

## Short Communications

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

Muslim Muslim<sup>1</sup>, Mochamad Syaifudin<sup>1\*</sup>

1) Program Study of Aquaculture, Department of Fisheries, Faculty of Agriculture, Sriwijaya University, Indralaya, South Sumatra, Indonesia. Jl. Palembang-Prabumulih KM 32, Indralaya, Ogan Ilir Sumatera Selatan, Indonesia. 30862

\* Corresponding author, email: msyaifudin@fp.unsri.ac.id

### Keywords:

aquatic biodiversity

Kelekar river

lebak lebung

swamp

### Submitted:

08 July 2021

### Accepted:

22 October 2021

### Published:

31 January 2022

### Editor:

Ardaning Nuriliani

### 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 and 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, meanwhile the highest value of Simpson's dominance index was 0.045. The biodiversity index of the three stations was in the medium category.

Copyright: © 2022, J. Tropical Biodiversity Biotechnology (CC BY-SA 4.0)

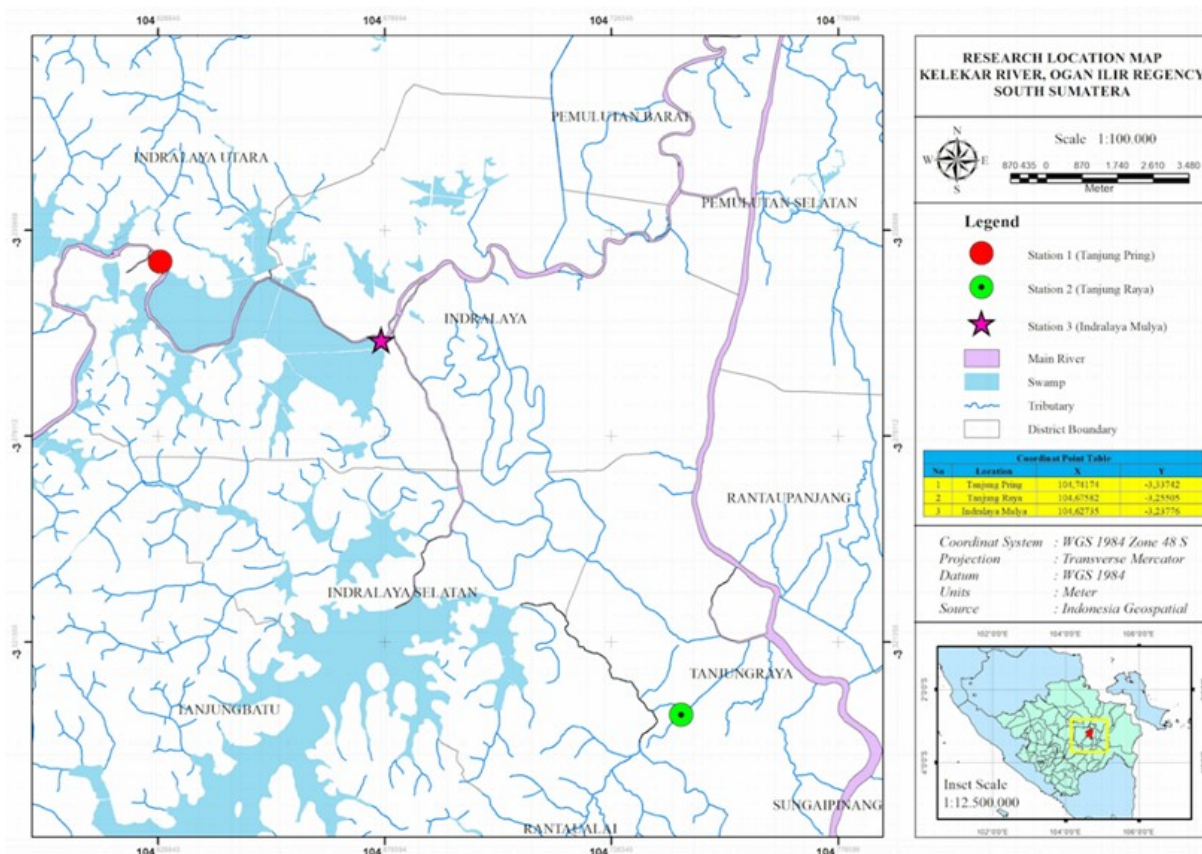
Floodplains are major, seasonal wetlands habitat that is formed by the overflow of flooding from the rivers with which they are connected. The biodiversity in these systems is very high and riverine faunas depend on the intimate linkage between the flowing water (riverine) component and the static water (floodplain) (Welcomme 2000). One of the floodplain areas is called "lebak lebung", known only in South Sumatra, 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 are 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 Tanjung sampling stations: (S1) Tanjung Pring (3°14'36.2" S 104°38'58.8" E), (S2) 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, then they were transferred to the laboratory for taxonomic identification. The specimens were identified using the keys of Kottelat et al. (1993), Kottelat & Whitten (1996), and Saanin (1984). Water



**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.

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

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

$$H' = \sum_{i=1}^S P_i \ln P_i$$

Where  $S$  is the number of species in the sample, and  $P_i$  is the 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,  $E$  (Evenness 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:

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

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

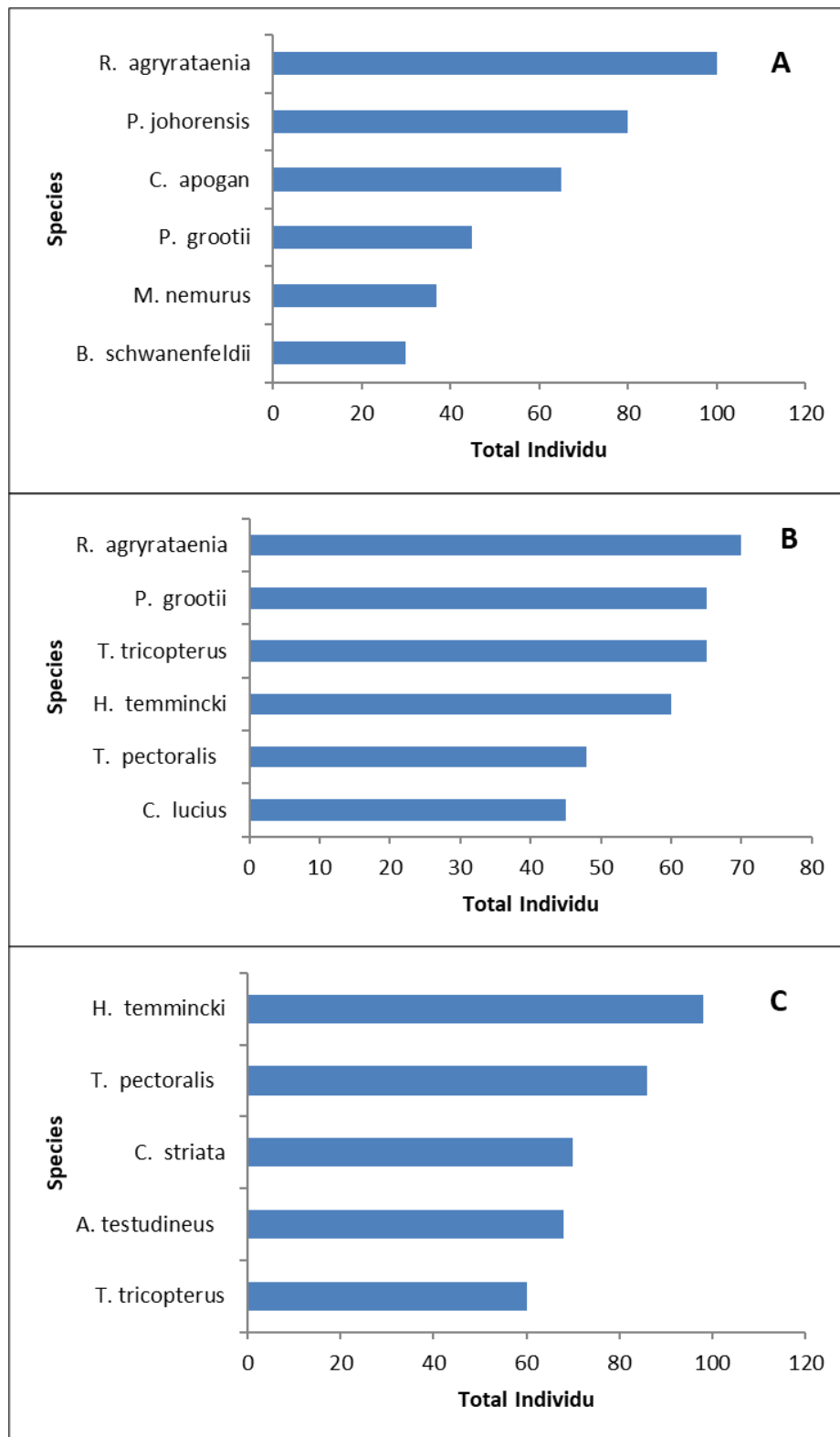
This study indicated a wide distribution of fishes in the Kelekar river floodplain. A total of 1509 individuals that were identified can be classified into 12 families and 17 genera. Five hundred and twenty-nine (529) individuals were dominated by members of Cyprinidae, followed by Osphronemidae (276), 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. agrirataenia* (185), followed by *H. temminckii* (165), *T. pectoralis* (146), *P. joborensis* (112), *Anabas testudineus* (100), and the least number of individuals were *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. tricolor*, *H. temminckii*, *P. pectoralis*, *C. striata*, and *A. testudineus*, while in the rainy season dominated by groups of white fishes, namely *R. agrirataenia*, *P. joborensis*, and *C. apogon*. The six species with the largest number of individuals found at each station were presented in Figure 2.

The dominance index indicated various dominant species. At station 1 (S1), the most dominant species, in order from highest to lowest are as follows: *R. agrirataenia* with a dominance index ( $C$ ) of 0.045, *P. joborensis* (0.029), *C. apogon* (0.019), *P. grootii* (0.009), *M. nemurus* (0.006), and *B. schwanenfeldii*

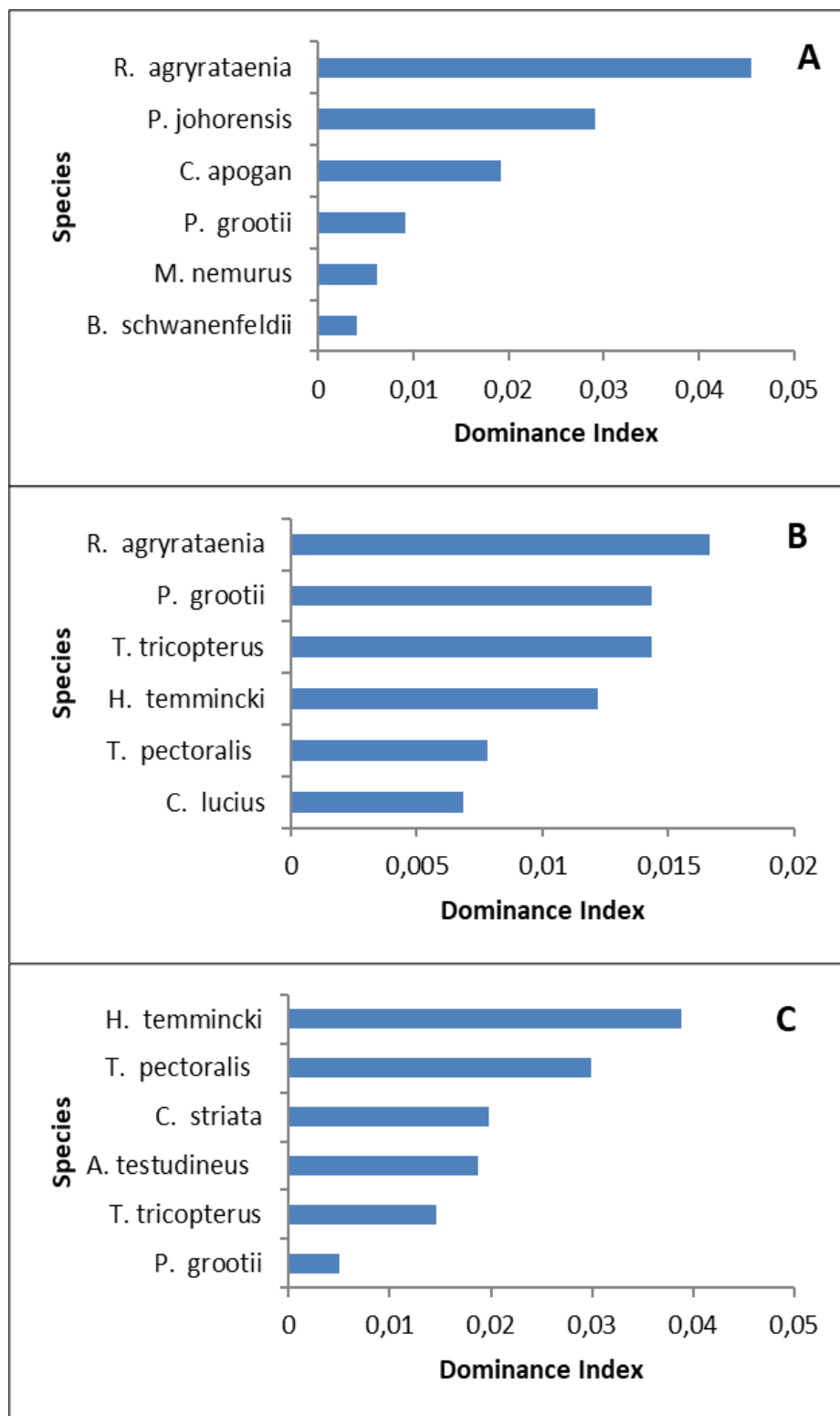
**Table 1.** Fish diversity of Kelekar floodplain in Ogan Ilir regency.

| Family               | Genus         | Species                          | Station |       |       | Total | Body weight (g) | Total length (cm) |
|----------------------|---------------|----------------------------------|---------|-------|-------|-------|-----------------|-------------------|
|                      |               |                                  | 1       | 2     | 3     |       |                 |                   |
| Anabantidae          | Anabas        | <i>Anabas testudineus</i>        | 2       | 30    | 68    | 100   | 10-90           | 3-12              |
| Bagridae             | Hemibagrus    | <i>Hemibagrus nemurus</i>        | 37      | 6     | -     | 42    | 100-250         | 20-30             |
| Channidae            | Channa        | <i>Channa pleurotholma</i>       | -       | 10    | 30    | 40    | 37-150          | 15-26             |
|                      |               | <i>Channa striata</i>            | 3       | 20    | 70    | 93    | 50-250          | 10-28             |
|                      |               | <i>Channa lucius</i>             | 5       | 45    | 13    | 63    | 20-150          | 8-20              |
| Clariidae            | Clarias       | <i>Clarias batrachus</i>         | 1       | 4     | 12    | 17    | 30-160          | 20-30             |
| Cyprinidae           | Puntius       | <i>Puntius joborensis</i>        | 80      | 30    | 2     | 112   | 0.2-0.4         | 3-6               |
|                      |               | <i>Puntioplites bulu</i>         | 30      | 12    | -     | 42    | 10-20           | 8-11              |
|                      |               | <i>Osteochilus hasselti</i>      | 25      | 15    | -     | 40    | 10-25           | 7-12              |
|                      |               | <i>Osteochilus schlegelii</i>    | 5       | -     | -     | 5     | 10-30           | 7-14              |
| Cylocheilichthys     |               | <i>Cylocheilichthys apogon</i>   | 65      | 10    | 2     | 77    | 15-20           | 8-13              |
| Hampala              |               | <i>Hampala macrolepidota</i>     | 2       | 15    | 1     | 18    | 20-200          | 14-20             |
| Barbonymus           |               | <i>Barbonymus schwanenfeldii</i> | 30      | 10    | -     | 40    | 100-200         | 15-20             |
| Rasbora              |               | <i>Rasbora argyrotaenia</i>      | 100     | 70    | 15    | 185   | 0.2-5           | 5-7               |
| Helostomatidae       | Helostoma     | <i>Helostoma temminckei</i>      | 5       | 60    | 98    | 163   | 20-120          | 10-18             |
| Mastocembelidae      | Mastocembelus | <i>Mastocembelus maculatus</i>   | 2       | -     | -     | 2     | 100-250         | 20-30             |
| Notopteridae         | Notopterus    | <i>Notopterus chitala</i>        | 2       | 1     | -     | 3     | 200-500         | 20-30             |
|                      |               | <i>Notopterus notopterus</i>     | 7       | 12    | 4     | 23    | 50-150          | 10-18             |
| Osphronemidae        | Trichogaster  | <i>Trichogaster trichopterus</i> | 6       | 65    | 60    | 130   | 6-12            | 3-9               |
|                      |               | <i>Trichogaster pectoralis</i>   | 12      | 48    | 86    | 146   | 10-25           | 8-12              |
| Pangasidae           | Pangasius     | <i>Pangasius pangasius</i>       | 2       | 5     | -     | 9     | 200-800         | 25-35             |
|                      |               | <i>Pangasius polyuramodon</i>    | 2       | 3     | -     | 5     | 130-300         | 15-30             |
| Pristolepidae        | Pristolepis   | <i>Pristolepis grootii</i>       | 45      | 65    | 35    | 145   | 20-80           | 5-12              |
| Tetraodontidae       | Tetraodon     | <i>Tetraodon palembangensis</i>  | 1       | 7     | 1     | 7     | 10-30           | 7-10              |
| Total                |               |                                  | 469     | 543   | 497   | 1509  |                 |                   |
| Diversity index (H') |               |                                  | 2.394   | 2.691 | 2.183 |       |                 |                   |
| Evenness index (E)   |               |                                  | 0.764   | 0.871 | 0.806 |       |                 |                   |

(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 were most dominant at each station are presented in Figure 3.



**Figure 2.** The six largest species found at each station. (A = station 1), (B = station 2), (C = station 3).



**Figure 3.** Six dominant species at each station. (A = station 1), (B = station 2), (C = station 3).

Water quality affects fish species abundance. Water quality at station 1 indicated that water temperature (24-28 °C), dissolved oxygen (6.56-7.61 mg.L<sup>-1</sup>), water acidity (5.6-7.0), while in station 2, water temperature (25-30 °C), dissolved oxygen (5.67-6.41 mg.L<sup>-1</sup>), water acidity (4.5-6.3). Station 3 denoted the value of water temperature (25-31 °C), dissolved oxygen (4.32-5.21 mg.L<sup>-1</sup>), 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).

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 the 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 lives 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 striped snakehead (*C. striata*), ocellated snakehead (*C. pleurophthalm*), Asian redbtail 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<sup>-1</sup>), *H. nemurus* (IDR 80,000-90,000.kg<sup>-1</sup>), *C. striata* (IDR 60,000-70,000.kg<sup>-1</sup>), *A. testudineus* (IDR 40,000-50,000.kg<sup>-1</sup>) and *H. temmincki* (IDR 25,000-30,000.kg<sup>-1</sup>). 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.

## AUTHORS CONTRIBUTION

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

## ACKNOWLEDGMENTS

We would like to thank the Fisheries Services of Ogan Ilir Regency, South Sumatra Indonesia and the local fisherman: Mr. Lukman, Mr. Nur Rohman and Mr. Ali for their assistance and facilities during the research.

## CONFLICT OF INTEREST

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

## REFERENCES

- Ajai, O. N., et al, 2020. Fish species diversity in Embaloh River, Banua Ujung Village, Embaloh Hulu Sub district, Kapuas Hulu District. *Jurnal Hutan Lestari*, 8. pp.1,61–68. doi:10.26418/jhl.v8i1.39291.
- Ammar, J., et al., 2014. Fish Diversity in Cala Lake, Musi Banyuasin Regency, South Sumatra. *Jurnal Depik*, 3 (3). pp.195–199. doi: 10.13170/depik.3.3.2147.



- Cheng, D. et al., 2019. Quantifying the distribution and diversity of fish species along elevational gradients in the Weihe River basin, Northwest China. *Journal of Sustainability*, 11(21), pp. 61-77. doi: 10.3390/su11216177.
- Patriono, E., & Junaidi, E., 2001. Inventarisasi jenis ikan di Sungai Kelekar Kecamatan Indralaya Kabupaten Ogan Ilir Sumatera Selatan. In: Prosiding seminar nasional hasil-hasil penelitian dan pengkajian 2010. Badan penelitian dan pengembangan daerah Propinsi Sumatera Selatan, Palembang.
- Fu, C. et al., 2004. Patterns of diversity, altitudinal range and body size among freshwater fishes in the Yangtze River basin, China. *Global Ecology and Biogeography*, 13(6), pp. 543-552.
- Haryono, H., 2007. The composition and abundance of freshwater fish in peat swamp areas of the Riau Province. *Berita Biologi*, 8(4), pp.231-239. doi: 10.14203/beritabiologi.v8i4.2113.
- Heip, C., 1974. A new index measuring evenness. *Journal of the Marine Biological Association of the United Kingdom*, 54(3), pp.555-557.
- Hossain, M. et al., 2014. Freshwater fish diversity at greater Noakhali, Bangladesh. *Chiang Mai University Journal of Natural Sciences*, 13(2), pp.207-225. doi: 10.12982/cmujns.2014.0032
- Kottelat, M. et al., 1993. *Freshwater fishes of Western Indonesia and Sulawesi*. Jakarta, Indonesia: Periplus Editions.
- Kottelat, M. & Whitten, A. J., 1996. *Freshwater Fishes of Western Indonesia and Sulawesi : additions and corrections*, Hongkong: Periplus.
- Li, X. et al., 2019. Freshwater fish diversity in the upper and middle reaches of the Lancang-Mekong River. *Biodiversity Science*, 27(10), pp.1090-1100. doi: 10.17520/biods.2019195.
- Magurran, A.E., 1988. *Ecological Diversity and Its Measurements*, Princeton, NJ: Princeton University Press. <https://doi.org/10.1007/978-94-015-7358-0>
- Muslim, M., 2012. *Perikanan rawa lebak lebung Sumatera Selatan*, Palembang: Unsri Press.
- Muslim, M., 2013. Potensi rawa lebak lebung untuk pengembangan budidaya ikan air tawar di Sumatera Selatan. In: N. Taufik, M. Masykur, H. Heldawati, W. Gustina, L.V. Prasetyo, B.A. Sakuro, & A. Gani (Eds), Seminar Nasional Pengelolaan Rawa dan Pesisir Yang Berkelanjutan. Tembilahan: Badan Perencana Pembangunan Daerah Kabupaten Indragiri Hilir.
- Muslim, M. & Lestari, L.W., 2005. Studi biodiversitas ikan di reservat perikanan Lebung Karang, Indralaya Ogan Ilir. Indralaya. Laporan Penelitian. Indralaya: Lembaga Penelitian Universitas Sriwijaya.
- Nurdawati, S. & Prasetyo, D., 2007. Fish fauna of swamp forest ecosystem in South Sumatera. *Jurnal Iktiologi Indonesia*, 7(1), pp.1-8.
- Saanin, H., 1984. *Taksonomi dan kunci idnetifikasi ikan jilid 1 dan 2*. Bina Cipta. Jakarta.

- Sweke, E. A. et al., 2013. Fish diversity and abundance of Lake Tanganyika: comparison between protected area (Mahale Mountains National Park) and unprotected areas. *International Journal of Biodiversity*, 2013(3), pp.516-522. doi: 10.1155/2013/269141.
- Syafei, L. S., 2017. Keanekaragaman hayati dan konservasi ikan air tawar (Biodiversity and conservation of freshwater fish). *Jurnal Penyuluhan Perikanan dan Kelautan*, 11(1). pp. 48–62. doi: 10.33378/jppik.v11i1.85.
- Syaifudin, M., et al., 2020. Barkod dna dan kekerabatan ikan di perairan tawar Sumatera Selatan (DNA barcoding and phylogenetic of freshwater fishes in Sumatera Selatan). In: Z. A. Muchlisin, Agustiana, B. Amin, A.D. Syakti, L. Adrianto (eds). *Ikan natif dan endemic Indonesia: Biologi, konservasi dan pemanfaatan*. Bandar Publishing, Banda Aceh.
- Welcomme, R. 2000. Fish biodiversity in floodplains and associated rivers. *Biodivers. Wetl. Assessment, Funct. Conserv.* 1, edited by B. Gopal, W.J. Junk and J.A. Davis, Backhuys Publisher, Leiden, The Netherlands, pp 61–87.
- Zaccone, G. et al., 2018. Air-breathing in fish: Air-breathing organs and control of respiration: Nerves and neurotransmitters in the air-breathing organs and the skin. *Acta Histochemica*, 120(7), pp.630-641. doi: 10.1016/j.acthis.2018.08.009.