Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 3, No. 12, p. 238-244, 2013
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

The dynamics of plankton compositions in juvenile-larvae gut of marble goby fish (*Oxyeleotris marmorata* Bleeker) collected from Hampalam river and pond in Kapuas Regency, Central Borneo

Evi Veronica[1*], Amin Setyo Leksono[2], Soemarno[3], Diana Arfiati[4]

[1]*Agriculture Science Graduate Program, Brawijaya University, Malang, Indonesia*

[2]*Department of Biology, Faculty of Mathematic and Natural Sciences, Brawijaya University, Malang, Indonesia*

[3]*Department of Soil Science, Faculty of Agriculture, Brawijaya University, Malang, Indonesia*

[4]*Faculty of Fisheries and Marine Science, Brawijaya University, Malang, Indonesia*

Article published on December 23, 2013

Key words: CROPGRO, soybeans, simulation, yield, sowing date.

Abstract

Appropriate and required feed types are optimally needed to support the viability and growth of Marble Goby Fish (Oxyeleotris marmorata). This research aimed to analyze species, composition, dynamic and density of plankton in gut of Marble Goby juvenile-larvae from Hampalam River and communities' dykes of Batanjung Village, Kapuas Regency, Central Borneo in 6 stations for 13 months. Abundance, diversity index (H'), evenness index (E), dominance index (D), and Morisita index were estimated. Plankton abundance and composition in gut of Marble Goby juvenile-larvae are 70% zooplankton and 30% phytoplankton. Relation of larvae length to plankton density in gut is significant. Paracalanus is the highest importance value of zooplankton (55%), while Merismopedia and Amphipleura are the highest of phytoplankton, 44.4% each. Zooplankton average value of H', E and D are 2.17, 0.85 and 0.14, respectively. Whereas phytoplankton average value of H', E and D are 1.52, 0.74 and 0.27, respectively. Cluster analysis based on Morisita Index implies indifferent feed consumption of Marble Goby on zooplankton composition. On the contrary, phytoplankton feed composition change along with the larval length. Those indicate that Marble Goby consume zooplankton continuously.

***Corresponding Author:** Evi Veronica ✉ evie_plk@yahoo.com

Introduction

Marble goby fish *Oxyelotris marmorata* Bleeker is one of the numerous fishes of the family Gobiidae in the stream and estuary in Borneo Island. This fish is one of economically important fish species in Borneo and its demand is currently increasing. Unfortunately, the fish consumption in Indonesia relies on the natural supplies, because larval survival rate is low.

One methods of conserving fish diversity in the river and stream is to control human activities by reducing fishing capacity to appropriate levels (Pauly *et al.*, 2002). Recently, several efforts have been conducted to domesticate this fish (Tavarutmaneegul and Lin, 1988; Chumaidi and Priyadi, 2003; Azwar *et al.*, 2007). The hatchery operations have been carried out by natural and artificial spawning. In those studies, hatching rate may reach 80-90% but larval survival rate fell into only 10% with the highest mortality occurred in age of 4-5 days. Furthermore, high mortality of the larvae is occurred during critical phase when the larvae starting to consume exogenous food. This situation could be due to limitation of right food for very small larval mouth opening (± 100 μm). In addition, passive feeding habits of the bottom fish are also suspected to cause of the low fish survival (Djamhur, 1992). The larvae tended to feed the most suitable food in surrounding environment.

Appropriate and required food types are optimum needs to support the viability and growth of fish larvae. Therefore, in order to address the problems above, it was necessary to study the dynamics of the plankton composition in the gut of fish larvae from Hampalam River and pond with the aim to analyze the type, composition, dynamics of plankton and the density of larval-juvenile fish.

Methods

This research was conducted in May 2011 to May 2012. Juvenile-larvae were collected every month from Hampalam River and pond in Batanjung Village, Kapuas Regency (03°21' S and 114°14' E). Research locations were consisted of 6 stasions, five located in upstream to estuary and a station located in local pond at the side of the stream.

Plankton of Water and Marble Goby's Gut

The 30 liters of river or pond water were filtered using 20 μm sized plankton net to obtain indigenous planktons. The filter was inserted into the bottle and added with 20 ml of 1% Lugol. Marble Goby juvenile-larvae were collected by using hand net prior to analyze of gut content. Collected juvenile-larvae were dissected and then gastric content filtered with 40 μm and 50 μm sized plankton net to obtain planktons.

The juvenile-larvae were grouped into 6 classes based on total fish length, as follow: Class I: 7.0-9.5 mm; Class II: 9.6-14.5 mm; Class III: 14.6-19.5 mm; Class IV: 19.6-24.5 mm; Class V 24.6-29.5 mm; Class VI: >29.6 mm. Water samples from rivers and ponds, and plankton samples from the gut were analyzed in the laboratory using a microscope to determine the type of phytoplankton and zooplankton according to identification book by Newell and Newell (1963); Yamaji (1982); Bold and Wynne (1985).

Data analysis

Plankton abundance was estimated using the formula according to APHA (1985). Diversity was calculated by using a Shannon-Wiener diversity index, Dominance index was estimated by using, while similarity was estimated using Morisita Index (Krebs, 1989). Regression analysis was conducted to determine the affect of total larvae length to the abundance of gut plankton. We compared abundance and species richness between juvenile-larva classes by adopting analysis of variance (ANOVA).

Results and discussion

A. Species, Composition and Density of Gut Plankton

During 13 months sampling, 81 individuals of juvenile-larvae of Marble Goby fish were collected. Natural food in juvenile-larvae gut were consisted of 15 genera of zooplankton (4 Phylum, i.e. Copepoda, Rotifera, Cladocera and Insecta), and 11 genera of phytoplankton (3 Phylum, i.e. Chrysophyta, Cyanophyta and Chlorophyta). Table 1 showed the species composition and abundance of zooplankton and phytoplankton from juvenile-larva gut.

Fig. legends

Class I = 6.6 - 9.5 mm
Class II = 9.6 - 14.5 mm
Class III = 14.6 - 19.5 mm
Class IV = 19.6 - 24.5 mm
Class V = 24.6 - 29.5 mm
Class VI = 29.6 - 47.0 mm

Table 1. Species composition and density (ind/L) of zooplankton and phytoplankton in Mable Goby juvenile-larvae gut.

Organism	***Genus/Species***	***Phylum/Divisio***	***Density (ind/L) in each Class of fish length***					
			I	**II**	**III**	**IV**	**V**	**VI**
Zooplankton	*Paracalanus*	Copepoda	17	26	23	29	33	32
	Chironomus	Insecta	2	12	11	11	7	18
	Keratella	Rotifera	6	11	8	9	9	15
	Calanus	Copepoda	8	15	16	10	10	9
	Daphnia	Cladocera	13	4	5	5	3	6
	Nauplius	Copepoda	7	3	7	5	2	4
	Trichocerca	Rotifera	6	3	2	3	3	3
	Mormonilla	Copepoda	7	5	5	3	7	1
	Cyclops	Copepoda	7	3	7	8	9	1
	Brachionus urceolaris	Rotifera	8	3	2	2	2	1
	Testudinella	Rotifera	7	4	5	4	5	1
	Wolga spinifera	Rotifera	0	3	2	3	0	1
	Monostyla bulla	Rotifera	0	0	2	2	4	1
	Lecane	Rotifera	6	3	2	3	3	1
	Drepanathrix	Cladocera	6	5	3	3	3	1
Total Abundance (ind/L)			13.75	37.27	43.93	51.90	57.23	63.70
Phytoplankton	*Oscillatoria*	Chyanophyta	13	28	11	0	0	29
	Merismopedia	Chyanophyta	13	0	22	26	24	26
	Navicula	Chrysophyta	13	10	6	5	4	10
	Amphipleura	Chrysophyta	9	13	6	5	6	9
	Eunotia	Chrysophyta	9	13	9	11	6	9
	Chlorella	Chlorophyta	18	16	22	13	28	8
	Nitzschia	Chrysophyta	0	0	4	13	8	5
	Pleurosigma	Chrysophyta	9	7	7	8	8	5
	Cymbella	Chrysophyta	0	0	7	6	4	0
	Gyrosigma	Chrysophyta	7	6	6	7	8	0
	Synedra	Chrysophyta	9	7	0	6	4	0
Total Abundance (ind/L)			10.50	15.23	24.44	21.07	25.17	19.58

Note:

Class I (6.6-9.5mm); Class II (9.6-14.5 mm); Class III (14.6-19.5 mm); Class IV (19.6 – 24.5 mm); Class V (24.6-29.5 mm); Class VI (29.6-47.0 mm).

Composition of zooplankton and phytoplankton in gut of Marble Goby juvenile-larva respectively are 70% and 30%. It means that juvenile-larvae of Marble Goby in Hampalam River and local food mostly as carnivore. Zooplankton composition of Rotifera, Copepoda, Cladocera, Insecta in gut of Marble Goby were 47%, 33%, 13% and 7%, respectively. While phytoplankton composition of Chrysophyta, Cyanophyta and Chlorophyta, were 73%, 18% and 9%, respectively.

Regression analyses for gut zooplankton showed that total larval length was positively correlated with zooplankton densities (y = 13.199 + 1.5108x; *P = 0.014*). The highest zooplankton density was found in Class VI and the lowest was in Class I. *Paracalanus* of Phylum Copepoda is the most abundant zooplankton genera. Phytoplankton densities was not positively correlated with total larval length (y = 13.31 + 0.2913x; P = 0.224). Phytoplankton density was uneven, however the highest density found in Class V and the lowest density in Class I. Highest genera density is *Merismopedia* of Phylum Chyanophyta.

Both regression analyses showed that zooplankton density was highly correlated to larva length level of Marble Goby, which implied that Marble Goby larvae food is zooplankton (carnivore). It was explained similarly in Emmanuel and Ajibola (2010) that many of Gobies were carnivorous, several are omnivorous and a few are herbivorous. Small benthic invertebrates and algae were common food of medium-sized gobies living near shore. In contrast, tropical reef-dwelling species may have very specialized food habits. Species living in freshwater streams and lakes often feed on diatoms and other microalgae. Effendi (1997) specifically mentions that larvae feed depend on available feed in water. Zooplankton and Phytoplankton are natural feeds for Gobies. Komarudin (2000) explained that Marble

Goby food was evolved by age. Mature gobies eat other fish, Crustacea, and water insect.

A. Dynamics of Gut Plankton

Cluster analysis based on Morisita Index implies indifferent feed consumption of Marble Goby on zooplankton composition (Fig. 3a). On the contrary, phytoplankton composition change along with the larval length (Fig. 3b); that meant composition dynamics of phytoplankton food was occurred through larval length. Those indicated that Marble Goby consume zooplankton continuously.

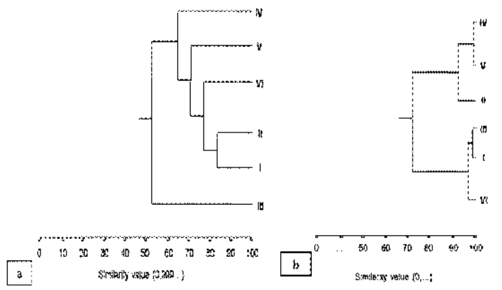

Fig. 1. Similarity of composition of plankton among different length size class of Marble Goby juvenile-larvae gut (a) Zooplankton, (b) Phytoplankton

Importance value was used to determine role amount of a species relatively to others in its community. The higher importance values of a species, the more major role its hold for its community (Fachrul, 2007). *Paracallanus* resulted as the highest important value of zooplankton for 55.7%. Next to *Paracallanus, Chironomus* hold the second important role which dominates in zooplankton as Marble Goby natural feed (Table 2). While both *Merismopedia* and *Amphipleura* is the highest importance of phytoplankton, each 44.4% (Table 3). Both phytoplanktons were affected by current fish catch. Compared to previous researches, natural feed of Marble Goby larvae are *Coelastrum* sp., *Paramaecium* sp, *Brachionus* sp. *Moina*, *Daphnia*, and less *Chlorella* sp. and *Eudorina* sp. (Insan *et al.*, 2000; Azwar *et al.*, 2007; Kanazawa, 1988; Chumaidi and Priyadi, 2003; Tavarutmaneegul and Lin, 1988; Pamungkas, 2004).

B. Diversity, Evenness and Dominance Indexes of Gut Plankton

Diversity, Evenness and Dominance Indexes in this research describe community characteristics and variation of natural larval food biologically. Zooplankton diversity index range 1.60 to 2.42, while dominance index 0.11-0.17, and evenness index is 0.79-0.89. On the other hand, phytoplankton diversity shows 0.88 to 1.87 index, dominance 0.15-0.47 and evenness 0.54-0.90 (Table 4). Zooplankton diversity is range from low to medium diversity, with low dominance and high evenness. It assumes that zooplankton species in 6.6 - 47 mm Marble Goby larvae's feed is diverse. Otherwise, phytoplankton species has low diversity, no dominance and high evenness.

Table 2. Relative and Importance Values (%) of Zooplankton genera in Mable Goby juvenile-larvae gut.

Genus	Relative Values (%)			
	Density	Frequency	Dominancy	Importance
Paracalanus	28.9	16.7	10	55.7
Chironomus	10.6	12.8	22.86	46.3
Calanus	12.7	14.7	10	37.4
Keratella	10.3	10.3	10.6	31.2
Cyclops	5.1	6.2	6.36	17.7
Miscellanies	32.3	39.3	40.17	111.5

Table 3. Relative Values of Phytoplankton genera in Mable Goby juvenile-larvae gut.

Division	*Organism*	*Relative Values*			
		Density	Frequency	Dominancy	Importance
CHLOROPHYTA	*Chlorella*	11.11	11.11	11.11	33.3
CHRYSOPHYTA	*Amphipleura*	14.81	14.81	14.81	44.4
	Gyrosigma	11.11	11.11	11.1	33.3
	Navicula	11.11	11.11	11.11	33.3
	Eunotia	7.4	7.41	7.4	22.2
	Nitzschia	7.41	7.41	7.4	22.2
	Pleurosigma	7.41	7.41	7.4	22.2
	Synedra	7.41	7.41	7.4	22.2
	Cymbella	3.7	3.70	3.7	11.1
CHYANOPHYTA	*Merismopedia*	14.81	14.81	14.81	44.4
	Oscillatoria	7.41	7.41	7.4	22.2

ANOVA analysis on zooplankton density for every length class is significantly different (p value = 0.041 < 0.05), which is increased along with length increasing. Otherwise, zooplankton density was indifferent to other variables, such as taxa number, diversity (H), dominance (D) and evenness (E). Similar to zooplankton, phytoplankton density only different significantly to length class (p value = 0.017 < 0.05), but indifferent to taxa number, diversity, dominance and evenness. This study showed that species richness and diversity of Marble goby food consistent trough class size. It suggest that this species is polyphagous fish feed on both zooplankton and phytoplankton.

Table 4. Diversity, dominance and eveness of zooplankton and phytoplankton in Mable Goby juvenile-larvae gut based on the length size class.

Index	Total Larval Length											
	I		II		III		IV		V		VI	
	Zoo	Phyto	Zoo	Phyto	Zoo	Phyto	Zoo	Phyto	Zoo	Phyto	Zoo	Phyto
H'	1.60	0.88	2.32	1.74	2.42	1.87	2.35	1.53	2.27	1.87	2.15	1.18
D	0.16	0.15	0.13	0.29	0.11	0.20	0.13	0.36	0.15	0.22	0.17	0.47
E	0.82	0.90	0.86	0.76	0.89	0.81	0.87	0.64	0.86	0.81	0.79	0.54

Ex.: H = Diversity Index, D = Dominance Index, E = Eveness Index,
Class I (6.6-9.5mm); Class II (9.6-14.5 mm); Class III (14.6-19.5 mm);
Class IV (19.6 – 24.5 mm); Class V (24.6-29.5 mm); Class VI (29.6-47.0 mm).

Conclusion

Marble Goby juvenile-larvae with total length 6.6 mm – 47.0 mm prefer zooplankton and insect consumer or carnivore than consume phytoplankton. Highest importance genera in community are *Paracalanus* of Copepoda Phylum and *Merismopedia* of Phylum Cyanophyta. Total larval length significantly affects gut plankton density in Marble Goby feed. Cluster analysis based on Morisita Index implies indifferent feed consumption of Marble Goby on zooplankton composition. On the contrary, phytoplankton feed composition change along with the larval length.

References

APHA (American Public Health Association). 1985. Standard methods for the examination of water and wastewater, 16th edn. APHA, AWWA and WPCF, Washington DC.

Azwar ZI, Melati I, Taufik I, Sutrisno. 2007. Improvement of Marble Goby Fish (*Oxyeleotris marmorata* Bleeker) survival rate in mass production system through natural feed of bioremediation ponds, shelter use, feed and environment management. Research Report. Department of Marine and Fisheries, Division of Marine and Fisheries Research, Research Center of Freshwater Aquaculture, Bogor.

Bold HC, Wynne MJ. 1985. Introduction to the algae,Second edition. Prentice -Hall. Inc. Englewood cliff, New Jersey.

Chumaidi MH, Priyadi A. 2003. Utilization of initial natural feed combination (nannoplankton, *Coelastrum sp. Paramaecium sp.* and *Brchionus* sp) and temperature setting to nurture Marble Goby Larvae. Proceeding of Research Result of Freshwater Aquaculture Fisheries Seminar, 22-23 Desember 2003. Bogor, 165-176.

Djamhur J. 1992. Effect of different levels of Rotifer density on growth and survival of fish larvae *Oxyeleotris marmorata* (Blkr), 1 – 14 days age. Faculy of Fisheries, Bogor Agricultural University, Bogor.

Effendie MI. 1979. Fisheries Biology Methods. Yayasan Dewi Sri, Bogor, 112.

Effendie MI. 1997. Fisheries Biology. Yayasan Pustaka Nusatama, Bogor, 161.

Emmanuel OL, Ajibola ET. 2010. Food and feeding habits and reproduction in Frillfin goby, *Bathygobius soporator* (Cuvier and Valenciennes, 1837) in the Badagry Creek, Lagos, Nigeria. International Journal of Biodiversity and Conservation, **12**, 414-421.

Fachrul MF. 2007. Bioecology Sampling Methods. Bumi Aksara, Jakarta, 198.

Insan I, Chumaidi, Utami R, Subamia IW, Kusdiarti, Asnawi. 2000. Corelation of age and mouth opening of Sand Goby Larvae (*Oxyeleotris marmorata* Blkr) with consumed natural feed type and size. Proceeding of Fisheries Research Result 1999/2000. Jakarta.

Kanazawa. 1988. A nutrition of Penaeid prawns and shrimp. Proceeding of the First International Conference on The Culture Of Penaeid Prawns/Shrimp. Iloilo City, Philippines, 123-130.

Komarudin UAK. 2000. Sand Goby: natural spawning and induction, in pond development, *Keramba* and *Hampang*. Penebar Swadaya, Jakarta.

Krebs CJ. 1989. Ecology Methodology. Harper and Row, Inc. Publishers, New York.

Newell GE, Newell RC. 1963. Marine plankton a practical guide, Hutchinson Educational LTD 178-202 Great Portland Street, London, W.1.

Pamungkas W. 2004. Mortality control of Sand Goby Larvae with feed and environment management. Warta Penelitian Perikanan Indonesia Edisi Aquakultur, **10** (3). ISN No. 0853/894.

Pauly D, Christensen V, Guénette S, Pitcher TJ, Sumaila UR, Walters CJ, Watson R, Zeller D. 2002. Towards sustainability in world fisheries. Nature, **418** (6898), 689–695.

Tavarutmanegul P, Lin CK. 1988. Breeding and rearing of Sand Goby (*Oxyeleotris marmorata* Bleeker). Fry Aquaculture, **69**, 299-305.

Yamaji I. 1982. Ilustrations of the marine plankton of Japan. Hoikusha publishing Co., Ltd. 17-13, 1-chome, Uemachi, Higashi-ku, Osaka, 540 Japan.