SPAWNING PERFORMANCE AND EMBRYONIC DEVELOPMENT OF RED EMPEROR SNAPPER (*Lutjanus sebae*)

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ABSTRACT

Snapper is one of economical marine fishes having opportunity for a candidate for mariculture species. Observation on spawning and embryonic development of red emperor snapper (*Lutjanus sebae*) was done to get information on reproduction performance of this species. Twenty pairs of mature fish were stocked in a floating net cage, fed with moist pellets. The result showed that red emperor snapper spawned throughout the year in new moon and full moon period, with total spawning of 59 times. Mating process took one hour fifteen minutes before they spawned at 2:20 am, average egg diameter of 963 *µm* and oil globule of 127 *µm* with fertilization rate of 90% and hatching rate of 75% after twenty two hour fifteen minutes of incubation at 27°C—28°C. Divisions of cell (1) took two hours thirty minutes, Blastula stage (2) for one hour, Gastrula stage (3) took around seven hours, Neurulla stage (4) needed one hour thirty minute, Head and optic lobe formation (5) just less than thirty minutes, body and organ development including tail and kuppfer's vesicle (6) needed four hours and thirty minutes, body movement and pulse of the heart (7) was observed at seventeen hours forty-five minutes after spawning, at nineteen hour thirty minutes tail was pointed and free from yolk (8), breaking of eggshell (9) started at twenty-one hour thirty minutes and start hatching (10) at twenty-two hour after spawning. Gastrula and body-organ development stage was suggested the most critical period in embryonic development. Red emperor snapper is highly potential species for mariculture based on the ability to produce egg throughout the year and spawn every two weeks, which performance does not occur in others species until now. From egg and oil globule analyses, egg diameter relatively higher in full moon period than that of the new moon period, and eggs production in April-October had ratio of oil globule to the egg of higher than 0.20%. In term of larval rearing that was suggested to use egg produced in April-October at full moon period.

KEYWORDS: Red snapper, spawning, embryonic development

INTRODUCTION

Red snapper is one of economical marine fishes living in tropical waters from shallow to the deep offshore waters (Sunyoto & Mustahal, 1997). Red emperor snapper *Lutjanus sebae* was part of the family Lutjanidae, a large tropical family with 17 genera and 103 species globally (Kuiter, 1996). Badrudin & Barus (1989) reported that red emperor snapper was caught from Java Sea to the south Borneo waters with other snapper species, Edrus *et al.* (1996) in their underwater observation around artificial reef in Jumeluk waters (Bali) that red emperor snapper was found at the bottom area of concrete and tire artificial reef was set at 25 m depth on black sand sea bed.

Exploitation of snapper increases by years especially in Java Sea, Borneo as far as Celebes waters (Marzuki & Djamal, 1992), to anticipate over fishing threatening sustainable yield of snapper, culturing of target species must be considered as other opportunity to conserve natural stock. Some snappers are reported successfully to culture by Sunyoto & Mustahal, (1997) are mangrove snapper *L. argentimaculatus* and golden snapper *L. johni*. Minimum biological size (gonad mature) of red snapper in general starts when the length of

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fish reach ± 40%—50% from their maximum length (Grimes, 1987).

Study on red emperor snapper *L. sebae* was started at Gondol Research Institute for Mariculture (GRIM) in 2000 with observation on the biological aspect, spawning, and embryonic development to larval rearing. Some of the aspects have been reported such as early larval development (Imanto & Melianawati, 2003), broodstock rearing in concrete tank facilities (Suastika *et al.*, 2003), feeding preference of larvae (Melianawati & Imanto, 2004) but not in detail description has been made of reproductive behavior, the sequence of embryonic development and eggs production performance as well.

This paper was complementary for a serial study on red emperor snapper *L. sebae*, focusing to the mating behavior, spawning and egg production performance and the development of embryo, for basic data to build a complete information of this species and finally to support mariculture development.

MATERIAL AND METHOD

At the GRIM, Bali, Indonesia, we have been conducting a series of observation on spawning and embryonic development of red emperor snapper (*L. sebae*) to get initial information on reproduction performance of this species. Twenty pairs of spawners were kept in floating net cage (9 m^2 square, 4 m depth), and fed with moist pellet containing 41% protein based on composition described by Sutarmat & Imanto (2001). The spawners were obtained from Riau waters and were reared for more than three years in net cage before transported to Gondol station by boat in 2000; average total length (TL) of male was 48 ± 2.70 cm with 2,600 ± 585 g in body weight (BW) and average TL of female was 51 ± 2.88 cm with 3,245 ± 660 g BW. Visual observation and making notes on mating process was started from nightfall on January 11, 2001 (23.30 h) until spawning aimed at dawn on January 12 (03.00-1.45 h). Embryonic development was observed from three-observation times on January 10, 11, and 12, respectively at ambient incubation temperature of 26°C—27°C. Measurement of eggs and oil globule were made from 30 samples from each spawning, and read under a stereoscopic microscope with an ocular micrometer. Hatching rate data were calculated from 3-replicates on 100 eggs incubated in 1-l beaker glass from each spawning.

RESULT AND DISCUSSION

Spawning Behavior

Pre-spawning

The male and female swam together faster than normal condition, and the movement of pair was known around midnight on January 11 (23.30 h) and continued with specific movement, and were described every 30 minute (Table 1).

Table 1. Mating - Spawning behaviour

TIME (a.m.)	MATING - SPAWNING BEHAVIOR January 12
0:30	Female and male were close together, attached their snout and made the angle of 30°-45°, movement of touching the snout were more frequent followed with swimming together around the net wall and changing the partner/couple occurred
1:00	Pair movement of couple was observed and swimming side by side with the female was in front of male, swimming pattern of the couple was a circle along the wall of net cage and went up and down
1:30	The couple moved together with fast swimming speed around the cage and some times made a sharp turning movement horizontally and vertically as well
1:45	First spawning occurred, female swam fast from the cage bottom to the surface with spiral movement followed by the male, and near surface the female released eggs and at the same time the male released sperms

Actual spawning

Spawning occurred at 01.45 h. at dawn of January 12. The female swam fast to the surface in spiral movement followed by male, and when the female released eggs near the surface the male react released the sperm afterward. The others followed performance pair's in-group, and took around 3 hours until all pairs spawned.

Spawning performance

Data on spawning performance were collected in 2001; total spawning was 59 times during the full moon and new moon period, and only in February and November spawning activity did not occur. Egg diameter was relatively bigger in average in full moon than that new in moon period (Figure 1).

From the spawning data collected in 2001, it showed that red emperor snapper *L. sebae* was a suitable candidate for marine fish culture species, based on capability to produce egg continuously throughout the year, similar to spawning performance of *L. sebae* in tanks facilities as reported by Suastika *et al.* (2003). Performance of spawning in 2001 is presented in Table 2.

Egg and oil globule

From egg and oil globule analyses based on volume, there is an important value to consider in term of larval rearing. The oil globule to egg volume ratios were different every spawning, from December to March the ratio was below 0.20%, and from April to October was over 0.20% and in average was 0.25% (Figure 2).

Success of larval rearing process is closely related to egg quality, bigger volume of egg and oil globule giving better result. Imanto & Melianawati (2003) reported that yolk volume carried by newly hatched out larvae of *L. sebae* was 1,808 ± 20.9 mm^3 and was totally absorbed after 60 h., oil globule still remained 0.26 x 10^{-4} ± 0.004 x 10^{-4} mm^3 after 106 h. after hatching, and suggested that bigger yolk would support better larval morphological development, and oil globule has a role as the endogenous reserve energy.

Embryonic development

Record on embryonic development stage was based on spawning at 2.15 h. on January 10, 2001. The fertilized eggs of *L. sebae* were spherical, floating on the surface with single oil globule. Egg diameter was 0.952 ± 0.029 mm and the oil globule was 0.131 ± 0.010 mm (Table 3).

First hatching occurred at 22 h 30 minutes after spawning (AS) and continued for one and half hours until 24 h AS.

Divisions of cell (1) took two hours thirty minutes, *Blastula* stage (2) for one hour, *Gastrula* stage (3) took around seven hours, *Neurulla* stage (embryonic shield) (4) needed one hour thirty minute, head and optic lobe formation (5) just less than thirty minute, body and organ development including tail and *kuppfer's vesicle* (6) needed four hours and

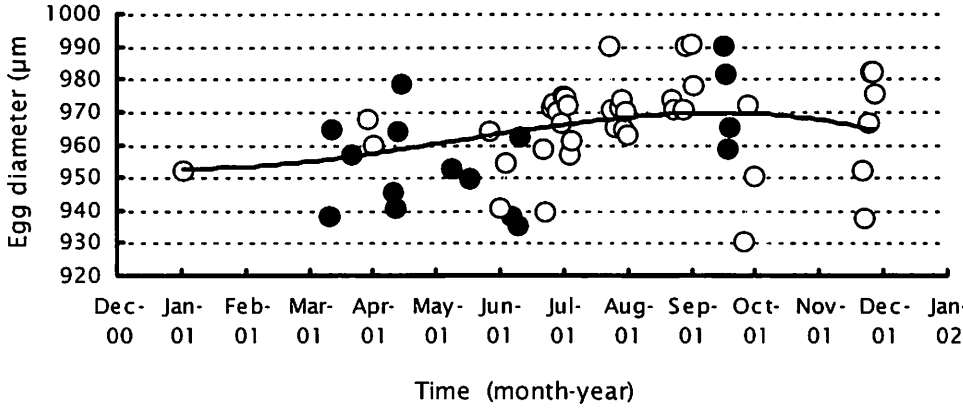

Figure 1. Spawning performance of *Lutjanus sebae* base on egg diameter produce in full moon (open circle) and new moon (close circle) period

Table 2. Spawning data at 2001 in average

Spawning time	2:20	AM
Egg diameter	963	*μm*
Oil globule	127	*μm*
Fertilization rate	90	%
Incubation temperature	27–28	°C
Hatching time	10:00	PM
Incubation time	19:39	(hour)
Hatching rate	75.86	%
Egg volume	0.46832	(mm^3)
Oil globule (OG) volume	0.00109	(mm^3)
Ratio OG/Egg	0.23	%

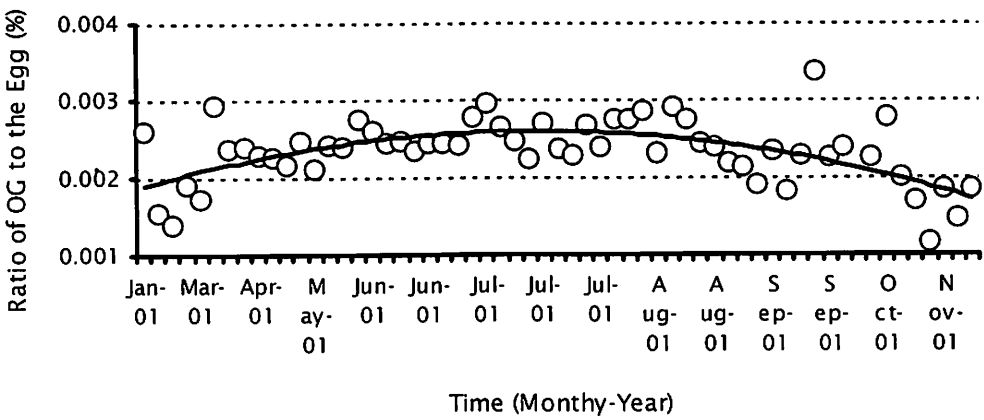

Figure 2. Distribution ratio of oil globule to the egg volumes of *L. sebae*

thirty minutes, that body movement and pulse of the heart (7) was observed at seventeen hours forty-five minutes after spawning, at nineteen hour thirty minutes tail was pointed and free from yolk (8), breaking of eggshell (9) started at twenty-one hour thirty minute and start hatching (10) at twenty-two hour after spawning (Figure 3). Gastrula and body development stages were the longest period to develop, similar pattern was also observed in *Siganus guttatus* with the longest period development of gastrula (2 h 35 min) and body (4 h 50 min) (Hara *et al.*, 1986). Tseng & Ho (1988) divided the embryonic development of red grouper *Epinephelus akaara* into three-stage namely A. cleavage, B. embryonic development, and C. hatching, at cleavage stage (A) development of *blastoderm* to the late gastrula took 4 h 30 min. and at embryonic development (B) from optic vesicles to the embryo began to leap was 6 h 30 min. Description of embryonic development may differ by species, however the same patterns were development of blastoderm cells spread over the yolk mass until the embryo began to leap and the hearts began to beat was the longest period of embryonic development for any kind of species. Melianawati *et al.* (2001; 2002) reported that gastrula and embryonic stage were very fragile in low temperature of incubation (21°C—22°C) for *Epinephelus microdon* and *E. coioides*.

Point of discussion

- Spawning performance of red emperor snapper *L. sebae*, showed the ability to produce eggs continuously throughout the

Table 3. Embryonic stage after spawning

Time After Spawning (hour: minute)	Embryonic stage
0:15	Two cells
1:00	Eight cells
1:45	32 cells
2:00	Multi cells
2:45	Blastula
3:45	Early gastrula (Blastoderm occupied more than half surface of yolk)
7:45	Gastrula
9:45	Late Gastrula
12:15	Neurulla (initial body development/embryonic shield)
13:45	Body-organ-tail and *kuppfer's vesicle*
18:15	Movement of body and heart
19:30	Tail was pointed and loose from yolk
22:00	Breaking egg shell
22:30	Hatching

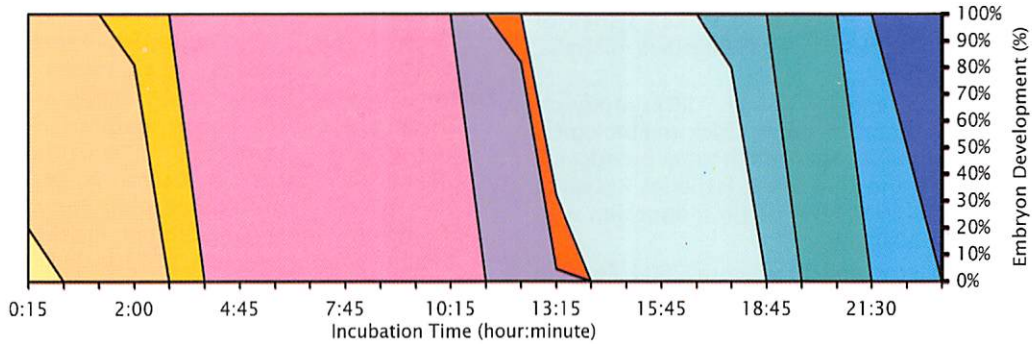

Figure 3. Embryonic development pattern of *L. sebae*

year, and was an important point to consider in selection of mariculture species.

- Egg and oil globule diameter or volume must be an important part to decide in larval rearing management, to use egg produced in April-October in full moon period would give better result and perhaps the best ones from July to August where the diameter of egg was bigger with oil globule to the egg ratio of over 0.25%.
- Gastrula and body-organ (embryonic) development stage was the fragile part in overall embryo development of red emperor snapper *L. sebae* the same as other species, should be taken into account in the incubation management strategy for an optimal result.

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