Species Assemblages of Fish Larvae and Juveniles during Flood Season at Bang Phra Reservoir, Chon Buri Province, THAILAND

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ABSTRACT

Species assemblages of fish larvae and juveniles at Bang Phra reservoir were investigated during 2012 flood season (July to November). The study aimed to determine species diversity and abundance of fish larvae and fish juveniles that important to indicate fish spawning and nursery ground. Fish larvae were collected by larvae net at 15 sampling stations in pelagic area. Fish juveniles were collected by beach seining along the littoral area. Results showed that totally 15 families and 22 species of fish larvae and juveniles were collected and all of these were economic species i.e. *Notopterus notopterus*, *Barbonymus gonionotus, Ompok bimaculatus, Oxyeleotris marmorata, Trichogaster microlepis, Trichogaster pectoralis, Trichogaster trichopterus* and *Channa striata*. Based on percentage of frequency of occurrence (%CO), the three most abundance larvae were *Parambassis siamensis* (95.00%), *Parambassis apogonoides* (33.33%) and *Gobiopterus chuno* (20.00%). Monthly abundance of fish larvae was highest October 2012, which average larval density was 1,585 individual/1,000 m^3. Relationship between fish larval density and environmental parameters was analyzed by using Spearman's r correlation coefficient (r_S). The results shown that transparency had significant relationship to total fish larvae density ($r_S = 0.381$).

Keywords: Fish larvae, Abundance, Distribution, Environment

INTRODUCTION

Understandings on fish larvae and juvenile assemblages in particular area are linked to their spawning and nursery grounds. Furthermore, pattern of fertilized egg, larval and juvenile distribution lead into strengthen overall fish population for proper fishery management strategies. Apart from that, deepening of research on sources and pattern of early life histories of fishes will improve predictability of recruitment and may promote fishery resource conservation (Welcomme, 2001; Miller, 2002).

Almost freshwater fish species in tropical lakes or reservoirs take advantage of rainfall and water runoff for spawning and breeding (Lucas and Baras, 2001). In early of rainy season, most Cyprinids and

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Silurids are upstream migrating in a long-distance ranging from feeding habitat to up-river inlets for their spawning (Welcomme, 2001). Many authors have stated that migratory freshwater fishes was highly sensitive and highly response to level of local rainfall. The local rainfall responding is appearing by aggregation and migrating of adults to up-river inlet for their spawning habitat. After mating, fertilized eggs are drifted to downstream area where the larvae are gradually developed along littoral zone of flooding area. Moreover, the most of littoral species are exhibiting both of morphological and physiological adaptation between the spawning and nursery ground within flooding area. Normally, the excellent nursery area for fish juveniles must be the shallow flooding area covering by grasses and shrubs that used for breeding ground, shelters and food sources (Fernandes, 1997; Welcomme, 2001).

The Bang Phra Reservoir, a 117 million m^3 storage capacity reservoir locates in Sriracha district, Chonburi province, East of Thailand. This reservoir was built as purposes of water supply for urban, industrial, irrigation and fishing activities. After the dam was operated in 1975, 4 fisheries surveys were carried out (Department of Fisheries, 1975; Kittiworachet *et.al*., 1985; Chookajorn *et.al*., 1985 and Doungsawat *et.al*. 1991). From the previous fisheries surveys, there were 5 major fishing activities in this reservoir which were gillnets, longlines, handlines, standing traps and push nets. The most economically important species that frequently found at the fish landing around reservoir were *Channa micropeltes, Channa striata, Notopterus notopterus*, *Mystus mysticetus, Trichogaster pectoralis* and *Barbonymus gonionotus*.

The aims of this study were to observe species assemblages of young of the year fish during July-November 2012 that expected period for fish spawning. The data collection was split into 1.) larvae net sampling for species diversity and abundance of pelagic fish larvae and 2.) beach seining for surveys fish juveniles in the littoral area. Furthermore, the relationship between fish larvae and some water quality parameters and hydrological conditions were also determined.

MATERIALS AND METHODS

Study area and sampling stations

This work carried out at Bang Phra reservoir. The reservoir locates in eastern part of Thailand at Sriracha district, Chon Buri province. The dam site situates at UTM 47P 712000-718000E, 1457000-1463000N. The storage capacity and surface area are 117 million m^3 and 16 km^2 at maximum storage level, respectively. There were 4 inflow canals i.e. Huai Kum Nueng, Huai Kum Song, Huai Kru and Huai Nong Kho canals in the western part of reservoir. In this study, the reservoir was divided into 3 zones due to the reservoir's topography. The first one was littoral zone (L-zone), which characterize by depth that shallower than 3 m, connecting with 4 inflow canals. The L-zone was covered by grasses and shrubs, which occasionally flooded, with the area about 18 km^2 (about 15% of reservoir area during high water level). There were 4 sampling stations in this zone, namely L1-L4.

The second zone was transitional zone (T-zone), this area has depth ranging between 3-6 m. There were 3 sampling stations in this zone namely T1-T4. The last zone was pelagic zone (P-zone), which deeper than 6 m. The deepest depth was about 13 m near the dam site. There were 8 sampling stations in this zone, namely P1-P8 (Figure 1).

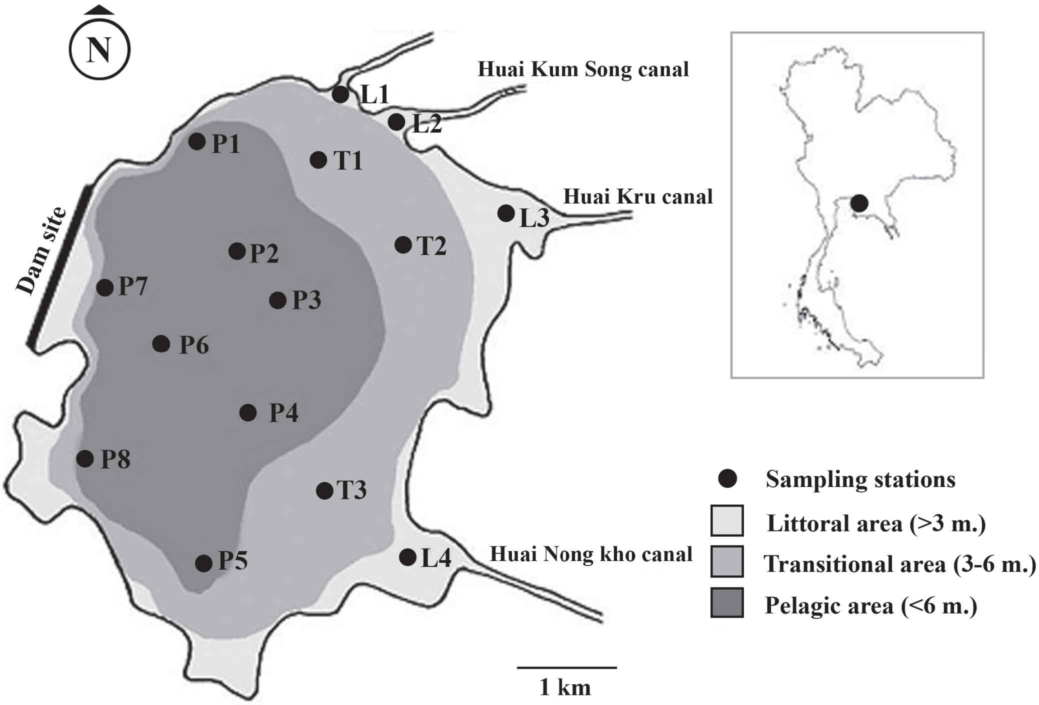

Figure 1. Location and map of Bang Phra reservoir with classified ecological zone and sampling stations

Sampling methods and environmental condition data

Fish larvae were sampled by larvae net with 50 cm in diameter of the mouth and 650 and 330 µm mesh net at cylindrical mouth and conical cod end, respectively. Amount of water volume, which passing through the net was calculated by using the calibrated flow meter attached at the mouth. The net was towed at depth of 0.5 to 1.0 m. Operation time for each sampling station was 5 minutes with boat speed approximately 3-5 knots. The larval samplings were operated in every month of the rainy season (July-October 2012).

Fish juveniles were sampled by using of 2.5 x 15.0 m and 1 mm mesh beach seine. The juveniles were sampled in shallow and flooded vegetative areas along bank of the littoral zone (L-zone). The juvenile samplings were operated in early flood season (October and November 2012). All of collected samples were fixed in 10% formaldehyde solution. Along with collecting of fish, the water quality was measured in each station. The dissolved oxygen (ml l^{-1}) and water temperature (ºC) were measured with DO meter YSI model 550A, pH was measured with pH meter YSI model pH-10 and transparency (cm) was measured with sechi disc. The important hydrological condition, water runoff from river inflows was also recorded by using data shown in the website of Hydro and Agro Informatics Institute, *http://www.thaiwater.net*.

Fish larvae and juvenile identification and data analysis

The collected larvae and juvenile were identified under stereo-microscope by using references such as, Rainboth (1994), Poungcharean (2008), Termvidchakorn (2003, 2005) and Termvidchakorn and Suksri (2011a, 2011b). The different development stages between of juvenile and larvae were classified by Ahlstrom (1984) and Balon (1985). The larval stage is finished when all of fin rays and scales completely. The juveniles were the fishes that its length less than one-third of the maximum species length (Dalzell, 1993). The maximal sizes of each juvenile species of this species were followed by Poungcharean (2008). Abundance of each taxa were counted and calculated as number of fish larval individuals per 1,000 m^3.

Dominant larval fish species throughout the study were determined by percentage of constancy of occurrence of fish larval species (%CO) developed by Schifino *et al*. (2004). The %CO aggregates the main evaluation from the ration of frequency of occurrence stations and total sampling stations within single index: %CO = (P/Q) 100, where P are number of sampling station where the species occurred, Q are total number sampling station. The dominant (or constancy), general (or accessory) and rare (or accidental) species were classified by %CO more than 50, 25-50 and less than 25 of %CO, respectively. These indices were totally calculated 15 fish larval sampling stations from 4 months (July-October 2012) which including of 60 samples. While occurrence of fish juveniles were recorded in totally 2 months (October-November 2012).

The relationship between water quality parameters (water temperature, dissolved oxygen, pH and transparency) to fish larvae indices (i.e. abundance of total fish larvae and dominant fish larval species) were analyzed by using Spearman rank correlation coefficient. A significance level of a minimum of 5% was considered in all statistical analyses.

RESULTS

Species diversity of fish larvae and juveniles

Total 15 families and 22 species of fishes were found during this study. All of these fish were 8 economically important species that found in fish landings around the reservoir i.e. *Notopterus notopterus, Barbonymus gonionotus, Ompok bimaculatus, Oxyeleotris marmorata, Trichogaster microlepis, Trichogaster pectoralis*, *Trichogaster trichopterus* and *Channa striata*. According as ONEP's criterion (the Office of Natural Resources and Environmental Policy and Planning), there were the juveniles of 3 alien species i.e. *Pterygoplicthys pardalis, Gambusia affinis* and *Oreochromis niloticus* that observed around littoral area.

There were 21 species of fish larvae and juveniles, collected by both of larvae net and beach seine and only one species, *Clupeoides borneensis* was collected by larvae net in the pelagic area. The species list, economic importance, ONEP's threatened status and zone of occurrences were shown in Table 1.

Table 1. Species list, ONEP's threatened status and economic importance and zone of occurrences. LN, fish larvae sampled by larvae net towing; BS, fish juvenile sampled by beach seining

No.	Family	Species	Economic importance	ONEP's threatened status	Zone of occurrences
1	Notopteridae	*Notopterus notopterus*	Economic		Littoral, Pelagic
2	Clupeidae	*Clupeoides borneensis*	Non-economic		Pelagic
3	Cyprinidae	*Barbonymus gonionotus*	Economic		Littoral
4		*Esomus metallicus*	Non-economic		Littoral
5	Siluridae	*Ompok bimaculatus*	Economic		Littoral
6	Loricariidae	*Pterygoplichthys pardalis*	Non-economic	Alien species	Littoral
7	Poeciliidae	*Gambusia affinis*	Non-economic	Alien species	Littoral
8	Adrianicthyidae	*Oryzius minutillus*	Non-economic		Littoral
9	Hemiramphidae	*Dermogenys pusilla*	Non-economic		Littoral
10	Syngnathidae	*Doryichthys boaja*	Non-economic		Littoral, Pelagic
11	Ambassidae	*Parambassis siamensis*	Non-economic		Littoral, Pelagic
12		*Parambassis apogonoides*	Non-economic		Littoral
13	Cichlidae	*Oreochromis niloticus*	Economic	Alien species	LN,BS
14	Eleotridae	*Oxyeleotris marmorata*	Economic		Littoral
15	Gobiidae	*Brachygobius xanthonaelas*	Non-economic		Littoral
16		*Eugnathogobius oligactis*	Non-economic		Littoral
17		*Gobiopterus chuno*	Non-economic		LN,BS
18	Osphronemidae	*Trichopsis vittatus*	Non-economic		Littoral
19		*Trichogaster microlepis*	Economic		Littoral
20		*Trichogaster pectoralis*	Economic		Littoral
21		*Trichogaster trichopterus*	Economic		Littoral, Pelagic
22	Channidae	*Channa striata*	Economic		Littoral

Abundance and distribution of fish larvae

During flood season of the Bang Phra reservoir, the most dominant fish larval species, according to percentage of frequency of occurrence (%CO), was *Parambassis siamensis* (95.00%) and the general species was *Parambassis apogonoides* (33.33%). Six species account for 25 %CO: *Gobiopterus chuno* (20.00%), *Oreochromis niloticus* (6.67%), *Trichogaster trichopterus* (6.67%), *Clupeoides borneensis* (3.33%), *Notopterus*

notopterus (1.67%) and *Doryichthys boaja* (1.67%) were inhabited either the littoral or transitional areas. The highest density was found in late rainy season, October 2012 and in excess of 1,585 individuals/1,000 m^3 on monthly average density. The most dominant species was *Parambassis siamensis* that found which highest abundance at average density of 1,559 individuals/1,000 m^3 (Table 2).

Monthly averages of fish larval density were shown in Table 2. Results indicated that the densities of total fish larvae were spatio-temporally varied according to topographical zone, species composition and abundance. Distribution plot maps (Figure 2) were graphically showed detail in amount of total density for each station. The total fish larvae were depended on the top 3 most abundant species that was *P.siamensis, P.apogonoides* and *Gobiopterus chuno*.

The horizontal distributions of fish larvae were differenced among sampling months, topographical areas and fish species. The distribution plot maps (Figure 2) were showed amount of total fish larval density, which proportion of *Parambassis*'s larvae. The highest fish larval abundance was recorded in late rainy season, i.e. October 2012, meanwhile *P. siamensis* larvae showed the highest abundance at the mouth of Huai Nong Kho river.

In July 2012, *P. apogonoides* was dominant species and abundances in

Table 2. Percentage of frequency of occurrence (%CO), zone of occurrence and average ± SD of fish larval density in Bang Phra reservoir between July and October 2012; L = littoral zone occurrence, T = transitional zone occurrence and P = pelagic zone occurrence

Species	%CO*	Zone of occurrences	Fish larval density (individuals/1,000 m^3)			
			July 2012	August 2012	September 2012	October 2012
Notopterus notopterus	1.67 (Acci.)	L		1±3		
Clupeoides borneensis	3.33 (Acci.)	T,P	1±2		1±5	
Parambassis apogonoides	33.33 (Acce.)	L,T,P	130±164	382±468	221±290	
Parambassis siamensis	95.00 (Cons.)	L,T,P	268±273	1±4	34±49	1559±1534
Oreochromis niloticus	6.67 (Acci.)	L,P	5±14	1±2		1±4
Gobiopterus chuno	20.00 (Acci.)	L,T,P	5±13	10±30	3±7	5±12
Doryichthys boaja	1.67 (Acci.)	L	1±3			
Trichogaster trichopterus	6.67 (Acci.)	L,T,P	6±16			21±64
Total fish larvae	-	-	315±297	395±460	260±277	1585±1537

Note * %CO classified by Schifino *et al*. (2004) when Cons. = Constancy species; Acce.= Accessory species and Acci = Accidental species

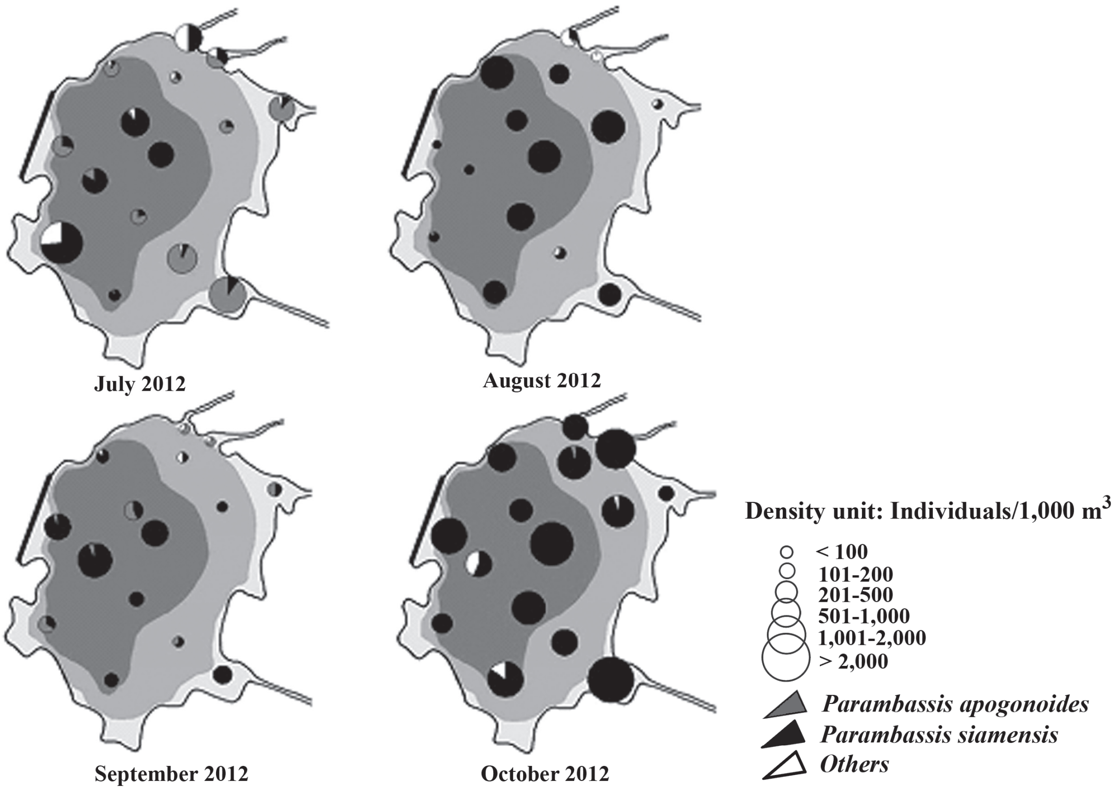

Figure 2. Distribution plot map of total fish larval density which proportion of *Parambassis*'s larval density in Bang Phra reservoir, between July–October 2012

transitional and littoral zones, while *P. siamensis* was abundances in pelagic zone. In August 2012, *P. siamensis* was dominant species and abundances in the eastern part of pelagic zone. In September 2012, total abundance of fish larvae were lower than the other months. In this month, the total fish larvae in transitional and littoral zone was varied among less than 100-500 individuals/1,000 m^3 of density level while *P. siamensis* was abundances in the center of pelagic zone.

Environmental conditions and fish larval relationship

The obtained values of environmental parameters were shown in Table 3. They were analyzed for their relationship to topographical zone and monthly average fish larval density. Results from rs showed that transparency had significant relationship total fish larvae ($r_s = 0.381$) and also water temperature had significant relationship to *P. siamensis* ($r_s = 0.359$).

Table 3. Descriptive summaries of environmental conditions that categorized in topographical zone of Bang Phra reservoir between July–October 2012

Month	Topographical zone	Water runoff (million m^3)	Dissolved oxygen (mg/l)	Water temperature (C)	pH	Transparency (cm)
July 2012	Littoral	10.30	4.25±1.45	31.0±1.3	7.56±0.58	35±26
	Transition		4.12±0.93	30.0±1.4	7.81±0.25	78±41
	Pelagic		4.83±1.58	29.8±0.7	8.08±0.50	78±35
August 2012	Littoral	15.12	5.91±1.18	29.1±0.4	7.73±0.35	23±5
	Transition		6.36±0.30	28.6±0.2	8.16±0.28	37±8
	Pelagic		6.88±1.04	29.0±0.4	8.41±0.23	43±6
September 2012	Littoral	18.23	4.87±0.84	30.7±0.2	7.79±0.73	30±9
	Transition		6.31±0.65	30.3±0.1	7.73±0.89	33±16
	Pelagic		5.77±0.62	30.4±0.3	8.11±0.61	55±11
October 2012	Littoral	37.95	3.78±0.50	29.5±0.3	7.52±0.14	50±8
	Transition		4.12±0.93	29.6±0.4	7.58±0.11	53±6
	Pelagic		3.25±0.61	29.6±0.3	7.65±0.11	59±10
Spearman's r_s correlation	Total fish larvae	r_s	0.169	0.251	0.021	0.381*
		Sig. (2-tailed)	0.196	0.053	0.873	0.003
		N	60	60	60	60
	P. siamensis	r_s	0.153	0.359*	0.114	0.225
		Sig. (2-tailed)	0.256	0.006	0.399	0.092
		N	57	57	57	57

Note * The r_s was significant at $\alpha = 0.05$

CONCLUSION

The fish larvae and juvenile surveys in Bang Phra reservoir indicated that at least 8 fish species were succeed on their spawning during July to October 2012. Twenty one (21) fish species were also succeed on their breeding during October to November 2012. Based on density of fish larval species, *Parambassis* spp. was superior succeed in their reproduction than other species in the Bang Phra reservoir. Rainboth (1996) and Okutsu *et.al* (2001) stated that *Parambassis* spp. is a small carnivorous fish that wildly distributes and dominances in river and eutrophic lake. It has faster growth, earlier maturation and spawning throughout of the year. It is a secondary consumer and important in the food web of river and lake ecosystem. In Pasak Jolasid reservoir, the trophic level (TL) of *Parambassis* spp. was estimated in TL = 2.5 and sometimes preyed by the carnivorous fishes in the system (Villanueva *et al*., 2008; Thapanand *et.al*., 2009). Therefore, *Parambassis* population should be contributed on total higher TL fish production of the reservoir. Moreover, other abundance non-economic importance species in the system, such as *Gobiopterus chuno*, *Clupeoides borneensis*, were also considered as ecological importance as natural food sources for economic-carnivorous species.

Based on fish larval assemblages, few numbers of collected cyprinid larvae could be contributed to the low potential to success in breeding of the species in the Bang Phra reservoir. Poungcharean (2008) had reported assemblages of fish larvae in Pasak Jolasid reservoir, the same pelagic fish larval sampling with this study, the cyprinid larvae were excessively obtained 99% of total fish larval density in high flooding period. Additionally Poulsen and Valbe-Jørgensen (2002) and Poungcharean (2008) stated that cyprinid fishes require continuously water runoff for spawning. The environmental conditions of flood period were induces its aggregation and inhibit upstream migrate for spawning. Some cyprinids exhibit upstream migratory behavior and breeding at the joint of river tributaries. However, there are fewer and non-continuously water runoff from 4 inflow canals in the Bang Phra reservoir with the average range between 10.30-37.95 million m^3/month. This amount of inflow water may probably not enough to induce the cyprinid fishes to spawn. Poungcharean (2008) had reported the average range water runoff in Pasak Jolasid reservoir during flood period which high density of cyprinid larvae was 68.90-371.71 million m^3/month.

The species list of fish juveniles in Table 1 indicated that the littoral area of eastern part of the reservoir should be the nursery ground of the reservoir. Twenty one (21) species of fish juveniles were observed and all of them were high valuable commercials i.e. *Barbonymus gonionotus*, *Ompok bimaculatus, Oxyeleotris marmorata, Trichogaster trichopterus* and *Channa striata*. Generally, the area in lake and reservoir that fishes would select for breeding must be shallow inundate water that densely covered with vegetation (Fernandes, 1997; Welcomme, 2001). Juveniles establish this area for nesting, feeding, natural defense from predators (Negroni *et.al*., 2012). Consequently, the fishing activities by small mesh-size gear in this area should be prohibited during the flood season (mostly in October-November) for fish conservation purpose.

The significant of rs between transparency and total fish larvae as well as water temperature and. *P. siamensis* larvae assured the effect of both water quality parameters to the fish spawning. In transparency waters, i.e., with lower amounts of suspended solid, fish egg and larvae are more vulnerable to predation. Also, temperature is the most important environmental influence driving development, growth and survival of fish during their early-life history (Pepin, 1991). Although this study associated with fish larvae to water qualities, some parameters were unlikely to govern fish larval living. Fluctuations in water quality parameters during the flood condition are common in the lake system (Potts and Wootton, 1989; Welcomme, 2001), but, in the overall, parameters remained within ranges and averages of optimal condition for fish spawning.

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