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Fish species composition in the Kaliotik River, Lamongan Regency, Indonesia

Fuquh Rahmat Shaleh[1*], Agung Pamuji Rahayu[1], Nuralim Pasisingi[2]

[1]Faculty of Fisheries, Lamongan Islamic University, Indonesia.
[2]Faculty of Fisheries and Marine Science, Gorontalo State University, Indonesia.
*Corresponding author: fuquhrahmat@unisla.ac.id

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ABSTRACT

This research aimed to determine the species composition of fishes in the Kaliotik River, Lamongan Regency. The sampling was conducted from March to May 2020 at four stations. A total of 1031 samples caught by the fishing net during the study consists of *Anabas testudineus, Trichogaster trichopterus, Hyposarcus pardalis, Mystus* sp., *Channa striata, Oreochromis mossambicus*. The fish diversity index values indicated that the river is in low to moderate condition. The species was also slightly evenly distributed in the waters with no dominant species. *Trichogaster* sp. and *Anabas testudineus* are the two dominant species found in the waters with a relative abundance of 44 % and 41 %, respectively. The Kaliotik River ecosystem balance was affected by disposal from human activities along the riverbank.

INTRODUCTION

Kaliotik is a river located in the Lamongan Regency, Indonesia. Several community activities, with markets and food stalls, are held on the riverbank, potentially providing waste input, including piles of plastic waste, discoloration, and unpleasant odors. Excess waste input load can disrupt river ecosystems' sustainable function (Pasisingi et al., 2014a), particularly fish. Many human activities in the river and the river area, including household waste disposal, overexploitation of fish, and land use activities. It might cause changes in the river's characteristics to decrease its population and diversity (Wahyuni & Zakaria, 2018).

Fish biodiversity is an essential component of an ecosystem as it is a critical factor in ecosystems' rules and functions (Mote, 2017). One of the indicators used in assessing ecosystem health is fauna biodiversity (Pavita et al., 2014). Samitra and Zico (2018) suggested that the aquatic ecosystem's damage impacts fish life both in quality and quantity. The input of waste into the Kaliotik River will have an impact on biodiversity and ecosystem balance. Therefore it is necessary to determine the species composition of fishes in the Kaliotik River as primary data to manage aquatic resources in Lamongan Regency.

MATERIAL AND METHODS

Sampling and study site. The research was conducted from March to May 2020 in the Kaliotik River, Lamongan Regency. The fishes were sampled purposively from four stations. Station 1 is located in Sidodadi Village before the city; Station 2 is in Telaga Bandung, located in the city center; therefore, the river flow passes through markets and residential areas. Station 3 is located in Kelurahan Temenggungan with a densely populated settlement along the riverbank. Station 4 is in Telaga Dapur located at the end of the city's river flow (Figure 1). Fishes from each station were collected using nets, and fishing rods with worm bites, then preserved using alcohol 70%. Sampling was conducted four times per month for three months. The caught fishes were put in a storage box and identified morphologically in the Lamongan Islamic University Fisheries Laboratory based on a key guide book for fish identification (Sukmono & Margaretha, 2017).

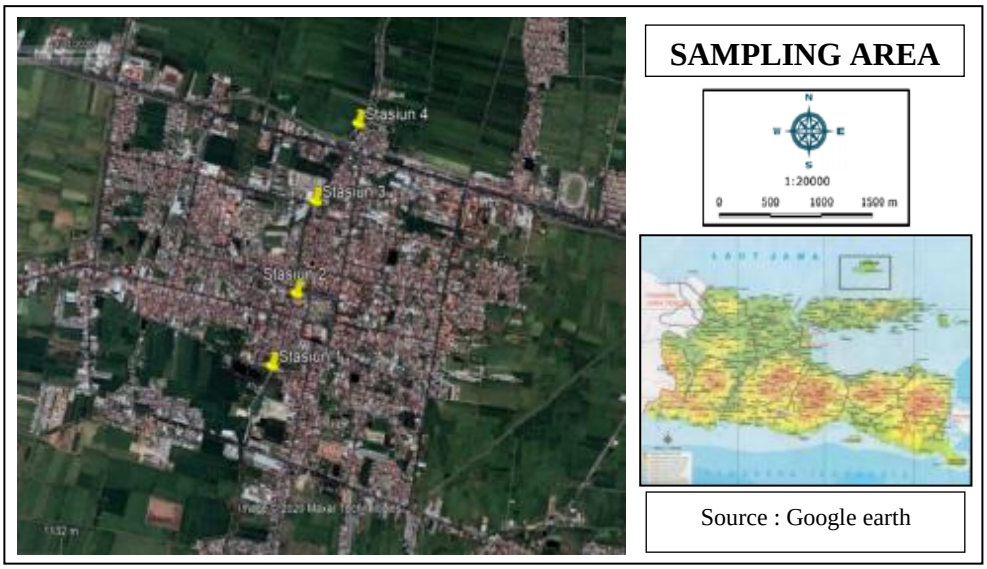

Figure 1. The fish sampling points along the Kaliotik River.

Data analysis. The relative abundance of each species was calculated using the following simple formula (Krebs, 1989):

$$Kr = \frac{n_i}{N} x100\%$$

Where:
Kr : the percentage of fish abundance
n_i : the individual numbers of the species-i
N : total number of individuals of all species

The Shannon-Wiener Diversity index was calculated by the following formula (Fachrul, 2007):

$$H' = -\sum_{i=1}^{s} \frac{n_i}{N} \ln \frac{n_i}{N}$$

Where:
H' : Diversity index
n_i : number of individuals of the species-i
N : total number of individuals
s : number of species

The assessment criteria determination based on the species Diversity index value as follow:
H '< 1 : low diversity
1 < H <3 : moderate diversity
H' > 3 : high diversity

The Evenness index was calculated as follow (Odum, 1971):

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

Where:
E : Evenness index
H' : Diversity index
H max : ln s
s : number of species found

With the criteria for the Evenness index values as follow (Fachrul, 2007):
E ~ 0 : The individual number of each species is highly different.
E ~ 1 : The individual number of each species is relatively equal.

The dominance index was calculated by the following formula (Odum, 1971):

$$D = \sum_{i=1}^{s} p_i^2$$

Where:
D : Dominance index
p_i : The individual proportion of fish species-i
s : number of species found

Dominance index value ranges from 0 – 1 by the following categories:
0 < C < 0.50 : Low dominance
0.50 < C ≤ 0.75 : Moderate dominance
0.75 < C ≤ 1 : High dominance

RESULTS AND DISCUSSION

Species and the relative abundance. There were 1031 fishes from six species in the Kalotik River sampled from March to May 2020. The species belong to two orders (Perciformes and Siluriformes) and six families (Anabantidae, Osphronemidae, Chanidae, Cichlidae, Bagridae, Loricarinae). Each species is familiar with its local name (Table 1).

Table 1. Fish diversity in the Kaliotik River

No	Ordo	Family	Species	Local name
1	Perciformes	Anabantidae	*Anabas testudineus*	Bethik
2		Osphronemidae	*Trichogaster trichopterus*	Sepat
3		Channidae	*Channa striata*	Gabus
4		Cichlidae	*Oreochromis mossambicus*	Mujair
5	Siluriformes	Bagridae	*Mystus* sp.	Keting
6		Loricarinae	*Hyposarcus pardalis*	Sapu-Sapu

The number (Table 2) and the relative abundance (Figure 2) of each fish species in the river caught during the research are various. At Station 1, there were only found four species. There were five species at Station 2 and 3, while at Station 4, there lived six species.

Table 2. An abundance of fishes in the Kaliotik River

No	Species	Station 1 (ind.)	Station2 (ind.)	Station 3 (ind.)	Station 4 (ind.)
1	*Anabas testudineus*	72	105	102	146
2	*Trichogaster trichopterus*	120	105	120	110
3	*Channa striata*	0	1	3	4
4	*Oreochromis mossambicus*	4	1	0	2
5	*Mystus* sp.	0	0	20	20
6	*Hyposarcus pardalis*	20	19	12	45

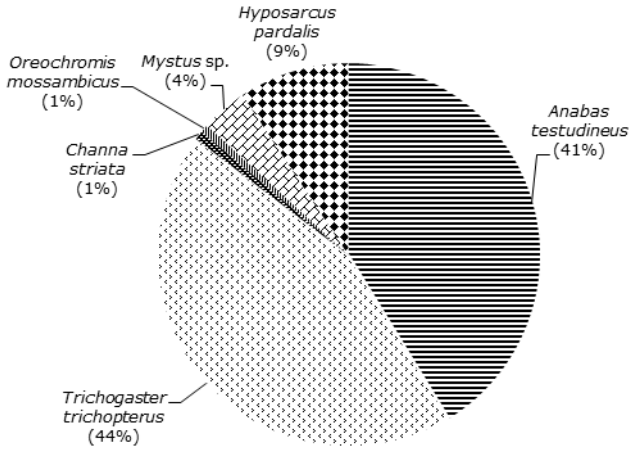

Figure 2. The percentage of fish species in the Kaliotik River.

The three dominant abundance fishes among six species found in the Kaliotik River were *Anabas testudineus*, *Trichogaster trichopterus*, and *Hyposarcus pardalis*. It is due to they are highly tolerant of living in extreme water conditions. The water quality in the Kaliotik River reported by Shaleh et al. (2020) was below the fishery quality standards and recognized in heavy polluted condition-based organic pollution.

A. testudineus belongs to the Labyrinithici fish and the Anabantiform order also familiar with blue gourami. The species is characterized by a specific organ located above its gills for the respiration of atmospheric oxygen. This feature functions in a specific adaptation to low oxygen levels (Degani, 2020; Sukmono & Margaretha, 2017). Likewise, *T. trichopterus* is also a labyrinth fish species (Muslim, 2019) resistant to living in humid waters with a low pH level. The fishes can breathe freely on the water surface. According to Zhang et al. (2019), *A. testudineus* is also commonly named freshwater climbing perch and can stand in persistent organic polluted waters, although the tolerance mechanisms are still unidentified. It is also remarkably adapted in a seasonal tropical environment and can tolerate brackish water in very turbid conditions (Zain et al., 2019). *Species C. striata* or snakehead fish is considered a sensitive indicator species of water pollution (Sasikala et al., 2020). The species as a bioindicator of light to moderate pollution based on the fish diversity index were also found in the Alo River, Sidoardjo, East Java (Latifah et al., 2020). In the upstream area of the Metro River, Lowokwaru District, Malang City, which is classified as lightly polluted, *C. striata* is also established (Komariah et al., 2020). Furthermore, *Hyposarcus* sp. is an invasive fish species in rivers in Indonesia. The species also found dominantly in the Ciliwung River (Qoyyimah et al.,

2016). The fish are predators and competitors to the native species (Hill & Lodge, 1999 in Elfidasari et al., 2016). Prayitno and Rukayah (2019) also reported that *H*. *pardalis* and *O*. *mossambicus* are foreign species introduced in the Banjaran River, which causes native fish populations to decline and even become extinct.

Diversity, Evenness, and Dominance Indexes. The values of the Diversity, Evenness, and Dominance indexes of fish obtained in the study are listed in Table 3. The fish Diversity index value can describe the aquatic ecosystem's complexity (Erika et al., 2018). The Diversity index in this study, ranging from 0.97 to 1.25, indicates that the fish species diversity condition in the waters is low to moderate. The Shannon-Wiener information theory's primary purpose is to measure the level of order and irregularity in a system. Fachrul (2007) stated that the diversity index is useful in studying environmental factors' disturbance to a community to determine the succession and stability.

Table 3. Diversity (H'), Evenness (E) and Dominance (D) Indexes of fishes in four sampling stations

Stations	H'	E	D
Station 1	0.99	0.71	0.43
Station 2	0.97	0.60	0.42
Station 3	1.12	0.69	0.38
Station 4	1.25	0.70	0.33

In detail, fish diversity at Station 2 is in the lowest category compared to other locations. It is due to the area of Station 2, which passes through the city center. Therefore, the input of waste into rivers from urban activities might reduce water river quality. Human activity in the upstream watershed area will bring high organic materials to the downstream, influencing the aquatic condition (Pasisingi et al., 2014b). Poor water quality causes low biota diversity. Nybakken (1992) stated that a high diversity value indicates a comfortable and stable environment, while a low diversity value indicates a stifling and unstable environment.

The evenness index value based on fish species data sampled from Kaliotik River was between 0.60 and 0.71. It indicates that the fish species in the Kaliotik River is slightly evenly distributed. Poor water conditions cause relatively uneven species distribution. Consequently, only certain fishes can survive. Krebs (2016) stated that a good ecosystem is characterized by high species diversity and an almost even distribution of individual species in waters. Evenness is closely related to species diversity and dominance (Buhdy et al., 2018)

Dominance index values depicting species richness in the river ranged from 0.33 to 0.43. In principle, the smaller the dominance index value, it shows no dominating species; otherwise, the greater the dominance, it indicates that certain species dominate (Odum, 1993). Polluted waters generally have relatively low species richness and are dominated by certain types (Astuti, 2015). Furthermore, Scheimer and Zalewski (1992) in Manullang and Khairul (2020) reported that high species diversity shows a good ecosystem balance. Otherwise, it indicates that there is damage to the ecosystem due to natural disasters and pollution. A small diversity indicates a high dominance of a particular species (Odum, 1971).

Decreasing ecological conditions reflected by only finding tolerant species of fish is the impact of poor water quality. In principle, the population decline of aquatic biota is caused by various factors. Firstly, habitat degradation causes the death of aquatic biota directly or indirectly. Secondly, new species introduction causes competition for food, space, and nutrients against native species. Also, water pollution is caused by the discharge of various types of waste, which can reduce water quality, thus threatening aquatic biota's life. Additionally, the human population, which continues to increase rapidly, demands that life necessities are met as soon

as possible. Moreover, overexploitation causes the loss of reproductive opportunities for the parent; hence, recruitment is unsuccessful (Djumanto & Probosunu, 2011).

CONCLUSION

There are six fish tolerant species found in the Kaliotik River with the composition sequentially from the highest to the lowest: *Trichogaster trichopterus* (44 %), *Anabas testudineus* (41 %), *Hyposarcus pardalis* (9 %), *Mystus* sp. (4 %), *Channa striata* (1 %), and *Oreochromis mossambicus* (1 %). The diversity, similarity, and dominance of fish indexes values indicate that the river is undergoing environmental stresses due to human activity along the riverbank, potentially disrupting water quality and influencing ecosystem stability.

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