Effect of Temperature and Zinc (Zn) Temporal Variation in Water on Size Distribution of River Catfish (Mystus sp.) at Blanakan River, West Java

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Abstract. River catfish (Mystus sp.) is a species commonly found in the Blanakan river. The community also consumes this species lived around Blanakan. This study aimed to investigate the effect of temporal variation of temperature and metal Zn on the Mystus sp. size distribution. The fish samples and water were collected from the river in the early and end of June to represent temporal variation. Simultaneously, the water temperatures were also recorded. The fish samples’ length and weight were measured. The AAS (Atomic Absorption Spectroscopy) was used to analyze Zn in water samples. The results showed that there was a temperature decrease from 32.9°C to 30.8°C. The Zn was also decreased from 1.12 mg/l to 0.14 mg/l. The length of Mystus sp. was increased from 13.27 cm to 14.00 cm. In contrast, the weight was reduced from 36.29 g to 32.88 g. To conclude, the temperature and Zn temporal variation affected the increasing length and reducing weight.

1. Introduction

Heavy metals are defined as a metal having a specific density of 5.0 with an atomic number 21 (Scandium) to 92 (Uranium) based on a periodic chemical system. Heavy metals can be divided into two types according to toxicological point of view, namely, essential heavy metals and non-essential heavy metals. Essential heavy metals are metals that are needed by organisms. However, in limited quantities, excessive amounts will cause poisoning, while non-essential heavy metals are toxic and detrimental to the organism's health. Zinc (Zn) is included in the group of essential heavy metals [1]. The most significant source of Zn comes from anthropogenic, agrochemical, sewer sludge, and fertilizer uses. This metal is needed for protein synthesis and energy in organisms [2].

River catfish named Lundu (Mystus sp.) (Figure 1) belongs to the order of Siluriformes, which is a group of prominent barbel fish. It generally classified as Siluriformes that lived in freshwater and found in estuaries of rivers and sea. Morphologically, Mystus sp. has four pairs of barbels. The length of the upper jaw barbels reaches the rectum, and the short barbel reaches the back of the eye. The body color is blackish-brown, and there are small spots on the head with the shape of a forked tail [3].

In the aquatic environment, temperature is one of the essential components in fish growth and development. Heat can affect the length and width of fish. [4] research showed that the increase in temperature had an impact on increasing fish body size. However, an increase in temperature can increase food intake and decrease body size. Correspondingly, this study aimed to determine the effect of temperature and Zn temporal variation in the water on the size distribution of river catfish (Mystus sp.) in the Blanakan river, Subang.
2. Methods

2.1 Study site
The Blanakan river is located in Subang district, West Java province. The station geo-coordinates were from upstream at -6.277444, 107.6599 to downstream (river mouth) at -6.240083, 107.667472 (Figure 2). The width of the Blanakan river is varied from 60 m near the river mouth to 11 m in the upstream. In upstream, the river was surrounded by settlements and paddy field, in midstream was transition area from paddy field to fish pond and downstream was dominated by the fish pond and revegetated by mangrove. The Mystus sp. samples were collected in stations 1, 2, and 3 in the mid and end of June 2019. The sampling station was in the Blanakan river, located between the river mouth and the inner part of the river. Each station has a distance of 300 m.

2.2 Temperature sampling and measurement
The temperature in the water was measured in each sampling station by using a thermometer [5].

![Figure 1. The river catfish Mystus sp.](image)

![Figure 2. The location of 3 stations across Blanakan river](image)
2.3 Zn sampling and measurement
Zn was sampled from water using a bottle sample. Then the Zn was analyzed using AAS (Atomic Absorption Spectroscopy) flame [6].

2.4 Measurement of catfish length and weight
River catfishes were captured at each sampling station by using nets and were taxonomically identified by using the identification book [7, 8]. The body length was measured to the nearest centimeter (cm), and body weight was recorded to the nearest gram (g). The total length of each fish was measured from the tip of the snout to the extended tip of the caudal fin using a measuring board [9, 10].

2.5 Data analysis
The data analysis to show the correlation was performed by using the allometric equation (y = ax^b). The y is dependent variables, and x is independent variables. The data than displayed in the two-axis chart to see the correlation trend. The first axis shows the temperature or Zn, while the second axis shows the weight and length of fish.

3. Results
The Mystus sp. weight collected was reduced from 36.29 g in mid-June to 32.88 g at the end of June. While the length was increased from 13.27 cm in mid-June to 14.00 cm at the end of June. The correlation equation of weight-length is weight = 4254.7length^{1.843} (Table 1).

Table 1. The allometric equation of weight, length of fish and temperature and Zn

| Variables          | Equation (y = ax^b)          |
|--------------------|------------------------------|
| Weight-length      | weight = 4254.7length^{1.843}|
| Water temperature-weight | weight = 0.195water temperature^{1.496} |
| Water temperature-length | length = 226.3water temperature^{-0.812} |
| Water Zn-weight    | weight = 36.1water Zn^{0.043}  |
| Water Zn-length    | length = 13.3water Zn^{-0.025} |
| Zn-length          | length = 226.3water temperature^{0.812} |

In Figure 3, it can be observed the correlation of water temperature with body length and weight of Mystus sp. As the temperature went lower from 32.9°C to 30.8°C in the river, it decreased the weight of Mystus sp. from 36.29 g to 32.88 g following the equation of weight = 0.195water temperature^{1.496} (Table 1). On the other hand, it increased the length of Mystus sp. from 13.27 cm to 14 cm (length = 226.3water temperature^{-0.812}, Table 1).
Figure 3. The correlation between the average temperature (°C) in water with weight (left) in gram and length (right) in cm of Mystus sp.

Figure 4. The correlation between the average of Zn (mg/l) in water with weight (left) in gram and length (right) in cm of Mystus sp.

It can be found in Figure 4 that as the Zn in water decreased from 1.12 mg/l to 0.14 mg/l, it decreased the weight of Mystus sp. from 36.27 g to 32.88 g. The equation is length = 36.1water Zn^{0.043} (Table 1). However, it increased the length of Mystus sp. from 13.27 cm to 14 cm (length = 13.3water Zn^{0.025}, Table 1).

4. Discussion
The Mystus sp. weight and length collected from the Blanakan river are comparable with other locations. In Blanakan, the Mystus sp. has a similar size as Mystus sp. lived in the Segara Anakan. However, it is smaller than Mystus sp. collected from the Siak river (Table 2). The Siak river is surrounded by intact forest; hence it provides more food needed for fish to grow. The allometric equation of weight and length of Mystus sp. in this study showed a negative correlation (Table 1). It indicated the Mystus sp. tended to be thinner. At the end of June, the observed Mystus sp. was increased more in length than in weight. This observed morphology variation is related to many factors, including food availability, season, and sex [11, 12].
Table 2. The comparable length (cm) and weight (gr) of Mystus sp. with other locations

| Length          | Weight       | Location                        |
|-----------------|--------------|---------------------------------|
| 13.27-14.00     | 36.29-32.88  | Blanakan River (this study)     |
| 2.00-14.00      | 5.00-30.00   | Segara Anakan river [13]        |
| 21.0-41.0       | n/a          | Siak river [14]                 |

n/a: not applicable

Table 3. The comparable Zn data (mg/l) with other locations

| Range/Value | Location                        |
|-------------|---------------------------------|
| 1.12-0.13   | Blanakan river (this study)     |
| 0.01-1.12   | Tondano river [15]              |
| 0.37-1.69   | Dumai coast [16]                |
| 0.98-2.79   | Kamal port [17]                 |

Table 4. The comparable temperature data (°C) with other locations

| Range/Value | Location                        |
|-------------|---------------------------------|
| 32.9-30.8   | Blanakan river (this study)     |
| 28.0-28.3   | Segara Anakan river [13]        |
| 30.1-30.4   | Dumai coast [16]                |
| 31.7-32.2   | Kamal port [17]                 |

Based on the results presented in Figures 3 and 4, it can be seen that there was an increase of Mystus sp. length, and decrease of Mystus sp. weight, temperature, and Zn. The reduction in temperature can be caused by several factors such as season, latitude, time of day, air circulation, cloud cover, water flow, and depth. Changes in temperature on the water surface can affect physical, chemical, and biological processes in water [18]. Compared with other research sites in Segara Anakan, Dumai coast, and Kamal port, the water temperature in the Blanakan river was the highest (Table 4). The Blanakan river has a higher water temperature compared to Segara Anakan since the aquatic ecosystems in Segara Anakan have more canopy cover. Meanwhile, the Blanakan river is comparable to Dumai and Kamal port since both locations are experienced anthropogenic disturbance and have less canopy cover.

Zn content in water of the Blanakan river was reduced from mid-June to the end of June with value was from 1.12 mg/l to 0.13 mg/l. When compared to other locations in the Dumai coast, Zn levels in the Blanakan river (Table 3) were lower. However, when compared to other sites such as the Tondano river and Kamal port, Zn levels in the Blanakan river were higher. The content of Zn that accumulates in the river mouth can be caused by the existence of residential areas in the upstream that contribute to household waste. In the downstream, there are agricultural activities that use much fertilizer. That adds to the accumulation of Zn in the river mouth of Blanakan, especially in mid-June, which is related to household waste and agriculture [2].

In this study, it can be seen that Mystus sp. has a decrease in weight at the end of June. At high temperature, the weight of Mystus sp. was higher than the weight of Mystus sp. at a lower temperature. These catfish are known as an omnivore fish, and the organisms consumed by Mystus sp. are crustaceans, insects, zooplankton, zoobenthos, and other benthos organisms [19]. High temperature increases the photosynthesis activity of plankton and leads to the increase of plankton abundance that consumed by Mystus sp. While the decrease in temperature affects the least abundance of plankton and reduces the number of food consumed by Mystus sp.; hence it decreases the weight [20].

The size distribution of Mystus sp. also depends on Zn content. In Figure 4, Mystus sp. individuals who have a higher weight were found in the river that has high Zn content, whereas smaller fish were
found in the river with lower Zn content. It relates to the eating activity of Mystus sp. Zn in the river occurs due to the dilution, and then the Zn is absorbed by plankton, which is a food source for Mystus sp. The presence of Mystus sp. with higher weight and higher Zn content in water simultaneously due to the higher plankton abundance, which is consumed by Mystus sp [15].

At the end of June, slimmer fishes indicated by reduced weight and increased length of individuals were found. At this time, the temperature and Zn were also reduced. The low temperature and sunray intensity decreased plankton activity. Low Zn also reduced the plankton population since Zn is needed by plankton. Respectively, with the absence of plankton, then the weight is reduced, and fish becomes thinner by increasing length. The smaller fish has a slender body, so it can be more productive and agile in swimming for finding food [21].

5. Conclusions
The temperature and Zn have influences on Mystus sp. length, and weight in the Blanakan river. The high temperature and Zn content in mid-June was related to the increase of weight and decrease in length. Conversely, by the end of June, the weight of Mystus sp. was lower, the length was higher, and Zn was also lower than in mid-June.

Acknowledgments
This research was funded by DRPM UI (Directorate for Research and Community Service of Universitas Indonesia)

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