*Jurnal Lahan Suboptimal : Journal of Suboptimal Lands*
*ISSN: 2252-6188 (Print), ISSN: 2302-3015 (Online, www.jlsuboptimal.unsri.ac.id)*
*Vol. 9, No.2: 192-198 Oktober 2020*
*DOI: https://doi.org/10.33230/JLSO.9.2.2020.505*

# Biodiversity of Fishes in Musi Estuary, South Sumatra, Indonesia

*Biodiversitas Ikan di Estuari Musi, Sumatera Selatan, Indonesia*

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(Received: 20 March 2020, Accepted: 6 October 2020)

**Citation:** Agustriani F, Purwiyanto AIS, Putri WAE, Fauziyah F. 2020. Biodiversity of fishes in musi estuary, South Sumatra, Indonesia. *Jurnal Lahan Suboptimal : Journal of Suboptimal Lands* 9(2): 192-198.

## ABSTRAK

Aktivitas tinggi di muara Musi akan berdampak pada keanekaragaman ikan. Penelitian ini bertujuan untuk menganalisa keanekaragaman hayati ikan di muara Musi di Sumatera Selatan. Metode yang digunakan adalah *experimental fishing* dengan cara mengumpulkan data dari daerah tangkapan nelayan, menggunakan alat tangkap gillnet milenium. Kelimpahan spesies ikan yang ditemukan adalah 21 spesies dari 16 famili. Tangkapan utama adalah *Hemibagrus nemurus* dengan kelimpahan relatif tinggi (RA) 35,4% tetapi frekuensi ketersediaan tinggi 100% adalah *Eleutheronema tetradactylum*. Nilai rata-rata indeks keanekaragaman sedang (H'= 1,47), indeks kemerataan sedang (J'= 0,48) dan indeks dominasi rendah (D= 0,32). Kondisi ini menunjukkan bahwa struktur komunitas dari spesies yang ditangkap oleh alat tangkap gillnet millenium berada dalam kondisi yang cukup stabil dengan jumlah spesies yang tersebar cukup merata dan tidak ada spesies yang saling mendominasi.

Kata kunci: alat tangkap, experimental fishing, indeks jaring insang

## ABSTRACT

The high activity in the Musi estuary will have an impact on fishes diversity. This research aimed to analyse the biodiversity of fishes in the Musi estuary in South Sumatra. An experimental fishing method was used for data collection by fishing ground following the local fishermen habit using gillnet millennium. The abundance of fish species found were 21 species and 16 families. The main catch was *Hemibagrus nemurus* with a high relative abundance (RA) of 35.4% but the high availability frequency of 100% is *Eleutheronema tetradactylum*. The average value of the moderate diversity index (H'= 1.47), the moderate evenness index (J'= 0.48) and the low dominance index (D= 0.32). This condition shows that the community structure of the species captured by the gill net is in a fairly stable condition with the number of species that are spread fairly evenly and no species dominate each other.

Keywords: experimental fishing, fishing gear, gill net, indexes

## INTRODUCTION

Musi Estuary is located in the territorial waters of the Banyuasin Regency which was a very important region for the economy of the people of South Sumatra. Banyuasin waters have good potential for fish resources (Fauziyah *et al.,* 2012, 2019a, 2019b, 2020). This estuary is used as a place for fishing, settlement, and transportation (Munthe *et al.,* 2012). In the period between 2014 and 2017, the number of fishing gear units operated by fishermen in Banyuasin has increased from year to year (BPS. 2015, 2018). Increased fishing effort can lead to overexploitation and depletion of available fish stocks.

Estuary supports habitat and sustain the production of coastal fisheries. Regulate the spread of fish larva and as a continuation of fish population availability (Amezcua *et al.,* 2019). Represents the important transition waters where marine and freshwater ecosystems meet and mix. Estuary is a dynamic system because of its tidal nature and its ecological is expected to change along with climate change and the arrival of new species (Connor *et al.,* 2019). The tidal properties in the estuary will affect the physiological performance of fish abundance (Christensen *et al.,* 2019).

Estuary is a productive habitat as a provider of fish and fisheries resources. Estuary has complex productivity due to its wealth of nutrients and microorganisms as a natural food (Contente *et al.,* 2011; Engman *et al.,* 2019). But this ecosystem is vulnerable to the threat of human activity especially anthropogenic. It will also affect the hydrological and biological conditions (Amezcua *et al.,* 2019). The complete activity in the estuary including Musi Estuary has caused ecological pressures in the region, this is evident from the results of the interview with fishermen that there has been a decline of fishermen's catches and the area of fishing.

To avoid the decline of fish resource diversity in Musi Estuary, it is necessary data and complete information so that it can be done preventive efforts and repeats the problem. The management of river estuary is necessary to preserve the sustainability of fishery Resources (Rosli *et al.,* 2012). The purpose of this research was to analyse the abundance and diversity of fish resources in Musi Estuary, South Sumatera.

## MATERIALS AND METHODS

The research was conducted in July 2018 in the Musi Estuary region, South Sumatera at a position of 2°15'50"-2°17 '30" South latitude and 104°56'4"-105°3'30" East longitude (Agustriani *et al.,* 2019). Determining the location of millennium gillnet was carried out in accordance with the fishing ground area.

The Hydro oceanographic factors are measured at each station (temperature, salinity, dissolved oxygen (DO), current velocity). Three repeats are recorded from each sampling station. Fish samples were taken using gillnet Millennium. Fish samples were analyzed for a species composition of relative abundance (RA) and frequency of appearance (FA) according to (Amezcua *et al.,* 2019; Connor *et al.,* 2019), the diversity index of Shannon (H ') corresponds to (Okyere *et al.,* 2011; Carles *et al.,* 2014) , the Diversity index (J') according to (Okyere *et al.,* 2011; Ravanbakhsh *et al.,* 2016), the dominance Index (D) corresponds to (Kumar *et al.,* 2010) (Davari *et al.,* 2011).

## RESULTS AND DISCUSSION

### Physical-Chemical Parameters

Physical parameters in these waters show varying values with water temperatures around 28.6-30.8°C, current speeds around 0.07-0.12 m/s. Likewise the chemical parameters of the waters, with an average salinity of 30 %, DO around 5.8-7.0 mg/L (Table 1). Salinity distribution is closely related to hydrodynamic elements, namely tides. At high tide, the effect of sea water is not too far into the river. Whereas at low tide, river water moves far into the

sea, and simultaneously influences the distribution of salinity in waters with currents carrying two different types of water masses. Salinity is also a major factor in influencing the abundance and diversity of fin and shell species in estuaries (Bhat *et al*., 2014).

DO values in Musi estuary waters are high, DO levels are higher due to open areas and diffusion of oxygen into water is easier. Based on KepMenLH No. 51 of 2004 and Regulation of South Sumatra No. 16 of 2005, the physical-chemical quality parameters of water in the Musi estuary are below water quality standards, making it safe for the sustainability of fish resources.

**Composition of Fishes Species in Musi Estuary**

Observations on 7 sampling trips in Musi Estuary waters using the gillnet millenium fishing gear were 21 species from 16 fish families (Table 2). Most species of fish come from the family Clupeidae (3 species), namely *Sphyraena jello, Anodontostoma chacunda* and *Sardinella fimbriata*, and Carangidae (3 species), namely *Parastromateus niger, Scomberoides lysan* and *Alepes vari*, then the family Leiognathidae with 2 species namely *Photopectoralis bindus* and *Caranx sexfasciatus*.

Based on habitat, the composition of fish species found in the waters of the Musi estuary, the fish community consists of freshwater, brackish and marine species. This result is consistent with research at Estuary Segara Anakan (Nurfiarini *et al.*,. 2015) which found four species categories, namely: 1) invasive species (migrants) from the sea dominated by Balystidae, Carangidae, Leiognathidae, Lutjanidae, and Mugillidae; 2) Native estuary species (fish species with complete life cycles occur in estuaries), including several species from Family Ambassidae, Clupeidae, Engraulidae, Gobiidae; 3) invasive species of freshwater including the families Cichlidae and Opichthidae; and 4) Anadromus species represented by Anguilla bicolor from the Angulidae family.

The number of fish species found in Musi estuary (21 species) using gillnet millenium fishing gear is lower when compared to other estuary areas, such as: Musi estuary using tramellnet has 48 species (Fauziyah *et al.,* 2019c). Estuary Segara Anakan which numbered 87 species (Nurfiarini *et al.,* 2015), Estuary Teluk Kendari has 76 species (Asriyana *et al.,* 2009) and Estuary Mayangan has 77 species (Simanjuntak *et al.,* 2000). Otherwise, in Estuary Pahang only 24 species were found (Jalal *et al.,* 2012), and Estuary Sepang Besar only 29 species were found (Asyikin *et al.,* 2014). The relative abundance ranges from 0.0%-35.4% in which the *Hemibagrus nemurus* species of the Bagridae family have a higher relative abundance, and then *Eleutheronema tetradactylum* (Polynemidae family) and *Sphyraena jello* (Clupeidae) each have relative abundance values of 35,4%, 21,6% and 16,5%. However, *E. tetradactylum* and *S. jello* are fish with the highest frequency abundance with 100% occurrence frequency (Table 2).

The frequency of occurrence and relative abundance for 21 species found in Musi estuary varies from low to high. Most of its relative abundance is in the low category (Table 2). *H.nemurus* has a relatively high abundance value but a low frequency appearance value. *Parastromateus niger* has a relatively low abundance value and vice versa moderate appearance frequency value. Variations in the relative abundance of each species are likely due to differences in species responses (tolerance levels) to the physical-chemical conditions of the waters. In addition, the physical-chemical condition of water also affects primary productivity (Kannappan *et al.,* 2013) and primary productivity affects fish abundance (González-Solis *et al.,* 2013) in estuarine waters.

Table 1. Waters quality of musi estuary

| Parameter | Trip | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Temperature (°C) | 28.7 | 28.8 | 28.6 | 30.8 | 28.8 | 29.0 | 28.6 |
| Salinity (‰) | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| Dissolved Oxygen (mg/L) | 6.5 | 6.8 | 6.8 | 5.8 | 6.6 | 7.0 | 7.0 |
| Current Velocity (m/s) | 0.12 | 0.1 | 0.08 | 0.08 | 0.07 | 0.08 | 0.95 |

Table 2, Composition of fish species, relative abundance (RA) and frequency of appearance (FA) at each sampling location in Musi Estuary, South Sumatra

| Family | Scientific Name* | Environment | | | Total Catch (kg) | RA (%) | FA (%) |
|---|---|---|---|---|---|---|---|
| | | Fresh | Brackish | Marine | | | |
| Clupeidae | *Sphyraena jello* | No | Yes | Yes | 127.2 | $16.5^{H}$ | $100^{H}$ |
| Polynemidae | *Eleutheronema tetradactylum* | Yes | Yes | Yes | 167.1 | $21.6^{H}$ | $100^{H}$ |
| Belonidae | *Tylosurus acus melanotus* | Yes | Yes | Yes | 63 | $8.2^{H}$ | $86^{H}$ |
| Chirocentridae | *Chirocentrus dorab* | No | Yes | Yes | 44.9 | $5.8^{H}$ | $86^{H}$ |
| Carangidae | *Parastromateus niger* | No | Yes | Yes | 4.3 | $0.6^{L}$ | $57^{M}$ |
| Sciaenidae | *Johnius belangerii* | No | Yes | Yes | 6.6 | $0.9^{L}$ | $100^{H}$ |
| Clupeidae | *Anodontostoma chacunda* | Yes | Yes | Yes | 3.4 | $0.4^{L}$ | $100^{H}$ |
| Carangidae | *Scomberoides lysan* | No | Yes | Yes | 40.4 | $5.2^{L}$ | $100^{H}$ |
| Engraulidae | *Thryssa kammalensis* | No | Yes | Yes | 0.3 | $0.0^{L}$ | $29^{L}$ |
| Leiognathidae | *Photopectoralis bindus* | No | Yes | Yes | 0.6 | $0.1^{L}$ | $43^{L}$ |
| Leiognathidae | *Caranx sexfasciatus* | Yes | Yes | Yes | 0.9 | $0.1^{L}$ | $43^{L}$ |
| Clupeidae | *Sardinella fimbriata* | No | Yes | Yes | 1.3 | $0.2^{L}$ | $71^{M}$ |
| Psettodidae | *Psettodes erumei* | No | No | Yes | 10.9 | $1.4^{L}$ | $43^{L}$ |
| Haemulidae | *Pomadasys argyreus* | No | No | Yes | 11.7 | $1.5^{L}$ | $29^{L}$ |
| Bagridae | *Hemibagrus nemurus* | Yes | Yes | No | 273.4 | $35.4^{H}$ | $43^{L}$ |
| Carangidae | *Alepes vari* | No | Yes | Yes | 3.7 | $0.5^{L}$ | $29^{L}$ |
| Drepaneidae | *Drepane punctata* | Yes | Yes | Yes | 0.4 | $0.0^{L}$ | $29^{L}$ |
| Trichiuridae | *Lepturacanthus savala* | No | Yes | Yes | 0.3 | $0.0^{L}$ | $14^{L}$ |
| Ariidae | *Plicofollis tenuispinis* | No | Yes | Yes | 1.1 | $0.1^{L}$ | $14^{L}$ |
| Plotosidae | *Plotosus canius* | Yes | Yes | Yes | 0.6 | $0.1^{L}$ | $14^{L}$ |
| Carcharhinidae | *Carcharhinus sp* | No | No | Yes | 10.2 | $1.3^{L}$ | $14^{L}$ |

Note: H: High; M: Moderate; L: Low; *According to valid name from www.fishbase.org

**Fish Biodiversity**

The index value of fish diversity (H ') caught using the gillnet millennium fishing gear is around 1.22-1.72 (moderate category), the uniformity index value (J') is around 0.4-0.52 (moderate), dominance index (D) around 0.22-0.41 (low). Based on the criteria, almost all species of fish caught by the gillnet millennium fishing gear did not dominate because of the diversity and uniformity of the moderate category (Table 3).

This condition illustrated that the waters ecosystem was stable (Carles *et al.*, 2014; Gunawan *et al.*, 2016). Species diversity is a useful parameter for community comparisons under the influence of biotic disorders or for knowing the state of succession and stability in communities (Olawusi-Peters *et al.*, 2014). Variations in the number of individuals and species that are thought to be closely related to factors affecting environmental stability are the ability of community structures to be unaffected by their component disturbances, such as water physicochemical factors (Kannappan *et al.*, 2013; González-Solis *et al.*, 2013) and biological factors. Physicochemical factors such as tides, temperature, flow velocity, salinity, nutrition, and substrate conditions. Whereas biological factors are usually related to adaptation patterns, predators, distribution or fixed habitat patterns.

Table 3. Gillnet millenium capture community structure

| Trip | Diversity (H") | | Evenness (J") | | Dominance (D) | |
|---|---|---|---|---|---|---|
| | Value | Category | Value | Category | Value | Category |
| 1 | 1.56 | moderate | 0.51 | moderate | 0.26 | low |
| 2 | 1.59 | moderate | 0.52 | moderate | 0.25 | low |
| 3 | 1.55 | moderate | 0.51 | moderate | 0.26 | low |
| 4 | 1.22 | moderate | 0.4 | low | 0.41 | low |
| 5 | 1.51 | moderate | 0.5 | moderate | 0.32 | low |
| 6 | 1.72 | moderate | 0.57 | moderate | 0.22 | low |
| 7 | 1.11 | moderate | 0.36 | low | 0.54 | moderate |
| Average | 1.47 | moderate | 0.48 | moderate | 0.32 | low |

Note: high (H" >3: J"> 0.6: D> 0.7); moderate (1<H"<3: 0.4<J"<0.6); low (H"<1: J"<0.4: D<0.5)

Fluctuations in temperature and salinity in estuary waters can be a pressure for estuary organisms, as a result these organisms make morphological and physiological adaptations to survive and colonize the estuary region. The relative abundance of species in a community is another factor that influences diversity (Olawusi-Peters *et al.,* 2014). Factors affecting diversity are time, spatial heterogeneity, competition, predation and productivity. The number of individuals from each species that is evenly distributed also does not show a tendency for species domination. This is also reinforced by the low dominance index value. The results are similar to results in the estuary waters of the Sembilang National Park in South Sumatra (Fauziyah *et al.,* 2012) and the Banyuasin Coastal Waters (Fauziyah *et al.,* 2018).

## CONCLUSION

The water quality in Muara Musi is still below the KepMenLH no. 51 of 2004 and Regulation of South Sumatra No. 16 of 2005. The number of fish species found at Muara Musi using the gillnet millennium fishing gear was 21 species. Most of its relative abundance is in the low category. The fish diversity index is moderate so the dominance index is low.

## ACKNOWLEDGMENTS

This research is part of the SAINTEKS Grants of Sriwijaya University PNBP in 2018. Thank you to Banyuasin team for helping while in the field.

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