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Distribution and Early-life Development of Thai River Sprat *Clupeichthys aesarnensis* Wongratana, Larvae, in Pasak Jolasid Reservoir, Lop Buri Province, Thailand

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ABSTRACT

The distribution of Thai river sprat *Clupeichthys aesarnensis* Wongratana, larvae, in Pasak Jolasid Reservoir, Lop Buri Province during April 2003 to February 2004 was studied bi-monthly by plankton net towing in 24 sampling stations. The environmental conditions and water qualities were recorded and measured *in situ*. The abundance of larvae showed differential significance in months ($P<0.0001$). The spawning of the Thai river sprat in Pasak Jolasid Reservoir occurred throughout the year but was high in early rainy season (June 2003: 46.87% of larval number) and low in dry season (December 2003 to February 2004: 1.46% of larval number) and irregularly in the reservoir. Development of myomere in yolk-sac larvae were not complete while the digestive gut opened at 82%NL in yolk-sac larvae and moved to the mid-portion or 59%TL in juvenile.

Key words: Thai river sprat, fish larvae, Pasak Jolasid reservoir

INTRODUCTION

Pasak Jolasid, a newly dam constructed to mitigate flooding in Pasak river basin and Lower Chao Praya river basin which includes Bangkok and adjacent province by His Majesty's initiation on development of Pasak river basin project. It has effectively created a large reservoir with maximum storage capacity of 960 million cubic meters and a large fishery resources in central part of Thailand (Royal Irrigation Department, 1999 and SUMAFISH, 2003). The populations of Thai river sprat (*Clupeichthys aesarnensis* Wongratana, 1983) were highly abundance after the dam was constructed. It is a commercial fish in the north-eastern part of Thai reservoir. There were fishery reports of Thai river sprat in Ubonratana and Sinrinthorn by bright light seining, breach seine and lift net. (Sirimongkolthawon,1994 and Jutagate, 2002). In Pasak Jolasid reservoir, Thai river sprat fisheries found only in the East of Middle parts by breach seining and push net during November to February.

Thai river sprat is a small fish with moderately elongate and compress body. Snout blunt with small-canine teeth are located on upper jaw. 16-18 scutes on the belly keel, 17-19 gill rakers, two last anal fin rays are detached from the others as finlet. Body is yellowish to gray coloration with silver write transverse-band from gill opening to caudal peduncle (Wongratana, 1983 and Whitehead, 1985).

Thai river sprat is a short-life span fish and has a pelagic schooling behavior for its

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spawning season. The fertilized eggs are suspended in water mass. The newly hatching larval have approximately 6.6 mm. in total length (TL), before developed from pre-flexion to flexion, post-flexion and juvenile stage, respectively. Thai river sprat is nocturnal fish, feeding on zooplankton (Whitehead, 1985 and Termvidchakorn, 2003).

Distribution of Thai river sprat occurrs in the river and reservoir of Mekong basin in Laos, Cambodia and Thailand. In Thailand, Thai river sprats are distributed and abundant in the north-eastern part. There were distribution records in Ubonratana (Khon Kaen province), Sirinthorn (Ubon Ratchathani province), Lompow (Kalasin province) and Pasak Jolasid reservoir (Lop Buri province) (Chookajorn *et al*., 1977 and Jutagate and De Silva, 2003).

The aims of this paper were to study distribution and developing stages of Thai river sprat larvae in Pasak Jolasid reservoir. The field-collection materials and provided information were used on size and occurrence of larvae collected in sampling stations covering the whole reservoir by griding, that was able to understand early-life histories and some environmental conditions that required spawning and nursery. Finally, the outputs of this paper were be able to support Thai river sprat fishery management in Pasak Jolasid and others reservoir based on spawning-nursery ground and timing information.

MATERIALS AND METHODS

1. Study sites

Pasak Jolasid reservoir is located in Pasak river at geological coordinated 14°50′ 32″ N 101°05′ 00″E. The dam has been operational since September 1999 with 960 cubic million meter at maximum level, 43 meters above the mean sea level, covering approximately 149 square kilometers. The dam receives most water from Pasak river, originating from Phetchabun mountain in the South of Loei province.

The 24 sampling stations were studied to ensure the coverage of the whole reservoir by griding. The sampling stations were located in 4 separated zones by different morphology of the reservoir as follows (Figure 1):

Zone 1: Upstream zone (14°50′ N to 15°11′ E) consisted of 4 stations along Pasak river. The both sides, especially the west were changed to floodplain flood season.

Zone 2: River inlet zone (15°00′ N to 15°05′ E) consisted of 8 stations in the upper part. It was shallow and widely area that received water from upstream with many of marginal grasses, litter and remnant woods visible especially when water level decreased.

Zone 3: Transitional zone (14°55′ N to 15º00′ E) consisted of 8 stations in the middle part. It was an open area with high wind and strong

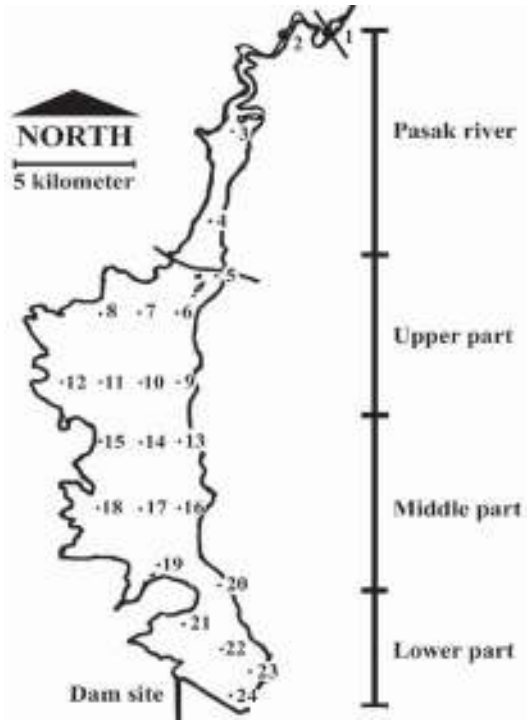

Figure 1 Sampling stations for Thai river sprat larvae in Pasak Jolasid reservoir, Lop buri province.

currents.

Zone 4: River outlet zone (14°50′ N to 14°55′ E) consisted of 4 stations in the lower part. It was an open and deeply area with high wind and strong currents.

2. Field surveys

The quantitative collection of fish larvae in the study area was carried out by the larval net that was cylindrical shape, 120 centimeter in length with 650 microns in mesh size at the mouth part and 330 microns at the 60 centimeters of the cod end with opening of 60 centimeters in diameter. The flow meter was attached at the mouth part to enable the estimation of water volume movement through the net. Larval net was operated by towing about 5 minutes at 0.5 meters under subsurface level with boat speed approximately 1 knot. The environmental conditions and water qualities were recorded and measured *in situ*. The sampling stations were operated every bi-monthly. All samples were kept in 10% water formalin and after sorting, the larvae were preserved in 4% neutralized formalin solution for analysis.

3. Identification and data analysis

Thai river sprat larval specimens were identified under stereo-microscope by Termvidchakorn (2003)'s guidebook. The estimation of fish larvae density was evaluated and standardized in 1,000 cubic meters of water volume. The characteristics i.e. body shape, myomere, strict and position of pigmentation in every stage of fish larvae were described and illustrated by stereo microscope and camera lucida. The difference of larvae density in each month was tested by ANOVA analysis and Duncan Multiple Range Test (DMRT).

RESULTS

1. Distribution of Thai river sprat larvae

Thai river sprats were collected from 6 survey periods during April 2003 to February 2004. Only 19 from 24 sampling stations in June 2003 and August 2003 were collected (Station 8-12) because the water level was decreased by irrigation discharge (Table 1).

Thai river sprat larvae were widely and irregularly distributed in Pasak Jolasid reservoir and Pasak river. The larval abundance were highest in June 2003 (46.87% of all surveys) and significantly different from the other months ($P<0.0001$), while in August 2003(16.42%),

2. Environmental conditions

Environmental condition data were measured from field survey. Dissolved oxygen and temperature of water are important parameters for fish larvae. Averaged dissolved oxygen was high in December 2003's survey (9.78±1.45ml/l) and low in August 2003 (4.76±0.87ml/l). Averaged

Table 1 Densities of Thai river sprat larvae in Pasak Jolasid reservoir during April 2003 to February 2004.

Observation	Number of sampling station	Density of larvae (inds./1,000 cubic meters; Mean±SD)	Density of larvae in **(%)**
April 2003	24	108.56 ± 270.24	17.83
June 2003	19	394.94 ± 560.28	46.87
August 2003	19	153.12 ± 185.67	16.42
October 2003	24	107.00 ± 249.97	15.99
December 2003	24	11.74 ± 16.28	1.91
February 2004	24	5.51 ± 11.33	1.01

water temperature was high in April 2003 (31.5±0.8°C) and low in December 2003 (23.0±0.3°C). The secondary data, averaged water level of reservoir was conducted from the Royal Irrigation Department's reports and then, water volume and water surface area were estimated from water level at the dam site (Table 2).

3. Development of Thai river sprat larvae

There were 4,787 individuals from the total of 6 sampling periods and all of these consisted of series of different larval developing stages. The complete specimens in each series were selected for taxonomical illustrations and descriptions as follows:

Yolk-sac stage (Figure 3a) 3.46 mm. in notochord length (mm.NL), body elongate with 37 myomere, head round, upper jaw reaching the middle of eye, strength gut opening at 82% of total length, yolk sac at anterior part of gut, fins not developed, the end of notochord (urostyle) strength.

Pre-flexion stage (Figure 3b) 4.11 mm. NL, body elongate with 39 myomere, head round, upper jaw beyond to anterior of eye, strength gut opening at 80% of total length, no yolk sac, fins not developed, the end of notochord descending upward to dorsal position.

Flexion stage (Figure 3c) 7.35 mm.NL, body elongate with 39 myomere, head round, upper jaw beyond anterior of eye, strength gut opening at 78% of total length, Pectoral, dorsal, anal, caudal fin developed, posterior gut vertical striated. Posterior gut and brain covered with melanophore pigments.

Post-flexion stage (Figure 3d) 11.61 mm. in total length (mm.TL), body elongate, strength gut opening at 78% of total length, fins developed except pelvic fin. Few melanophore pigments covered on brain, caudal fin base and spotted along anal-fin base.

Juvenile stage (Figure 3e) 11.61 mm.TL, body deeply, gut opening at 63% of total length, fins developed, scutes at belly developed. (Figure 3f) 20.83 mm.TL, body widely, gut opening at 59% of total length, similar to adult.

DISSCUSSIONS

There were very few studies on freshwater fish larvae in Thai reservoir for prediction spawning ground and season. Although there were several studies about spawning ground but methodology and some objectives were not different. However, the variety of Thai river sprat's distribution data from this study can be used to indicate spawning ground and season in Pasak Jolasid reservoir. Because the fish in larval stage has a limited ability to movement in water volume especially in Pasak Jolasid reservoir which is

Table 2 Environmental condition data which parallel measured and recorded with surveys in Pasak Jolasid reservoir during April 2003 to February 2004**.**

Observations	Dissolved oxygen (ml/l; Mean±SD)	Water temperature (C; Mean±SD)	Water level (m)	Water surface area* (km^2)	Water volume (million m^3)
April 2003	6.85 ± 1.98	31.5 ± 0.8	39.50	121.08	474.21
June 2003	5.51 ± 2.97	29.6 ± 2.1	37.58	93.37	271.94
August 2003	4.76 ± 0.87	29.3 ± 0.2	36.88	72.89	235.77
October 2003	8.27 ± 1.60	29.9 ± 1.2	41.64	143.98	763.43
December 2003	9.78 ± 1.45	23.0 ± 0.3	42.36	156.63	755.53
February 2004	8.77 ± 2.01	24.4 ± 0.1	40.45	144.57	616.00

* estimated from Royal Irrigation Department (1999)'s operation rule curve

standing waters, thus the occurrences of larvae in sampling stations indicated specific spawning in each area determined.

The results showed that, spawning of Thai river sprat occurred throughout of the year according to Sirimonkonthawon (1994) and Chookajorn *et al*.(1997). The populations of Thai river sprat in northeast Thailand is a short-life span, spawning period is peaked in June to July or rainy season and low in December to February or cold season. Occurrence of larval population surveys in June and August which covered this period was regarded according to their spawning season.

Abundance of larvae was high in June-October or rainy season because of the optimized of their environmental conditions such as water temperature of 29.3-31.5 °C, the optimum level for general tropical fishes was supported by Termvidchakorn (2003) who explained that low temperature in cold season was the factor that inhibited the gonad development in fish especially in tropical zone. In addition, notification of fixing spawning season and fishing gears from 16 May to 15 September in every year from Department

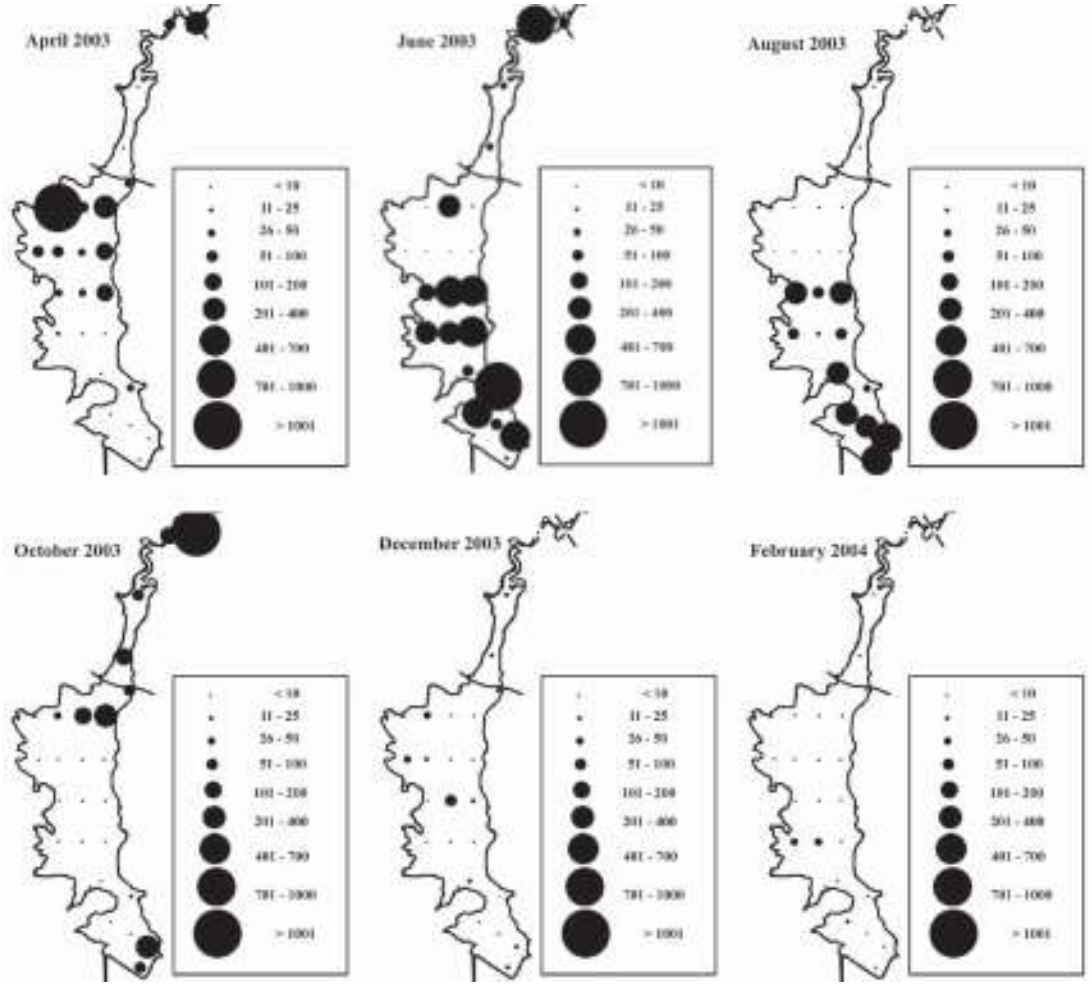

Figure 2 Distribution of Thai river sprat in Pasak Jolasid reservoir during April 2003 to February 2004 (size of dark cycling replicated density of Thai river sprat larvae per 1,000 cubic meter of water volume).

of Fisheries protects and provides parent stocks survival to spawn. On the contrary, Jutagate (2002) discussed that catches and efforts of Thai river sprat fisheries in Sirinthorn reservoir were low because of wind effect, which created turbulent water in northeast monsoon as well as Pasak Jolasid reservoir which received impact form northeast monsoon. Abundance of larvae was low in December to February. As well as the above reason, the water temperature in this period was as low as 23.0-24.1 °C and this period was an opening of fishing season, there were Thai river sprat's fishery in Pasak Jolasid reservoir. In addition, rising of water level to the maximized level in October and slow deceasing till April (Royal Irrigation Department, 1999) provided Thai river sprat larvae's favorableness as their habitat. It reduced chances of larval catchments by fish larvae net or other samplings because yield of larvae per water volume deceased.

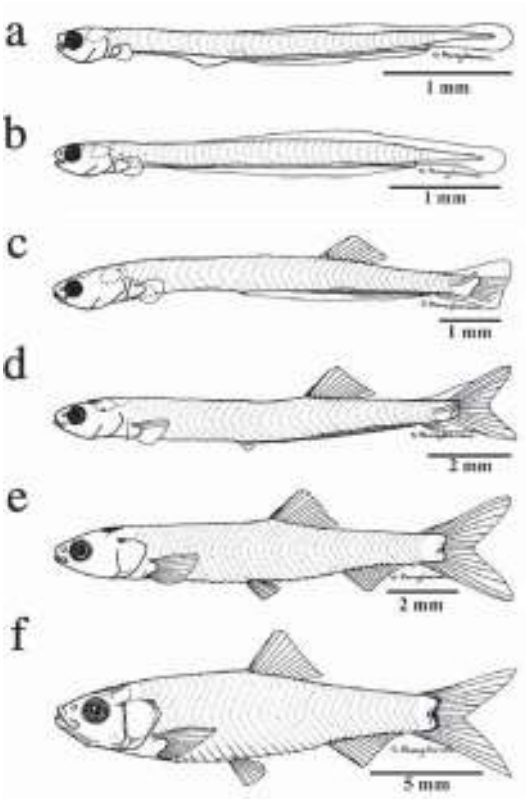

Figure 3 Larval development of Thai river sprat (a) Yolk-sac stage; 3.46 mm.NL (b) Pre-flexion stage; 4.11 mm.NL (c) Flexion stage; 7.35 mm.NL (d) Post-flexion stage; 11.61 mm.TL (e) and (f) Juvenile stage; 12.03 and 20.83 mm.TL.

This study showed that Thai river sprat larvae were more abundant in offshore or river canal than near shore (Figure 2). Whitehead (1985) described that the mostly clupeids fish was a pelagic schooling fish and spawning in open area, the fertilized eggs and early-life stages were suspended in water volume as plankton. Lima and Lima (2004) explained that fish in early life stage had a passive movement, wind and current was a rule for their drift and distribution. The offshore of Pasak Jolasid reservoir was an area that strongly received impacts from wind and current as the same.

Populations of Thai river sprat in Pasak Jolasid reservoir were in higher abundance than before the dam was constructed. This was because the environmental changed from running to standing water condition. This changing was conducted to provide Thai river sprat's habitat. However, Thai river sprat were found in Pasak river before the dam was built by Electric Generating Authority of Thailand (1982) and Department of Fishery (1994), but there were only few numbers of populations. After the dam was constructed, populations of Thai river sprat were high and had production to the fishery level. From this survey, it was found that there were Thai river sprat fisheries in the East-Middle part of reservoir by breach seine. Additionally, Department of Fisheries (2002) and SUMAFISH (2003) reported that Thai river sprat were in high abundance after the dam was constructed.

Development of Thai river sprat's myomere in yolk-sac larvae were not complete. Figure 3a shows 37 developed myomere, with opened digestive gut at 82%NL in yolk-sac larvae

and moving to 59%TL in juvenile (Figure 3b-f). Malanophore pigmentation occurred on brain, anal-fin base and caudal-fin base after flexion stage. The results were similar to those reported by Termvichakorn (2003). The other pigments or coloration might be lost from preservation by neutralized formalin solution especially silver write transverse-band, located from posterior gill opening to caudal-fin base not visible from preserved specimens. However, yellowish coloration on caudal-fin base was visible from some preserved specimens. In identification, Thai river sprat larvae may be misidentified among Boneo river sprat (*Clupeiodes boneensis* Bleeker, 1851) especially before post-flexion stage specimens. It was a small clupeids fish found in Pasak Jolasid reservoir but not in abundance. However, Thai river sprat larvae could be separated by the last two anal-fin rays detached form the others (Whitehead, 1985 and Rainboth, 1996).

CONCLUSIONS

Spawning of the Thai river sprat in Pasak Jolasid reservoir occurred throughout of the year but was high in early rainy season and low in cold season and irregularly in anywhere of the reservoir. Low water temperature and current affected spawning and larval drift to suitable habitat. Development of myomere in the yolk-sac larvae was not complete while the digestive gut moved form posterior into mid-portion of body in juvenile.

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