. *Tetraodon palembangensis*	1	7	1	7	10-30	7-10
Total			469	543	497	1509		
Diversity index (H')			2. 394	2.691	2.183			
Evennes index (E)			0.764	0.871	0.806			





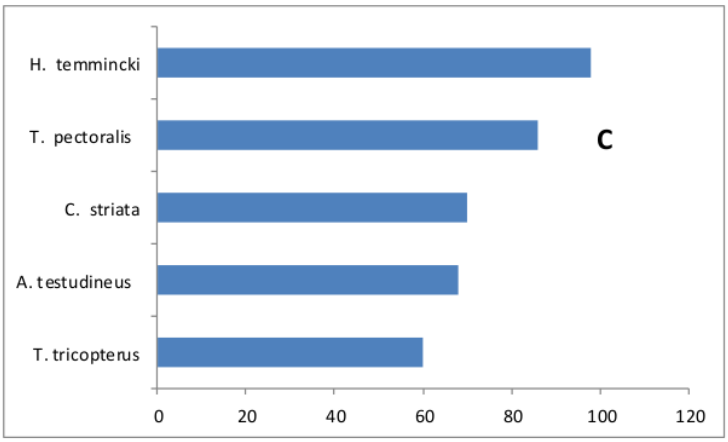


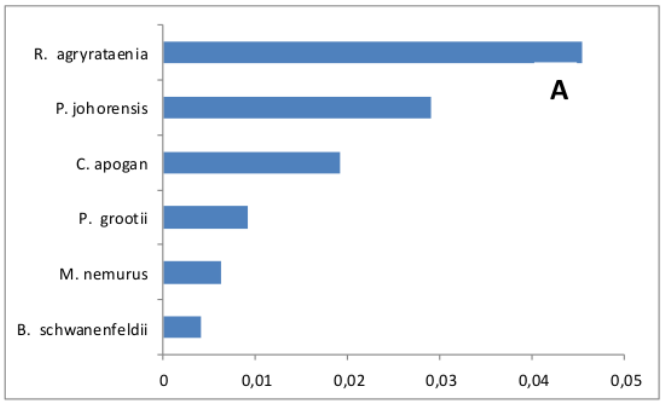
Figure 2. The six largest species found at each station. (A = station 1), (B = station 2), (C = station 3); (vertical axis = species, horizontal axis = dominance index).

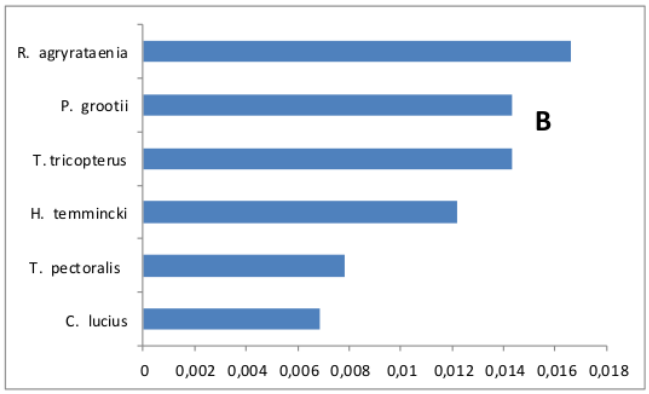
The dominance index indicated various dominant species. At station 1 (S1), the most dominant species, in order from high to low are as follows: *R. agryrataenia* with a dominance index (C) of 0.045, *P. johorensis* (0.029), *C. apogan* (0.019), *P. grootii* (0.009), *M. nemurus* (0.006), and *B. schwanenfeldii* (0.004). At S2, the most dominant species are: *R. agryrataenia* (C= 0.016), *P. grootii* (0.014), *T. tricopterus* (0.014), *H. temmincki* (0.012), *P. pectoralis* (0.008), and C. *lucius* (0.007). Meanwhile, at S3, the dominant species are *H. temmincki* (C= 0.039), *T. pectoralis* (0.030), *C. striata* (0.020), *A. testudineus* (0.019), *T. tricopterus* (0.015), and *P. grootii* (0.005). The six species that are most dominant at each station are presented in Figure 3.

Water quality affects fish species abundance. Water quality at station 1 indicated that water temperature (24-28 ºC), dissolved oxygen (6.56-7.61 $mg.L^{-1}$), water acidity (5.6-7.0), while in station 2, water temperature (25-30 ºC), dissolved oxygen (5.67-6.41 $mg.L^{-1}$), water acidity (4.5-6.3). Station 3 denoted the value of water temperature (25-31 ºC), dissolved oxygen (4.32-5.21 $mg.L^{-1}$), water acidity (4.0-5.6).

The Floodplain of Kelekar River indicated high diversity of freshwater species as it was showed in Table 1. However, the number of species found is inadequate. There are still more species that are not captured during this study, due to the limited ability of fishermen and existing fishing gear, chosen fishing grounds, and time constraints of fish collection. Nevertheless, the total number of families in this study was higher than the previous study (Patriono & Junaidi 2001; Muslim & Lestari 2005). The presence of species affects the number of species, individuals, families, and also affects the diversity, evenness, and dominance values (Magurran 1988). Furthermore, fish species composition is affected by habitat heterogeneity, environmental gradients, and human activity (Cheng et al. 2019). Natural river structures and varying habitat conditions can establish geographic barriers that constrain the dispersal potential of fish species (Fu et al. 2004). The fast population growth

and economic development in the riverbank in recent decades could lead the fish diversity and aquatic resources to confront serious threats (Li et al. 2019).





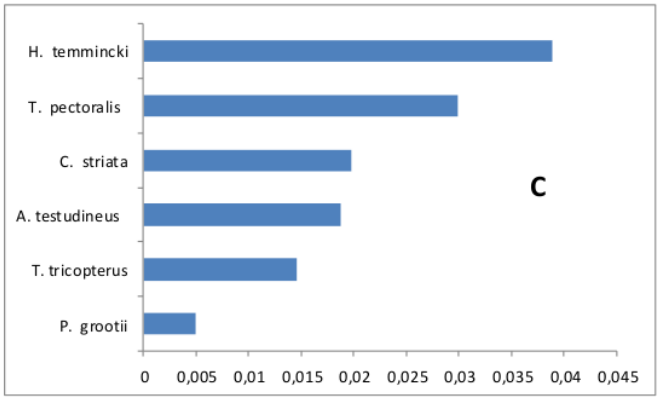


Figure 3. Six dominant species at each station. (A = station 1), (B = station 2), (C = station 3); (vertical axis = species, horizontal axis = dominance index / C)

The Shannon-Wiener diversity index represented the richness and proportion of each species, whereas the evenness and dominance indicated the relative number of individuals in the sample and the fraction of common species, respectively (Hossain et al. 2014). The highest Shannon-Wiener index was at the S2, while the lowest was at the S3 site. The diversity of fish species describes the entire scope of ecological adaptation, as well as the evolution of species to the environmental condition. Therefore, the diversity of fish can differ from a location to another (Syafei 2017). The index of species diversity in the Kelekar floodplain was relatively moderate. According to Magurran (1988), diversity is high if the diversity index value (H ') > 3; moderate 1 < H '< 3. At the S3 station, the water quality tends to be poor in comparison to S1 and S2, where the dissolved oxygen and the water acidity were quite low. The flooded swamp which are overgrown by high-amount of aquatic plants cause low dissolved oxygen levels so that only certain fish species can survive. The fish which has additional air-breathing organs, for instance, the labyrinth, can survive in waters with low dissolved oxygen levels (Zaccone et al. 2018).

The uniformity of individual distribution of a species at all stations was high. Based on evenness index values (Heip 1974), Cypriniformes was dominant species at S1, Cypriniformes and Anabantiformes at S2, and Anabantiformes at S3. At S1, the dominant fish are whitefishes, however, at S3, blackfishes were dominant. One of the species *P. grootii* indicated the six dominant species at three stations. This species live in the headwaters (main river), tributaries, and floodplain. Several freshwater fish in South Sumatra waters have been barcoded their DNA, especially an endemic species of this region. There was a high similarity (%) of gen COI DNA mitochondria (95-100%) of stripped snakehead (*C. striata*), ocellated snakehead (*C. pleuropthalma*), Asian redtail catfish (*H. nemurus*), Pangasidae (*P. macronema*), *T. trichopterus,* and & *T. pectoralis* against the same species in

the NCBI GenBank, except in bagridae (*Mystus singaringan*) which showed a lower percentage (89%) in comparison to the same species (Syaifudin et al., 2020).

There are differences in water quality between the main river habitats, tributaries, and flooded swamps. The water quality in floodplains tends to be more acidic than the other two habitats. Dissolved oxygen content in main river habitats tends to be higher than in tributaries and floodplains. In the riverine, the water flows so that the oxygen content is higher and the water temperature tends to be lower than the other two habitats. In Figure 3 (A), the most dominant species at station 1 was the Cyprinidae family. Fish from this family distribute in a wide area including main rivers and tributaries and are even slightly found in flooded swamps.

The study found that seven species have important economic value because of their high selling price and demand, i.e *N. chitala* (IDR 80,000-120,000.kg^{-1}), *H. nemurus* (IDR 80,000-90,000.kg^{-1}), *C. striata* (IDR 60,000-70,000.kg^{-1}), *A. testudineus* (IDR 40,000-50,000.kg^{-1}) and *H. temmincki* (IDR 25,000-30,000.kg^{-1}). All these species were native fish that were cultured prospectively. Fish of high economic value are potential candidates for cultured species. Environmentally, these native species are well adapted, so that their entire life cycle can take place perfectly. The Kelekar floodplain could become a pivotal source of aquaculture for *N. chitala*, *H. nemurus, C. striata, A. testudineus, H. temmincki*. Further research and attempts should be made to improve local people's ability to conserve and culture the fish.

Author contribution

Design the research: MM; collected and analysed the data: MSF, MM; Funding Acquisition: MM, writing-original draft: MSF; writing-review and editing: MSF, MM.

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Conflict of Interest

The authors declare no competing interests regarding the research or the research funding.

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