Full Paper

FOOD HABITS OF THE YELLOW RASBORA, *Rasbora lateristriata*, (FAMILY: CYPRINIDAE) BROODFISH DURING MOVING TO SPAWNING GROUND

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Abstract

The purpose of this research was to clarify the food habits of yellow rasbora (*Rasbora lateristiata*) when moving into spawning site during spawning season. Specimens of yellow rasbora were collected between July and August, 2007 from spawning site surveys during spawning season in their natural environment which run yearly from April to August. There were 628 individual fish collected from spawning ground, and 30 of them were selected to analyze the gut content. Samples were preserved in alcohol solvent until identified their gut content in laboratory.

The results showed that yellow rasbora broodfish fed plankton continuously both in the day and night while moving into the spawning site. Percent Index of Relative Importance values indicated the most important prey items of yellow rasbora were phytoplankton (68.43%), and then zooplankton (29.79%), leaf cut (0.02%), little caterpillar (0.01%), insect larva (0.15%), and unidentified items (1.60%), respectively. Chrysophyta and protozoa was found the most dominant of phytoplankton and zooplankton in the gut content, respectively. Based to the ratio between gut length and total length, and the feeding mode, *R. lareritriata* is categorized to an omnivorous feeder.

Key words: Water properties, phytoplankton, Lakes Sentani

Introduction

Members of the genus *Rasbora* are widely distributed along the east and southeast area of the Asian continent (Kottelat, *et al*. 1993), as well as in Africa (Nelson 2006), and in Sumatra, Borneo, Java, Bali and Lombok. In Java island, this species was occured in several streams inhabitat in shallow area with relatively fast flowing water and plenty of gravel in riverbottom. *Rasbora lateristriata* (Cyprinidae) is riverine fish found in mountainous streams of Yogyakarta regency. It used to be an important protein source for communities residents in the old days. However, since the last decade, environmental degradation, heavy fishing, illegal use of poison, and fragmentation of rivers by construction of some dams along the habitat of this fish have driven it to the edge of extinction. Eventhough it hasn't officially been listed as an endangered species yet in Indonesia, however a sharp decline in numbers was occured since building the dams in same rivers, especially a dam found in the middle Ngrancah river (Triyatmo, *et al*. 1997; Setyobudi, 2000). Despite decreasing in individual numbers which lead to being an endangered species, *R. lateristriata* was little studied. A study program of *R. lateristriata* was initiated with the aim to understand the habitat conditions and use, reproduction (Djumanto et al. 2008), and feeding behavior of the fish.

Feeding studies can provide researchers with important insights towards understanding potential fishery impacts on freshwater. Information about feeding of spawner freshwater fishes in Yogyakarta regency, both in rivers and reservoirs, is rare. Yellow rasbora is one of the riverine fish, yet life history information is extremely limited for this species and its diet especially during spawning seasons are unknown.

The fish family cyprinidae has great economic importance in Central Java (Djumanto 2000). In Yogyakarta special regency, investigations on the biology of rasbora of this genus was rare (Triyatmo, *et al*. 1997; Setyobudi, 2000). The spawning behavior of *R. lateristriata* in the natural environment has been studied (Djumanto, *et al*. 2008), however there are still left some questions about the biology of *R. lateristriata*. This species has recently become important to the riparian communities of the Sermo Reservoir area of Kulon Progo regency principally because of its affordability, tasteful flesh and relative abundance in comparison with other genus in the river.

Tropic ecology is a key in evaluating the ecological role of a population or species in the community of any ecosystem. There is a general understanding that yellow rasbora occupy low trophic levels, the adults feeding mainly on phytoplankton and zooplankton

(Piet and Guruge, 1997). There have been some studies on the feeding habits of various rasbora species. However, these studies were usually superficial descriptions of yellow rasbora diets from the data of one season and or small samples which were unable to examine the variations spawning seasons and fish size classes. Also, little is known about the feeding habit of signal yellow

rasbora in central Java. A better understanding of the diets and rations of yellow rasbora is very important value to culture and useful in the assessment the potential ecological impact on the native communities. Therefore, there have been calls for detailed quantitative studies of the feeding habits of yellow rasbora.

The present study has examined the feeding ecology of the yellow rasbora in the river of Ngrancah, the major inlet river into Sermo reservoir. Emphasis was placed on assessing spawning season related feeding habits, as well as the feeding intensities daily ration and periodicities. We describe the composition of the diet of the yellow rasbora in terms of number, mass, and frequency of occurrence of the prey items.

Materials and methods

Description of study site

On the western side of Yogyakarta regency, Ngrancah River and its upstream tributaries form the major water system where yellow rasbora occurs. The Ngrancah River (7^{0}48’34”S and 110^{0}06’38’’E; Fig. 1) is the main river that water run through Sermo Reservoir. The stream is about 29 km long, but descends from a more than 1000 m high mountain area to the sea. It runs through hilly of Turgo goes into Sermo Reservoir in hilly of Hargowilis subdistrik, and then flows out from the dam to the Ngrancah River below the dam. The river then joint with some rivers and forming serang river with rivermouth in Indian ocean.

The station was selected based on occurring fish spawning site, the variety of habitats, and their accessibility. Samplings and observations were performed weekly from June to August 2007.

The study site was characterized by clean freshwater with fast flowing and gravel type riverbed. It was located between reservoir and sediment check dam erosion controlled nearly 500 m above the reservoir. Two climatic seasons, namely wet and dry season, was prevail in this area. Water elevated around 2.0 m during the rainy season and 0.5 m in the dry season.

Spawning site

To promote the brood fish to spawn, the spawning site was provided and constructed in the riversides around 500 m above the reservoir. The place for spawning site was selected that have clean water flows smoothly, shallow, available enough of sand and gravel, and no garbage around them. Spawning site was constructed

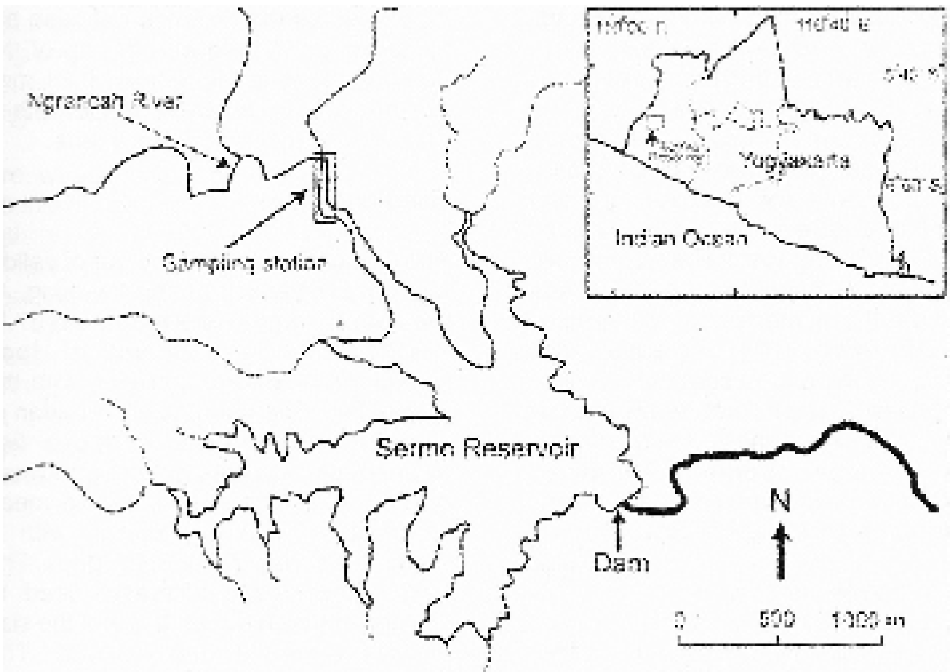

Fig. 1. A map showing sampling station located in Ngrancah River

from the sand, pebble and small stone which was arranged in oval shape around 2x3 m in size located at the depthless than 30 cm. The spawning site has one entrance gate where the fish trap was operated to catch the brood fish in the spawning site.

Fish sample

Fish were cathed using casenet in the evening from riverbed, and sampled using fishtrap made of bamboo in the spawning site after mating were completely finished. We caught female fish 148, and male fish 141 from riverbed, and female fish 109, and male fish 230 from spawning site during the period from June to August 2007. Information recorded for each specimen included measurements for total length (TL) to the nearest 0.1 mm, body weight and gonad weight (W) to the nearest 0.01 g.

To describe the type of feeding and diet in the gut, we grouped the sample fish based on size and sex, and then selected sum 30 individuals based on representation of the groups. The selected fish were analyzed by total length classes. Yellow rasbora 5.4-6.9 mm TL were grouped into small size classes, 7.0-8.9 mm TL were group into medium size classes, and then 9.0-11.2 mm TL were group into large size classes in order to enable the detection of minor changes in food habits apparent in these intervals of ontogeny.

The selected samples were measured for their gut length and total body length to the nearest 0.1 mm. The value of relative gut length (RGL) was calculated by ratio of gut length and total length. If the RGL is less then unity, the fish is a carnovorous while more the value RGL the fish tend to be herbivorous, and then an intermediate value indicates the omnivorous nature of the fish. To identify the food items, the gut contents of selected samples were identified and counted under a stereoscopic microscope and a compound microscope. The gut contents was poured into small glass volume. Then, one milliliter of gut content was taken out and put into a sadwich rafter glass for examination under a light microscope (x400). We used both the numeric and occurrence methods (Biswas 1993) to calculate the numeric (NF%) and occurrence (OF%) frequencies of each food item by total length class. We analyzed similarity in diets through species. Relative abundance was ranked based on occurring the specimens in the samples.

Food habits measurements

Stomach contents of each yellow rasbora were sorted and placed into the following functional categories: phytoplankton, zooplankton, insect, debris, and other. Plankton was defined as small, non-elusive, prey that occurred suspended in the water column. Phytoplankton was plant category of plankton, whereas zooplankton was animal category of plankton. insects were defined as members of the class Insect. The volumetric contribution of gut content was expressed as a percentage of whole stomach contents. Gut content volume (GF%) was estimated using water-displacement in graduated cylinders. Mouth gape measurement was done by open the mouth to its maximum capabilities. Gape height was measured as the distance between the tip of the premaxilia and the tip of the dentary bones to the nearest 0.01 mm. All measurements were made with a caliper on preservation specimens.

Results

The amounts of food in the gut of yellow rasbora broodstock during traveling to the spawning ground varied from 37.577.1%, and the amount of food consumed tended to increase with the size of fish. The numeric contribution of plankton to the diets of these fish (6.8-10. cm SL) was different between groups. This increase in group mean feed intake was associated with a marked increase in the mouth gape. The length body sizes increases lead to mouth gape were wider, therefore the size of food consume was increase. The amounts of food consumed by bigger size of broodfish, however, tended to reduce.

Fish tended to consume most of their food during the afternoon feeding and stay in the spawning ground, and towards the end of the spawning activities, the gut content was over 55% of the volume (Table 1). Most of feeding fish were registered as having fed inclusively during the night, bigger proportions were recorded as having fed during both day and night, and few fish were recorded as having consumed food exclusively during the hours of darkness. The remaining fish had eaten some food during the day and during the hours of darkness, although consumption tended to be greatest during the daytime.

There was a linier regression on the relationship of the total length to the mouth gape and feed size. Increasing total length of fish will be followed by increasing of mouth gape and feed size (Fig. 2). The line slope of linier regression of the body length size to the mouth gape was higher than to the feed size. However, fish tended to consume bigger size of food, and the size of food depended on the availability and kind. Bigger size of fish will select to the bigger size of food, hence the fish will get enough of food to fulfill the need for life.

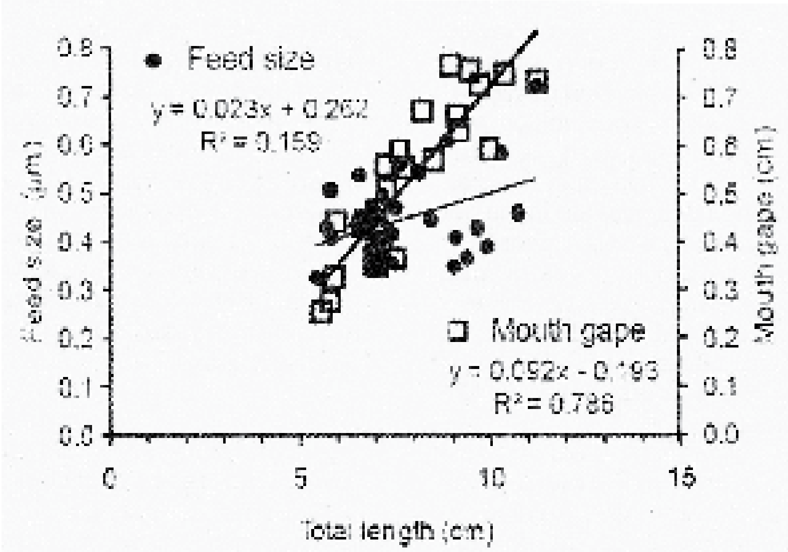

Fig. 2 The relationship between total length to the feed size and mouth gape of yellow rasbora broodfish

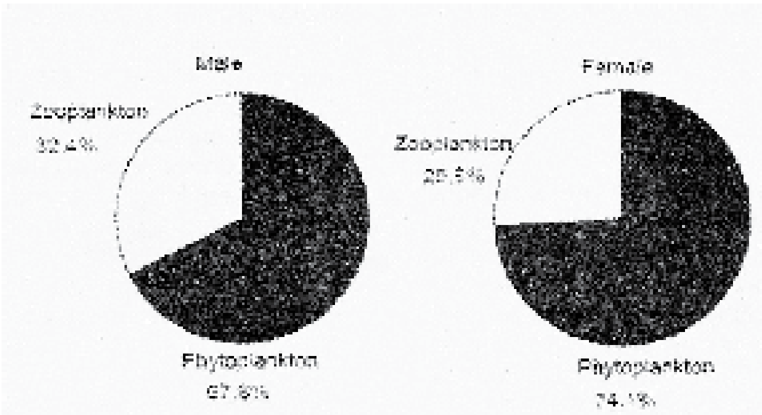

Fig. 3 The percentage of zooplankton and phytoplankton in the diet of yellow rasbora broodfish

Plankton accounted for the most dominant of the diet in both male and female of yellow rasbora broodfish. Female was more than 32% of the diet consisting of zooplankton, on the other hand male was less than 25% of the diet comprised of zooplankton (Fig. 3). In contrast, female was more than 74% of the diet consist of phytoplankton, whereas male was more than 67% of the diet comprise of phytoplankton.

Food composition of the diet showed variation among size group of body length (Fig 4.). The main food items that caused the variation, zooplankton and phytoplankton, showed similar variations in their proportion in the diet. The proportion of zooplankton in the gut of *male yellow rasbora* was higher than female, however the numbers of food items consume were decrease in male fish, and in contrast was increase in female fish. The proportion of zooplankton in bigger size of female fish was decrease, on the other hand was increase in male fish. Gut content analysis showed the yellow rasbora was an opportunistic omnivore, feeding on various plankton associated prey organisms. Small size (≤7.0 cm SL), medium (7.0-9.0 cm SL) and large (≥ 9.0 cm SL) had distinct feeding patterns. Overall, phytoplanktons were both the most frequently eaten prey and contributed the greatest volume in all size classes sampled.

Both male and female of yellow rasbora brood fish fed mainly phytoplankton with 58.2% consisting of genus belong to divisi chrysophyta, and then followed by divisi chlorophyta about 17.7%, and class euglenophyta about 15.8% in all the guts sampled (Fig. 5). Cyanophyta despite being present in the diet was less important comprising about 6.0%. Other food such as, leaf cut and debris, consisted of 2.3% in the diet.

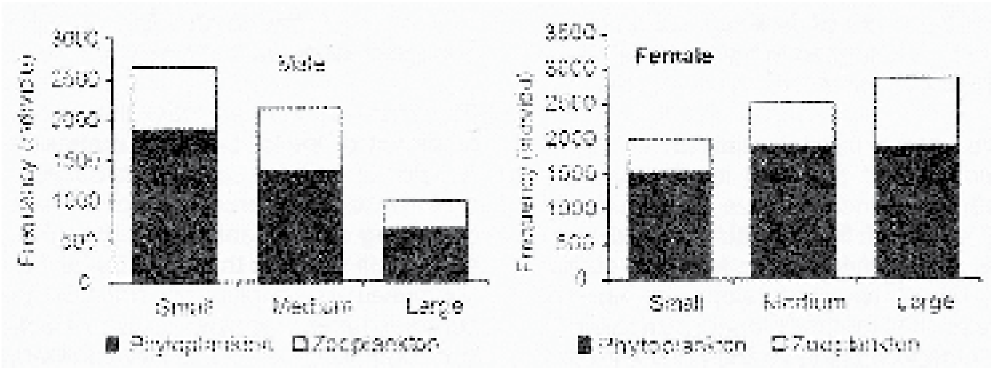

Fig. 4 Food composition in the diet yellow rasbora brood fish in different size of body length

Zooplankton was consisted of some type of food. Phylum *protozoa* were the most commonly eaten of zooplankton and numerically contributed most (76.6%) to the diet and followed by class rotifera (13.1%) then cladocera (9.7%). Others zooplankton prey such as insect, contributed little numerically 0.5%. There was evidence of occasional feeding within the surface water on the meroplankton such as mosquito larva and caterpillar.

Yellow rasbora was the omnivorous species that exhibited significant variation in feeding of phytoplankton and zooplankton (Appendix 1). However, phytoplankton was consumed much number than zooplankton. Phytoplankton was containing divisio of chrysophyta, chlorophyta, euglenophyta, cyanophyta, and other, while zooplankton was composed of phylum protozoa, class rotifer and cladora, and other. There were 18 genus in divisio chrysophyta, followed by 24 genus in divisio chiorophyta, and then 9 genus in euglenophyta, and 7 genus in cyanophyta.

Divislo chrysophyta was consist of 24 genus, and the most dominant was *Synendra* sp.*and Nitzschia* sp. with number frequency and occurrence frequency was 26.4%,13.4% and 100%, 100%, respectively. Other genus in chrysophyta composed only small proportion with number occurrence less than 9.0%. Although genus *Surirulla* and *Tabellaria* in the divisio chrysophyta were consist only small proportion in the diet, however the occurrence frequency that genus was 100% showing each fish consumed for their diet.

In the divisio chlorophyta was found the genus *Chlorococum* the most dominant with number frequency 23.3% and occurrence frequency 76.7%, followed by *Oocystis* with number frequency 12.0% and occurrence frequency 50.0%, and then followed by genus *Coelastra* with number frequency 10.9% and occurrence frequency 60.0%. Although the number frequency of genus *Staurastrum* was 10.2%, but occurrence frequency found the most at amount 90%.

Divisio euglenophyta was the third dominant of phytoplankton in the diet, and genus *Euglena* was found the most dominant with number frequency 73.4% and occurrence frequency 93.3%, and other genus composed only small proportion with number frequency less than 8.2%. In the class cyanophyta, genus *Merismopedia* was found the most dominant with number frequency 76.2% and occurrence frequency 96.7%, and followed by *Anabaena* with number frequency 16.8% and occurrence frequency 63.3%. Other genus in cyanophyta consist only small proportion with number frequency less than 3.2%.

Other food found in the diet was unidentified food and leaf cut, which found in small size of fish.

Zooplankton was found in the diet and consists of some classes, and a class protozoa was the most dominant followed by rotifera and cladocera. Genus *Difflugia* belong to class protozoa was found the most dominant with number frequency 35.9% and occurrence frequency 100%, followed by *Verticella* and *Nebela* with number frequency 16.5%, 9.2%, and occurrence frequency 93.3%, 83.3%, respectively. Stentor, despite being present in the diet, was less important both in number frequency (5.7%) and in occurrence frequency (76.7%). *Rugipes* sp. was most often eaten with number frequency 5.8% and occurrence frequency 53.3% to the diet (Appendix 1). *Centropyxis* and *Lesquereusia* were also frequently eaten (4.5% and 4.3%), yet were roughly important numerically (63.3% and 86.7%, respectively) and few *Ophrydium*, *Campanella* and *Leucophrydium* were consumed. Other protozoan prey such as *Tintinnopsis*, despite being common in the diet, contributed little numerically (0.5%).

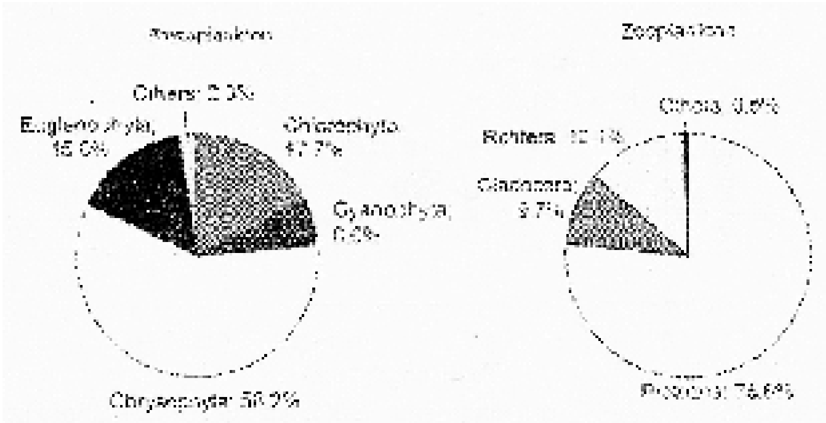

Fig.5 The type of food found in the diet of yellow rasbora brood fish

Although the omnivore small pelagic fish had diet changes in their gut contents, only the proportions of phytoplankton and zooplankton in the gut of yellow rasbora varied significantly.

No macrophytes were found in the guts of fishes collected both in the spawning ground and spawning site. In the spawning ground the proportion of phytoplankton was higher while the proportion of zooplankton was lower than during the day. The diet of the brood fish of yellow rasbora was the high proportion of phytoplankton at dusk and zooplankton at dawn after spawning takes place, this fish showed significant diel changes in feeding behavior during spawning season.

The relationship between gut length and total length of yellow rasbora showed the proportion of gut length to the total length less than one (Fig. 6) with equation Y=0.92x+0.533. Increasing total length will be followed by gut length in equal proportion. Based on the proportion of gut length to total length, the fish was categorized as omnivore and feeding mainly phytoplankton and zooplankton. The fish feed actively both during the day and night, and there were diel variation on composition of food, however the proportion of phytoplankton was higher than others. The fish was actively feed in the upper layer of water body and shoreline of the reservoir. Yellow rasbora was mainly diurnal feeder and feeding activity evenly distributed over the 24-hour period. The typical diurnal feeders was active from dawn until dusk. For most of the diurnal feeders their activity was based on their gut fullness and inversely related to proportion of digested matter.

Discussion

Food composition of adult yellow rasbora showed plankton was the main item of the diet. Fish mostly fed on phytoplankton and zooplankton both during the day and night. Phytoplankton as energy source of yellow rasbora numerically has higher proportion on the diet than zooplankton. Besides that, plankton is principally primary producers in food chain at waters,

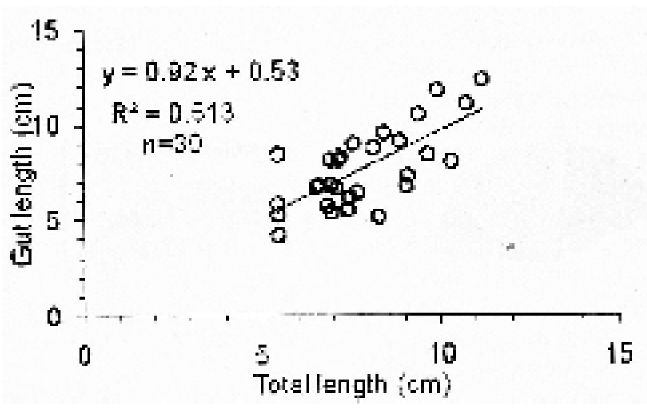

Fig. 6 The relationship between gut and total length of yellow rasborra brood fish collected from spawning ground.

so the herbivore and omnivore fish use plankton as energy source (Mann, 2000). Yellow rasbora was the ones of the primary consumer in the base of pyramidal ecology. Also, yellow rasbora was as prey for predator fish, such as snake head and red devil, formed a food chain in the ecosystem of reservoir. The presence and absence of yellow rasbora will affect to other fishes due to contribution of energy flow into the ecosystem. Therefore, yellow rasbora has played an important role for fish community forming in Sermo reservoir which the main water source input is Ngrancah river.

Ngrancah river, like on many other rivers in Yogyakarta, is characterized by a steep topography, which results in a short run, fast and varying seasonal water flow. The strong water flow that is governed by heavy rainy erodes the bedrock on its way to the narrow floodplain (10-30 km wide) and creates a series of deep pools connected by riffles and runs in the mountain area.

This habitat provides the fish not only with high levels of dissolved oxygen, but also calm feeding, resting and breeding grounds (Kido,1997). Nevertheless, the fish still have to tolerate a wide range of dramatic environmental changes caused by heavy rains, such as floods and muddy water.

Yellow rasbora move to the upper reaches of its range during, early dry season and to stay at lower pool during the cool temperature occurred in the early dry season. By the end of the rainy season would increase of water transparency which could create benefits fish by supplying a clean and freshly water lead to produce a great variety of spawning ground and abundant food such as plankton (Han *et al*., 2002). In the case of Yellow rasbora, the end of rainy season could be equally important for dispersal of their progeny, providing the heavily crowded larva of with a migration path to the upperparts of the stream and an opportunity there to exploit new resources.

The presence or absence of a species relates to the microhabitat of the area was affected by local habitat for feeding ground, spawning ground and nursery ground, and escaping from predator (Han et al., 2002). The substrate components in a habitat might be a more determining factor than others. In this study, yellow rasbora brood stock moved to the upper stream to find out the spawning site and foraged prey during the day and night. These places provided brood stock not only for spawning, but also for forage the prey, and provide shelter for the progeny (Huskey and Turingan, 2001). The brood stock needed to denser of plankton, the presence of small pebble, shallow water column, and clean freshly water to lay out the eggs during spawning season.

Spawning at the end of the rainy season would have advantages. It would reduce the risk for the offspring to grow in rough conditions. The larva would not be swept away by fast water flow, and they would have time to grow during dry season to become the size that can withstand the floods in the following rainy season. In addition the plankton at the spawning grounds grew well throughout the year and would provide plenty of food for the larva even in the dry season. A similar timing of spawning was also occurred for other local fish species and reported for other cyprinids in southern India (Harikumar *et al*., 1994).

The gravel in riverbed along upstream was provides a habitat of low velocity flow to prevent drifting of fertilized egg and yolk sac larva downstream since their swimming ability is weak. In addition, predation risk for yolk sac larva occupying shallow areas may be lower because larger fish tend to avoid these areas (Harvey 1997). Adult yellow rasbora fed on the zooplankton and phytoplankton that grew on rocks in all seasons. The uptake of insect larvae was probably unintentional, on the other hand, fed on phytoplankton, zooplankton, insect larvae and adult insects. The general feeding habit of yellow rasbora could be considered an omnivorous since the gut contain was composed of phytoplankton and zooplankton, and the proportion of the gut length and total length was almost unity. Yellow rasbora distributed at higher altitudes, more than 800 m, and sometimes higher than 2000 m (Kottelat *et al*., 1993). It could tolerate a water temperature lower than 20° C. The low water temperature in tributaries at high altitudes might increase dissolve oxygen, but limit growth of phytoplankton. Therefore, yellow rasbora became adapted to a general diet when invading the upper stream with limited food, while became an omnivorous in utilizing the abundant phytoplankton and zooplankton in the upstream.

Annual rainy season in Yogyakarta falls between October and March, creatinc periodical floods along tributaries and rivers. The intensity of flow could affect the survival of larva and juvenile fish, since the larva fish was very weak. Yellow rasbora brood stock took advantage by spawn in the end of the rainy season. It suggesting the spawning site of yellow rasbora characterized by dense of plankton, clean freshly water, shallow area, gravel river bed, cooler-water, usually 2-3° C lower than daily average temperature, the slower water flow, the narrower stream with more shallow sandy-pebble flats, and the more abundant plankton growth, would be important for the success of reproduction.

Conclussion

Yellow rasbora was omnivorous feeder, diet composed of phytoplankton and zooplankton, proportion of gut length to total length was unity. Phytoplankton in the diet was dominantly by chrysophyta, and then chlorophyta and euglenophyta, while zooplankton was dominantly by protozoa and rotifera. The fish fed continuously during the day and night. Increasing of total length will follow by mouth gape and food size, however bigger fish tended to selective to the kind of food.

Recommendation

It is suggested to conserve the spawning habitat of the yellow rasbora located in the inlet of reservoir along Ngrancah river.

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Appendix 1 **Ini ketiknya belum selesai**

	Phytoplankton	No	NF%	OF%
I	Chrysophyta			
1	Campylodiscus sp.	458	8.5	93.3
2	Cylclotella sp	27	0.5	26.7
3	Cymatopleura sp.	48	0.9	16.7
4	Cymbella sp.	27	0.5	30.0
5	Diatom sp.	277	5.2	83.3
6	Epithemia sp	371	6.9	96.7
7	Fragillaria sp.	14	0.3	6.7
8	Frustulia sp.	26	0.5	16.7
9	Mallomonas sp.	1	0.0	3.3
10	Melosira sp.	481	9.0	96.7
11	Navicula sp.	128	2.4	70.0
12	Nitzchia sp.	717	13.4	100
13	Pinnularia sp.	11	0.2	6.7
14	Stauroneis sp.	30	0.6	43.3
15	Surirella sp.	328	6.1	100
16	Synedra sp.	1416	26.4	100
17	Tabellaria sp.	910	17.0	100
18	Tribonema sp.	93	1.7	50.0
	Total	5363	100	
II	Chlorophyta			
1	Asterococcus sp.	7	0.4	6.7
2	Basicladia sp.	1	0.1	3.3
3	Chlorella sp.	23	1.4	13.3
4	Chlorococum sp.	379	23.3	76.7
5	Closteridium sp.	18	1.1	26.7
6	Closteriopsis sp.	54	3.3	46.7
7	Coelastra sp.	178	10.9	60.0
8	Crucigenia sp.	74	4.5	63.3
9	Microspora sp.	71	4.4	56.7
10	Oocystis sp.	195	12.0	50.0
11	Pediastrum sp.	13	0.8	26.7
12	Planktosphaeria sp.	63	3.9	46.7
13	Protococcus sp.	80	4.9	46.7
14	Scenedesmus sp.	1	0.1	3.3
15	Schizogonium sp.	14	0.9	3.3
16	Sphaerrocystis sp.	11	0.7	6.7
17	Spirogyra sp.	35	2.1	23.3
18	Staurastrum sp.	169	10.4	90.0
19	Cosmarium sp.	80	4.9	66.7
20	Desmidium sp.	99	6.1	30.0
21	Hyalotheca sp.	22	1.3	3.3
22	Micrasterias sp.	38	2.3	33.3

	Zooplankton	No	NF(%)	OF(%)
I.	Protozoa			
1	*Arcella* sp.	261	8.6	93.3
2	*Campanella* sp.	89	2.9	80.0
3	*Centropyxis* sp.	135	4.5	53.3
4	*Chilodontopsis* sp.	4	0.1	6.7
5	*Cothurnia* sp.	4	0.1	10.0
6	*Difflugia* sp.	1083	35.9	100
7	*Euglypha* sp.	13	0.4	6.7
8	*Lesquereusia* sp.	130	4.3	66.7
9	*Leucophrys* sp.	5	0.2	6.7
10	*Leucophrydium* sp.	42	1.4	33.3
11	*Lionotus* sp.	4	0.1	6.7
12	*Nebela* sp.	278	9.2	83.3
13	*Ophrydium* sp.	100	3.3	60.0
15	*Polyoeca* sp.	1	0.0	3.3
16	*Radiophrys* sp.	6	0.2	3.3
17	*Rugipes* sp.	174	5.8	53.3
18	*Stentor* sp.	171	5.7	76.7
19	*Tintinnopsis* sp.	14	0.5	23.3
20	*Trachelophyllum* sp.	4	0.1	6.7
21	*Trichodina* sp.	1	0.0	3.3
22	*Vorticella* sp.	499	16.5	93.3
Total		3018	100	
II. Rotifera				
1	*Ascomorphella* sp.	53	10.3	70.0
2	*Brachionus* sp.	136	26.3	73.3
3	*Eosa* sp.	20	3.9	13.3
4	*Epiphanes* sp.	5	1.0	6.7
5	*Filinia* sp.	157	30.4	93.3
6	*Hexarthra* sp.	1	0.2	3.3
7	*Kellicottia* sp.	2	0.4	3.3
8	*Keratella* sp.	41	7.9	40.0
9	*Leucophrydium* sp.	33	6.4	36.7
10	*Polyarthra* sp.	2	0.4	10.0
11	*Rotaria* sp.	25	4.6	40.0
12	*Trochocarce* sp.	42	8.1	50.0
Total		517	100	
III. Cladocera				
1	*Ceriodaphnia* sp.	1	0.3	3.3
2	*Daphnia* sp.	230	60.1	93.3
3	*Moina* sp.	152	39.7	93.3
Total		383	100	
IV.	Others			
1	insect	20	95.2	6.7
2	Caterpillar	1	4.8	3.3
Total		21	100	

23	Onychonema sp.	4	0.2	6.7
24	Pleurotaenium sp.	1	0.1	3.3
	Total	1630	100	
III	Euglenophyta			
1	Chlamydomonas sp.	5	0.3	6.7
2	Dinobryon sp.	68	4.7	20.0
3	Euglena sp.	1065	73.4	93.3
4	Gonyaulax sp.	119	8.2	46.7
5	Monomastrix sp.	11	0.8	10.0
6	Peridinium sp.	102	7.0	50.0
7	Phacus sp.	23	1.6	26.7
8	Trachelomonas sp.	3	0.2	6.7
9	Volvox sp.	55	3.8	13.3
	Total	1451	100	
IV	Cyanophyta			
1	Anabaena	93	16.8	63.3
2	Chroococcus sp.	2	0.4	10.0
3	Coelospaerium sp.	1	0.2	3.3
4	Merismopedia sp.	422	76.2	96.7
5	Nostoc sp.	18	3.2	10.0
6	Polycystic sp.	14	2.5	16.7
7	Symploca sp.	4	0.7	6.7
	Total	554	100	
V	Others			
1	Unidentified	210	98.6	36.7
2	Leaf cut	3	1.4	3.3
	Total	213	100	