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ABUNDANCE AND UTILIZATION OF NATURAL LIFE FEED FOR REARING OF ASIAN CATFISH (*Pangasianodon hypophthalmus*) LARVAE IN OUTDOOR POND

Didik Ariyanto# and Evi Tahapari

Research Institute for Fish Breeding

ABSTRACT

In early rearing period, the larvae of Asian catfish (*Pangasianodon hypophthalmus*) were fed with *Artemia* nauplii at the first 10 days. Since *Artemia* cyst price is quite expensive, it will be a constraint in development of the Asian catfish hatcheries. This study was conducted to evaluate the abundance of natural life food in pond and utilization of it for substitute *Artemia* cyst in Asian catfish larvae rearing. The Asian catfish larvae at the age of 5 days after hatching were used as the test fish. Sampling of natural life food in fertilized pond was conducted before the fish stocked. The fish larvae were stocked in pond after ten days from ponds fertilizing. At the 2nd day after larvae fish was stocked, five fish samples were collected for identify the type of food which consumed by fish. The results showed that abundance of natural life food which found in ponds ranged from 70,200 to 180,600 individual/L. Index of diversity, uniformity and dominancy for phytoplankton and zooplankton ranged from 2.407 to 2.732; from 0.032 to 0.043 and from 0.112 to 0.204, respectively. Based on the analysis of digestive tract of fish, it was found that index of selectivity and index of preponderance for natural life food ranged from 0.94 to 0.62 and from 0.17 to 67.03, respectively. This study suggested that Asian catfish larvae at the age of five days after hatching can utilize the natural life food in ponds to replace the use of *Artemia* cyst in indoor hatchery system.

KEYWORDS: **Asian catfish larvae; natural life feed; utilization; outdoor rearing system**

INTRODUCTION

One of the most common cultured catfish in Indonesia is Asian catfish (*Pangasianodon hypophthalmus*). This species has developed rapidly since 1981, which initiated the successful of artificial induced breeding in Indonesia by Hardjamulia *et al*. (1987). Since that, breeding activities of this species were developed especially in West Java likely in Subang, Bogor, and Sukabumi, and also in the areas nearly Jakarta (Sadili, 1998).

In general, the artificial breeding of Asian catfish, especially in the larval rearing is conducted in indoor hatchery. Nevertheless, this system is in-efficient mainly caused by the use of *Artemia* nauplii for the first 10 days to feed the larvae (Tahapari, 2009a). Dependency of the breeders on the availability of the first feed for these catfish larvae will increase as the prices, and will impact on the final productivity of their hatchery (Sadili, 1998). Besides, indoor system for rearing Asian catfish larvae also requires more facilities and skills (Tahapari, 2009a). Due to some constraints in indoor system of the Asian catfish larvae rearing, especially the dependence of the first feed of larvae, a low-cost alternative technology for larval rearing should be developed.

In nature, the first feeds of Asian catfish larvae are phytoplankton and zooplankton found in aquatic environments. As the tropical country, Indonesia is an ideal place for microorganisms, not only for phytoplankton and zooplankton but also for other benthic organisms (Odum, 1996). Abundance of the natural life feed which available in the waters are expected to reduce the dependence of the Asian catfish breeder against these kinds of feed of larvae which are commonly used in indoor system. But, utilization of the natural life feed in pond for Asian catfish larval rearing was not well studied, especially the species and abundance of them in the ponds as well as the preponderance of fish to those natural life feeds.

This experiment was conducted to evaluate the index of diversity, uniformity and dominance of the natural life feed in rearing ponds as well as the index of selectivity and preference or preponderance of natural feed in the digestive tract of the Asian catfish

Correspondence: Research Institute for Fish Breeding. Jl. Raya 2 Pantura Sukamandi, Subang 41263, West Java, Indonesian.
Phone: + (0260) 520500
E-mail: *didik_ski@yahoo.com*

cultured in outdoor ponds. The ability of Asian catfish larvae to use natural life feed in ponds will reduce the dependency on supply of *Artemia* nauplii, as the first feed of Asian catfish in indoor hatchery.

MATERIALS AND METHODS

The experimental animals were Asian catfish larvae obtained from catfish hatchery of Research Institute for Fish Breeding (RIFB) in Sukamandi, Subang, West Java. The larvae used were at the age of five days after hatching. Body weight and length of larvae were 0.14 ± 0.02 g and 1.19 ± 0.25 cm, respectively.

Experimental Methods

Preparation of The Ponds

Asian catfish larvae were reared in three units of the earthen concrete ponds with sized of 200 m^2 each. Preparation of the ponds in accordance with standard operational procedure (SOP): drainage, removing of mud, drying, liming, fertilizing and filling water to the ponds. Ponds fertilization was conducted 10 days before the fish larvae stocked. Fertilization of ponds was not only carried out with fermented organic fertilizer, but also with addition of inorganic fertilizer such as urea and TSP (Tahapari, 2009b).

Preparation of Larvae

Artificial spawning was done by using six males and six females of Asian catfish followed the standard operational procedure (SOP) of Asian catfish induced breeding (Tahapari, 2009a). The hatched larvae were housed and reared in 10 aquaria for five days before stocked in experimental ponds. Started on day three after hatching, the larvae were fed with *Artemia* nauplii until five days of age.

Fish Rearing in Ponds

Stocking of experimental animals in ponds were conducted on 10 days after ponds fertilization. Stocking density was 100 fish.m^{-2}. The fish were reared in ponds for five days without artificial feed. On the 2nd days, five fish were sampled from each pond for identification of the natural life feed in their digestive tract.

Other Variables and Data Collection

Analysis of Natural Life Feed Abundance in Experimental Ponds

Analysis of natural life feed abundance in experimental ponds was conducted for both phytoplankton and zooplankton. Sampling was carried out with plankton-net on 10th day after fertilizing the ponds before stocking the larvae. The water samples were sent to the Laboratory of Limnology, Indonesian Institute of Science (LIPI), in Cibinong, West Java for identification. The species and number of phytoplankton and zooplankton identification were based on Sachlan (1982) and Hutabarat & Evans (1986). Identification result was used for analysis some ecological indexes, i.e. diversity, uniformity and dominancy of life feed in experimental ponds. These indexes were calculated based on formulas from Shannon-Weaver (1949) in Sachlan (1982).

$$H' = -\sum_{n=1}^{s} pi \ln pi$$

where:
H' = index of diversity
S = number of types
pi = ni/N
ni = number of individual types/species in the ith
N = total number of individual

$$e = \frac{H'}{H maks}$$

where:
e = index of uniformity
H' = index of diversity
H max = maximal of the diversity index

$$C = \sum (Pi)^2$$

where:
C = index of dominancy
Pi = quotient between the number of individual ith (ni) by the total number of individuals in the community (N)

Analysis of Natural Feed in The Digestive Tract of Test Fish

Analysis of natural feed in the digestive tract of the fish was done on the second day after stocking the fish in ponds by dissecting five samples of fish drawn randomly from each pond. Identification of the species and number of phytoplankton and zooplankton were based on Sachlan (1982) and Hutabarat & Evans (1986) and were conducted in laboratory of Limnology, Indonesian Institute of Science (LIPI), in Cibinong. Several indexes were also calculated i.e. index of selectivity (Ivlev, 1961) and index of preponderance (Natarajan & Jhingaran, 1961) of life feed in digestive tract of test fish.

$$E = \frac{ri - pi}{ri + pi}$$

where:
E = index of selectivity
ri = percentage of natural feed in the digestive tract of fish
pi = percentage of natural life feed in the waters

$$Ii = \frac{Vi \times Oi}{\sum (Vi \times Oi)} \times 100\%$$

where:
Ii = index of preponderance
Vi = volume of one type of natural feed
Oi = occurrence of one type of natural feed

Analysis of Pond Water Quality

Water quality variables in ponds were the temperature, dissolved oxygen, pH, nitrite, ammonia, and turbidity of the water. All parameters were performed every two weeks by sampling site at the same location across the experimental ponds. Sampling was conducted three times a day, i.e. at 05:30 h, 13:00 h, and at 17:00 h.

Analysis of Data

Data of the species and abundance of the natural feed in ponds and in the digestive tract of the fish and water quality were analyzed descriptively.

RESULTS AND DISCUSSIONS

Species and abundance of natural life feed in all experimental ponds were presented in Table 1. This table showed that the number of natural life food in those ponds ranged from 70,200 to 180,600 ind./L; consisting of 23-31 types/species. Diversity index of the plankton type in all ponds ranged from 2.35 to 2.73, higher than the results of Setijaningsih (2011), which observed the diversity index of plankton in the tilapia pond (ranged from 0.38 to 0.67 in all ponds). The high value of the diversity index of plankton in this study suspected due to inorganic or organic ferti-lizer that has been fermented in the ponds. Diversity index of the plankton type in all ponds indicated that the water ponds condition were relatively stable and suitable for development of the plankton. Besides that, the species uniformity index and dominance index respectively ranged from 0.03 to 0.04 and from 0.11 to 0.20, indicating that striking kind of dominance does not happen in this water (Lee *et al*., 1978).

Phytoplankton is a microscopic organism that can photosynthesize because of their chlorophyll and also serve as a producer of oxygen (O_2). In the right amount of phytoplankton plays an important role in water primary productivity. Wardoyo (1982) stated that productivity of the water was determined by its ability to produce organic material from inorganic material. Phytoplankton are also as feed for zooplankton and both of them are the feed source for fish. Therefore, in aquaculture, the high level abundance of phytoplankton and zooplankton in ponds strongly support to the success of fish seed production.

Jaya (1999) explained that phytoplankton in ponds have several important rules other than as an oxygen producer and the feed source for the organisms (fish) that are kept. Available also an absorbing and enriching oxygen and eliminate toxic compounds to the organism. The optimal density of phytoplankton and zooplankton for fish culture is about 80,000-120,000 cell/mL (Jaya, 1999). Due to this, farmers usually monitor the density and type of both phytoplankton and zooplankton by observing the brightness or transparency of water ponds and water color as well. Expected brightness is between 30-35 cm. The presence of existing phytoplankton and zooplankton in ponds highly depends on water pond condition and nutrient contained in that water. At certain location with adequate nutrient ability, phytoplankton and zooplankton abundance in ponds can be obtained easily. Fertilized ponds in this experiment which serves the nutrient in the water greatly affected the species and abundance of the phytoplankton and zooplankton. The abundance of both phytoplankton and zooplankton in the larval rearing of catfish is quite high. These conditions have a positive impact on the survival of fish larvae due to the availability of natural life feed. The levels of natural life feed diversity in these ponds were quite good, and the need of the larvae to natural life feed relatively assured. Besides useful as a natural feed, high abundance of phytoplankton and zooplankton indicates that the ponds were in good condition and free from contamination (Nybakken, 1992; Nontji, 1993).

Utilization of phytoplankton and zooplankton in the ponds by fish larvae in this experiment was showed in Table 2. The dominant species of natural life feed consumed by Asian catfish larvae at the age of five days after hatching in pond-I was *Nauplius* (53.03%), in pond-II was *Chlorella* (67.03%) and in pond-III was *Brachionus* sp. and *Daphnia* sp, up to 14.79% and 62.66%, respectively. This result showed that Asian

Tabel 1. Abundance, index of diversity, uniformity, and dominance of phytoplankton and zooplankton found in the Asian catfish rearing ponds

Species	Abundance of natural life feeds (individual.liter^{-1})		
	Pond-I	Pond-II	Pond-III
Actinastrum sp.	-	5,400	2,400
Anabaena sp.	-	-	600
Ankistridesmus falcatus	1,800	6,000	2,400
Ankistrodesmus spiralis	1,200	-	-
Characium sp.	-	-	600
Chlorella sp.	2,400	10,200	-
Chroococcus sp.	43,200	-	-
Cosmarium sp.	2,400	3,600	600
Crucigenia sp.	1,200	-	-
Cymbella sp.	1,200	-	-
Diatoma elongatum	1,800	-	1,200
Dictyosphaerium sp.1	1,200	4,200	7,200
Eudorina sp.	-	3,000	600
Eudorina sp.2	600	-	-
Eudorina sp.1	1,200	-	600
Gloeocystis sp.	38,400	-	-
Keratella cochlearis	-	-	600
Mallomonas sp.1	1,200	1,200	1,800
Merismopedia sp.	1,800	3,000	1,800
Micractinium pusillum	15,000	10,200	12,600
Micractinium sp.2	2,400	-	1,800
Microcystis aeruginosa	3,000	6,600	16,800
Nauplius	-	1,800	600
Navicula anglica	3,000	5,400	600
Navicula hasta	12,000	77,400	1,200
Navicula sp.3	-	4,800	600
Navicula sp.4	-	600	-
Nitzchia sp.	-	5,400	600
Ochromonas sp.	-	-	600
Oedogonium sp.1	1,200	-	-
Oocystis sp.2	5,400	-	600
Ophiocytium sp.	-	-	600
Oscillatoria sp.	8,400	-	-
Pandorina sp.	1,200	-	3,000
Pediasrum duplex	1,200	4,200	600
Phacus sp.1	1,200	8,400	-
Phacus sp.2	1,200	9,000	1,200
Scenedesmus acuminatus	600	3,000	3,600
Scenedesmus acutus	-	-	1,800
Scenedesmus arcuatus	600	3,600	-
Scenedesmus longissipina	1,800	600	1,800
Scenedesmus sp.5	-	-	600
Selenastrum sp.	-	3,000	-
Synedra sp.	-	-	600
Total of individual	157,800	180,600	70,200
Total of type	29	23	31
Index of diversity	2.41	2.35	2.73
Index of uniformity	0.03	0.04	0.03
Index of dominancy	0.16	0.2	0.11

catfish is an omnivore fish which eat all kinds of feed, both of phytoplankton and zooplankton in the waters.

Regarding to the complex nature of the feeding habit of Asian catfish in fertilized earthen ponds, it is necessary to calculate the selectivity index, which might throw some light on fish's feed preference. According to Ivlev's equation (Ivlev, 1961), values of selectivity index are between +1 and –1. Positive values indicate a positive selectivity of a certain kind of feed while negative ones indicate a negative selectivity. Table 2 indicated that, Asian catfish did not consume feed at random but have the ability to select and choose the preferred feedstuff. A higher level of larvae of Asian catfish in the pond-II against phytoplankton was suspected due to the number and composition of the phytoplankton in this pond is very high, compared to the pond-I and III (Tabel 1). Higher level of Index of Preponderance of zooplankton especially of *Nauplius* sp. in pond-I showed that the high consumption of larvae to its. So, the absence of *Nauplius* sp. found in pond-I was suspected due to all or almost all of this plankton were eaten by the fish. As same as in pond-I, high level of Index of preponderance of *Brachionus* sp. and *Daphnia* sp. (Tabel 3), two types of zooplankton which not found in the water of pond-III (Tabel 1), were suspected due to all or almost all of these plankton were eaten by the fish. This phenomenon conclude that although Asian catfish selected the type of natural feed, but the number and abundance of natural life feed slightly affected its consumption patterns.

Successful of maintenance of Asian catfish larvae which were stocked in the ponds at the age of five days after hatching significantly reduce the amount of *Artemia* nauplii given in indoor hatchery system. *Artemia* nauplii usually are given to the larvae during 3-10 days after hatching. Through direct rearing in ponds starting on the age of five days after hatching, it means that feeding withf *Artemia* nauplii is only performed for two days only. This result suggested that natural life feed in ponds can save *Artemia* nauplii.

Water quality variables in ponds including temperature, dissolved oxygen, pH, nitrite, ammonia, and the turbidity level are shown in Table 3. Generally, quality of water variables in experimental ponds were normal and appropriate for fish culture.

Table 2. The abundance, index of selectivity, and preponderance of life feed found in the digestion system of Asian catfish

Fish in pond	Organisms	Species	Total of individu	Volume (mm^3)	Index of selectivity	Index of preponderance
I	Phytoplankton	*Melosira* sp.	2	0.0016	-	1.89
		Glaucocystis sp.	2	0.0225	-0.22	26.52
	Zooplankton	*Nauplius* sp.	1	0.09	-	53.03
		Not identified	1	0.0315	-	18.56
II	Phytoplankton	*Navicula* sp.	9	0.0078	-0.25	19.35
		Melosira sp.	8	0.0035	-	7.72
		Pararella sp.	5	0.002	-	2.76
		Chlorella sp.	38	0.0064	0.62	67.03
		Spirotaenia sp.	4	0.0014	-	1.54
		Not identified	2	0.0003	-	0.17
	Zooplankton	*Nauplius* sp.	1	0.0036	-	0.99
		Not identified	1	0.0016	-	0.44
III	Phytoplankton	*Chlorella* sp.	29	0.0245	-	10.49
		Closterium sp.	4	0.0035	-	0.21
		Microcystis sp.	17	0.0397	-0.43	9.97
		Scenedesmus sp.	12	0.0014	-0.94	0.25
		Dictyosphaerium sp.	1	0.1111	0.44	1.64
	Zooplankton	*Brachionus* sp.	19	0.0527	-	14.79
		Daphnia sp.	23	0.1845	-	62.66

Table 3. Water qualityvariables in Asian catfish larval rearing ponds

Ponds	Temperature (°C)	Dissolved oxygen (mg/L)	pH	Ammonia (mg/L)	Nitrite (mg/L)	Turbidity (cm)
I	27.8-31.4	0.9-9.4	7.6-9.5	0.02-0.04	0.25-0.28	17.0-21.0
II	27.9-31.1	0.9-8.2	8.0-9.5	0.02-0.03	0.29-0.35	16.0-20.0
III	27.9-31.7	0.9-9.8	8.3-9.3	0.02-0.02	0.21-0.27	12.0-12.5

Note: Analysis was conducted every two weeks, three times a day, i.e. 05:30 AM, 01:00 PM, and 05:00 PM

Pond water temperature ranged within 27.8°C-31.7°C. According to Boney (1983), generally planktonic organism can adapt to changes of temperature. Water temperature plays an important role in metabolic process in aquatic ecosystem (Odum, 1996). Temperature also plays an important role in the growth and proliferation of organism, especially the phytoplankton and zooplankton. Based on these roles, water temperature is an important determinant of the level of aquatic productivity (Komarawidjaja *et al*., 2005). In the context of aquaculture, Boyd (1990) explained that optimum temperature for growth and development of cultured organisms (fish) ranged between 27°C-29°C. It plays an important role in the rate of metabolism and respiration of those aquatic organisms (Radiarta, 2013). Suminto (1984) and Chrismadha & Ali (2007) explained that pH is also plays an important role on the survival of fish and also on the fluctuation of phytoplankton and zooplankton abundance that is needed in aquaculture.

Dissolved oxygen (DO) is also a critical factor for the life of aquatic organism. In term of aquatic ecosystem, dissolved oxygen determines the rate of metabolism, and respiration of the whole ecosystem. Besides as the determinant of the metabolic rate of aquatic ecosystem, the level of dissolved oxygen is essential for growth and survival of the aquatic organisms. Boyd (1990) reported that dissolved oxygen level which suitable for aquatic organism is 5-8 mg/L.

Nitrate was the source of nitrogen that important for phytoplankton development both in the sea and freshwater (Boney, 1983). Bocek (1991), and Nybakken (1992) also explained that nitrogen and phosphate most likely as a limiting factor for phytoplankton development. These nutrients were used in some processes such as in the photosynthesis, protein synthesis, and also as the constituent genes as well as the growth of organism (Oktora, 2000). Wardoyo (1982) and Soedibjo (2006) explained that the level of orthophosphate in the water indicates the levels of aquatic fertility.

CONCLUSION

The values of diversity, uniformity and dominance indexes of both phytoplankton and zooplankton in larval rearing pond of Asian catfish stocked at five days after hatching strongly supported larval survival. Abundance and types of plankton in outdoor larval rearing ponds could save the use of *Artemia* nauplii in Asian catfish hatchery. Further study, however, is needed to determine the performance of the larvae reared in outdoor ponds compared to feeding with *Artemia* nauplii.

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