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Behavior Study of *Periophthalmus variabilis* and *Boleophthalmus boddarti*

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Abstracts

This Gelodok fish (Mudskipper) which is called as amphibious fish have unique activity that can live in terrestrial and aquatic area. This study aims to study the daily activities of fish population 2 types of *Periophthalmus variabilis* and *Boleophthalmus boddarti* by using the scan sampling method and ad libitum. This research was conducted in September 2017 at the mouth of the river Tluwuk, Pati, Central Java. Observations were made for 150 minutes with a time interval of 5 minutes. The results showed that fish activity *P. variabilis* (v) was different from *B. Boddarti* (b). *P. varibilis* spends more time on land (90%) than in water (10%) whereas *B. Boddarti* activity is more in water (60%) than in land (40%). Observed activities are walking (a = 24,08 %., b = 11,73%), jumping (a = 4.01%, b = 0.65%), feeding / catching prey (a = 5,01%, b = 7.82%), swimming (a = 2.01%, b = 11.72%), moving dorsal fins (a = 4.01%, b = 3.26%), moving caudal fins (a = 2 , A = 2.67%, b = 7.82%), escape predators (a = 3.34%, b = 6.51%), head movements (a = 4.01%, b = 15.63%), entering holes/nesting (a = 0.67%, b = 1.95%), and inactive (a = 40.13%, b = 19 , 54%).

Keywords: Periophthalmus variabilis, Boleophthalmus boddarti, Animal Behavior

1. Introduction

Gelodok fish abundant amount and many found on the north coast of Java. Most amphibians fish (gelodok fish) are found in tropical and subtropical regions with geographic spread across the Pacific Indo-pacific and Pacific seas. Mudskipper live at air and water temperature 21-30º C and humidity 60-80%. The species of amphibian fish found in the tropics are more amfibious than in other areas (Murdy, 1989; Sayer dan Devenport, 1991; Al-Behbehani dan Ebrahim, 2010).

Species of batch fish belonging to the genus *Boleophthalmus*, *Periophthalmodon*, *Periophthalmus*, and *Scartelaos*, are referred to as Mudskippers because they have several

characteristics such as amphibious life that is on vision, breathing apparatus and movement on land (MacNae, 1968). *Periophthalmus variabilis* and *Boleophthalmus boddarti* is a species of gelodok fish (mudskipper) whose life history is able to be inside and outside water (Gordon, 1998). These fish use pectoral fins, pelvic fins and caudal fins as motion instruments while on land and in water. The morphology of fish has two forms of pelvik fins that are fused with a complete frenum and a complete type (Larson *et al*., 2008). In gelodok fish (amphibian fish) pectoral fin is used to swing when walking on land, while pelvic fins (stomach) is used as a pedestal of fish when out of water (Lagler *et al*., 1962).

Behavior of fish gelodok able to live in terrestrial and aquatic environment causes this fish has a special tool structure composed of bones, muscles and joints so as to support the movement. Murdy (1989) mentions that pectoral fins of amphibious fish (gelodok) have different muscles than muscles in non-amphibian fish. For example, in the pectoral fin of the mudskipper, the superficialis abductor muscle is divided into two parts with one has insertio on the dorsal fin fingers and the other has insertio on the ventral fin (pelvic) fingers. The existence of this muscle causes mudskipper able to control and move its pectoral fins flexibly when moving on land.

Different substrates and conditions in aquatic and terrestrial environments make the fish activity different to different habitats. The aquatic environment is affected by water pressure while in the terrestrial environment is affected by the force of gravity. Behavior / activity of *Periophthalmus variabilis* and *Boleophthalmus boddarti* in the mainland and in the water such as swimming, searching for prey / feeding, spawn, walking, and leaping are interesting to learn. Although some aspects of this fish already studied such as respiration, excretion, thermoregulation, and fluid balance, but so far there has been no research that discusses how the behavior / activity of fish gelodok *Periophthalmus variabilis* and *Boleophthalmus boddarti* in their habitat.

The study was conducted in September 2017. Gelodok fish taken from the river mouth area of Tluwuk Village, Wedarijaksa Subdistrict, Pati Regency, Central Java. Observations of the mechanisms of movement are carried out in their natural habitat and in the laboratory. The object of this research is fish population of *Periophthalmus variabilis* and *Boleophthalmus boddarti* at estuary of village of Tluwuk distric Wedarijaksa Pati. The subject of this research is the behavior of gelodok fish population including activities of moving, swimming, walking, feeding, jumping, reproducing, and nesting.

2. Experiments Procedure

Tools and material

The tool used in this research is camera, handycam, counter, watch, nets and stationery. The material used is the population of fish gelodok type *Periophthalmus variabilis* and *Boleophthalmus boddarti*.

Research methods and design

This research is descriptive research that aims to describe the data obtained from the observation and documentation in the field which then continued with the analysis. Data analysis is done by enriching the information, looking for causal relationships, comparing, and finding patterns on the basis of the original data obtained from the field (Sugiyono, 2004).

The method used in observing the activity of gelodok fish is scan sampling method and ad libitum method. Sampling scan method is a sampling method used to calculate the individual activity in a population that is done based on a certain time interval (Saputra, *et all,* 2015). while the ad libitum method is to record all activities at the time of observation by using activity constraints (Altmann, 1974).

Data collection technique

Data of fish behavior of gelodok at river mouth of Tluwuk Village is obtained from behavioral observation using scan sampling method, ad libitum and documentation result. The work steps of scan sampling and ad libitum are as follows:

a. Determine the location point / habitat of observation in terrestrial and aquatic
b. Determine the population of *Periophthalmus variabilis* and *Boleophthalmus boddarti*
c. Observed the behavior of 2 species of gelodok fish with time 120 minutes with interval 5 minutes.
d. Record the number of individual fish gelodok within 120 minutes with intervals of 5 minutes
e. Processing the observed data in graphical form
f. Analyze observational data

Analysis and interpretation of data

Data analysis is done by descriptive both quantitative and qualitative. Data result of fish behavior record of gelodok then analyzed by using method of percentage. Then the percentage is described in accordance with the objectives of the study.

3. Result and Discussion

The results of research that has been done shows there are some fish activity Periophthalmus variabilis and Boleophthalmus boddarti in aquatic and terrestrial areas. The activities are include walking, jumping, swimming, eating / catching prey, moving the fins, moving head, and inactive. Observation results activities of gelodok fish in detail presented in the following table.

Table 1. Comparison of fish activity gelodok generally in aquatic and terrestrial environments

No	Para-meter	Gelodok Fish			
		Peiophthalmus variabilis		***Boleophthalmus boddarti***	
		Time	(%)	Time	(%)
1	Activities on aquatic	108	90%	72	60 %
2	Activities on terestrial	12	10%	48	40%
Total		120	100%	120	100%

Table 2. Parameter of Comparison of specific fishing activities in aquatic and terrestrial environments

No	Parameter
1	Walking (a)
2	Jumping (b)
3	Climbing (c)
4	Feeding/catching prey
5	Swimming (e)
6	Fins movement Dorsal (f)
7	Fins movement Caudal (g)
8	Raising Operculum (h)
9	Predator escape (i)
10	Pergerakan kepala (j)
11	Inactive (k)
12	Nesting (l)

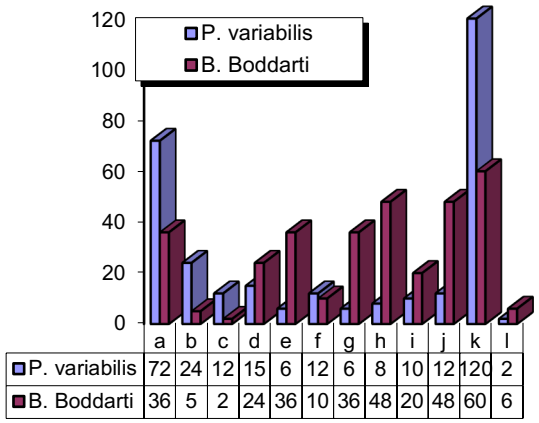

Figure 1. Graph of activity comparison of Fish gelodok *P. variablis* and *B. Boddarti*

The result of observation of fish population behavior of gelodok fish presented in table 1 and 2 shows that fish activity of *Periophthalmus variabilis* differs from *Boleophthalmus boddarti*. *P. varibilis* spends more time on land (90%) than in water (10%) whereas *B. Boddarti* activity is more in water (60%) than on land (40%). This behavior as reported by Aligaen (2011) that some mudskipper members of *Periophthalmus* genus spent most of his life on the mainland almost 90% of his life.

P. variablis fish activity observed in this study is running (24.08%), jumping (8.03%), climbing (4.01%), feeding / catching prey (5.01%), swimming (2.01%), moving dorsal fins

(4.01%), moving caudal fins (2.01%), enlarge operculum (2.67%), escape predator (3.34%), head movement (4.01%), entering hole (0,67%), and inaktif (40,13%). *P. variabilis* behavior is silent (inactive) as much as 40.13% in land, precisely under mangrove plant to avoid predators and other disturbances. Members of fish species of *Periophthalmus* and *Periophthalmodon* is on land when the tide is low. Then if the high tide they are in the hole (Polgar, 2009). High activity percentage is walking (24.8%), precisely during the day *P. variabilis* out of the hole walking with the help of pectoral fin to swing (propulsive / retracting and recovery / recover) as described by Pace and Gabe (2009) and use the pelvic fins to support the body. Feeding activity as much as (5.01%), according to Gordon *et all* (1985) most members of *Periophthalmus* are classified as carnivores that prey on fish and insecta in the intertidal area. These fish more often dwell under the mangrove trees while waiting and search for food (prey) in the form of small crustaceans and small insects. This fish has the ability to jump (8.03%) quickly when capturing prey and avoiding predators by way of bouncy (bend caudal fins) to get the force pushing his body. *Periophthalmus variabilis* fish has a unique ability that is able to attach / climb (4.01%) vertically on different substrates such as in mangrove roots, in rocks, in corals and bamboo stems. The fish is able to stick for several minutes with the help of pectoral fins that appear to be holding on to the substrate and supported by the presence of unfused pelvic sisip to scrape (suction) on the substrate. The ability to climb the substrate is due to the fact that *P. variablis* has flexible pelvic fins, strong grip / friction resistance and mucus (Wicaksono, *et all*, 2016). Sometimes the fish is attached only to pelvic fins without the use of pectoral fins, but is unable to survive in such a position. According Polgar (2012) this behavior is called the behavior of rest (perching behavior) and can last up to several minutes.

The *B. boddarti* fish activities observed in this study were walking (11.73%), jumping (1.63%), climbing (0.65%), eating / catching prey (7.82%), swimming (11 , 72%), moving dorsal fins (3.26%), moving caudal fins (11.72%), enlarging operculum (7.82%), escape predator (6.51%), head movement (15.63%), entering hole (1.95%), and inaktif (19,54%).
Boleophthalmus boddarti spends his time in the mud and in the aquatic regions (60%). According to Polgar (2012) members of *Boleophthalmus* live in areas where there is no vegetation, bright areas and no wet mud flow (low intertidal areas). *B. boddarti* has a habit of lifting dorsal fins (3.26%) when walking, winking, raising and shrinking the operculum (7.82), and making a jumping motion (1.63). The gelodok / Mudskipper has eye (vision) that can adapt in terrestrial and aquatic environments. Her eyes can blink as they are covered by the eye membrane to keep the eye moist (Abid *et all*., 2014). *B. Boddarti* has a fused fins structure which causes the area of the fin surface to be widened and narrowed the fin fins to be less flexible and this fish has a small friction force, so *B. boddarti* is unable to attach or climbing and supporting its body on a substrate vertically (Hidayat, 2015).

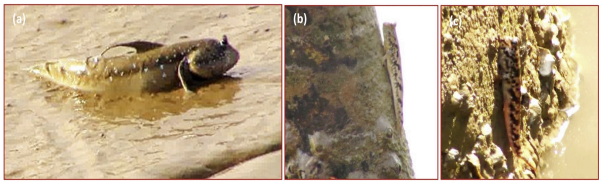

Figure 2. Fish activity *B. Boddarti* (a) and *P. variabilis* (b, c) (Wicaksono, *et. all*., 2016)

The observation also shows the activity of *B. boddarti* that is, at the time of the afternoon, this fish goes into the hole (1.95%) as the hiding place (nesting). In the morning *B. boddarti* exits the hole to the aquatic area to soak / swim in the water (11.72%) and feed (7.82%) in the mud. This fish often moves / runs (11.73%) along the sludge area with the help of its pectoral fins to swing as the forelimb functions on the tetrapod and uses the pelvic fin as its body support. The fish is feeding by turning its head right to left while opening its mouth. *B. boddarti* belong to a group of herbivores that feed on algae in water and in the mud. This is consistent with Ravi (2013) research that members of the genus *Boleophthalmus* are herbivores that feed on algae and diatoms on the surface of the mud in a

way moving his head (15.63%). Almost 50% of food found in the stomach is diatoms.

Behavior that has not been observed in this research is marrying behavior, In male gelodok has some kind of copulation tool on the genitals. After fertilization, the eggs of this fish are stored in the hole and guarded by the female parent. The eggs are sticky and cling to the mud walls. Gelodok fish generally do spawning seasonally and some do it up to twice a year. There are two parts in the fish gonad that develop in different times. Thus, once the glodok fish is spawn, there is still a part in its gonad that will prepare the next spawning to be performed within a period of about three months. After spawning, fish eggs gelodok stored in holes in the bottom of the waters and guarded by the parent. The eggs are sticky and stick to the mud walls and can reach 70,000 grains (Nasution *et, all,* 2016).

4. Conclusion

Based on the results of the research can be concluded that fish activities *P. variabilis* (v) is different from *B. Boddarti* (b). *P. varibilis* spends more time on land (90%) than in water (10%) whereas *B. Boddarti* activity is more in water (60%) than in land (40%).

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