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Copepod nauplii-A suitable feed for the hatchlings of yellow tail Damsel *(Neopomocentrus nemurus)*

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ABSTRACT

The present investigation was carried out to observe the suitable feed for the larvae of yellow tail damsel fish Neopomocentrus nemurus. Egg clutches were obtained from a single pair was maintained in 200 liter circular tanks under controlled conditions. Eggs were laid in earthen pots and male guarded the clutch until they hatched. Hatching took place 89 to 107h at 29 °C after post fertilization. Larvae were divided into two different experimental groups and fed on different feeding combinations in order to find out the first initial suitable feed for larval survival and growth. First group (Group A) was fed with Brachionus plicatilis and second one (Group B) with mixed copepod. Highest survival rates (7%) were observed when the mixed copepod offered to the larvae forms (Group B). This shows that mixed copepod is the most important suitable feed for rearing the young ones of yellow tail damsel fish N. nemurus.

Key words: Yellow tail damsel, *Neopomocentrus nemurus*, livefeed, copepod, hatchlings.

INTRODUCTION

Production of animals for the aquarium hobbyist trade is a rapidly growing sector of the aquacultural industry, and it will continue to become more important as restrictions are placed on collecting animals for the wild. Aquaculture is generally considered to be the rearing or husbandry of aquatic organisms for commercial purposes Landau (1992). Majority of aquaculture production in worldwide is devoted for food production and ornamental fish rearing.

Tropical and subtropical countries are among the world's largest exporters of ornamental marine species for the private aquarium trade. The World ornamental fish Customs Organisation Market indicates that global exports in 2005 were valued at US$237,636,000 and that global imports were worth US$282,549,000. Estimates suggest that, in terms of value, the majority (at least

90%) of the trade in ornamental species comprises freshwater species (Henley, 1984; Andrews, 1990; Basleer, 1994; Olivier, 2001; Gerstner et al., 2006). The marine ornamental fish plays a growing role in the international fish trade. Since 1985, the international trade in exports of ornamentals, which usually takes place in the majority of developing countries, followed an increasing trend with an average growth rate of approximately 14% per year. The entire industry has been estimated to be worth around US$15 billion.

The damselfishes constitute one of the major groups of marine ornamental fishes inhabiting tropical coral seas. Their unique behavior, bright colours, small size and quick acclimiation to captivity make them very attractive to marine aquarists. There are about 300 species of damselfishes belonging to 22 genera under the family Pomacentridae, majority of which inhabit the Indo-Pacific region and about 100 species and 18 genera have been recorded in Indian Ocean. The yellow-tailed damsel *N. nemurus*, which belongs to the large Perciform family Pomacentridae, is one of the most common marine fishes on tropical reefs, Allen (1975). All damsel fish are benthic spanners, typically depositing their eggs on a piece of coral or rock which the male has previously cleaned and which afterwards he guards vigorously. Damsel fish are small often aggressive and frequently colourful fish usually found close to reef surface, characterized by single nasal opening on each side of the head. The dorsal fin is long and continuous. Damsels do well in captivity unless you have a very large tank, however, say 200 gallon or more. Because of so colourful and active many aquarists desire to keep them.

Since Pomacentridae family play an important role in the trade of ornamental fish Wilkerson (1998), the aim of the study was to describe the breeding condition, hatching processes and to find out the proper diet of the initial phase for larval success.

MATERIALS AND METHODS

Ten sexually matured live fishes were collected in January 2007 from the Palk Bay area, along the coast of India are caught from the wild, measuring approximately 5.5 – 6.4 cm. During the first month, the ten fishes are kept all together in a 1000-L tank. Then, when pairs were formed, they are transferred into 500-L breeding tanks. Males are usually more territorial than females. The water quality was maintained at optimum level. A photoperiod consisting of 12 h of light and 11 h of darkness was provided exclusively. Earthen Pots and Roof tops were placed in the tank as a surface on which the fish could spawn. The fish were fed twice a day using chopped fish, clams, ribbed clams, green mussels, shrimps, beef liver, fish liver, squid and fish eggs. The live feeds such as polycheates, *Acetes* sp and *Artemia* sp were also provided.

Behavioral observations

Behavioral observation were taken 3 times a day (7-8 am, 12-1 pm, 5-6 pm) during the first two months to record the male choice of territory and on courtship behavior.

Sampling of embryos and larvae

The subsample of the embryos (24, 48, 72, 96, 106h) were taken from one pair to observe the development stages of post hatch. The main development stages were photographed under the microscope.

Hatching

An hour before hatching at about 103h of post fertilization at 29°C, the pot with egg clutch was transferred to 200- L larval rearing tank. Characterized by the same chemical physical characteristics of the breeding tank. The tank was covered by the thick black sheet and the egg clutch was left in darkness for about 1 h. After this period 90% of hatching took place. Aeration was provided inside the pot in order to create a water flow.

Zooplankton culture

B. plicatilis at the average size of 239 µm were cultured on mixed *Nannochloropsis oculata* and *Chlorella marina* at 30 ppt salinity and 29°C temperature. The same phytoplankton's was used for the mixed copepod culture.

Larval rearing

The inner sides of each tank was coated with light green colour and the water was gently replaced twice by dripping system. The sides of the tank was covered with black sheets to reduce light reflection while the phytoplankton was used 50000 cells/ml to condition the tank. Larvae were divided into two different groups Group A fed with *B. plicatilis* and group B fed with mixed copepod in order to find the first suitable prey for larval survival of yellowtail damsel. Totally 1000 larvae were stocked in each tank and each experiment group was maintained in triplicate. All the experimental groups were subjected to an extended photoperiod (12L/12D). The experiment was continued for ten days to find out the first phase suitable feed for larvae.

RESULTS

Optimum water quality parameters were maintained during the experimental periods (temperature 26^{o}C to 32^{o}C, salinity 27 to 32ppt, pH 7.8 to 8.3.and DO 4.0 to 6.5 mg/L). Among ten fishes one pair began spawn after 3 months; the pair has been moved to breeding tank. The courtship begins on the 4th day before spawning, with the initiative in courtship being taken by male; the male drove all the fishes except paired female. The male maintained its territory and actively cleaned the nest site by rubbing with the pelvic fins, pick off loose particles and algae with their mouths. So often the male moved towards female and invite her to the cleaned nest. For the first three days the females enter into the nest several times but did not spawn. On the fourth day the females enterer the nest with distended venter and the courtship consisting of sidclutchee to side shaking motions with close contact with males. The female lays eggs during early morning hours.

During incubation period, both the parents were carefully looked after the eggs. Male spends 70% of time in the nest, it fanned the eggs by fluttering the pectoral fins and by mouthing it removes the dead or weakened eggs and dust particles. Male assumed nearly all responsibilities of for caring the eggs than the females did. On the fourth day evening, fanning of the eggs by males are increased.

Table 1. One way ANOVA between two experiments

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	7093.889	1	7093.889	**19.95912**	**0.000298**	4.413873405
Within Groups	6397.578	18	355.421			
Total	13491.47	19				

The eggs were encased in a flexible, transparent and the cleavage stage (8 cell stage) were well developed at 5 h of post fertilization. At about 24 h of post fertilization the embryonic shield was evident and a very large yolk sac was present at 96 h of post fertilization. The heart located in small cavity, was beating posteior body cavity was prominent and the anal pore was evident, a reduction in yolk mass was observed. At about 107 h the embroyos were ready to hatch the tail had wrapped completeley around the egg, reaching its distal to the adhessive side and the embryos showed the typical metallic eyes.

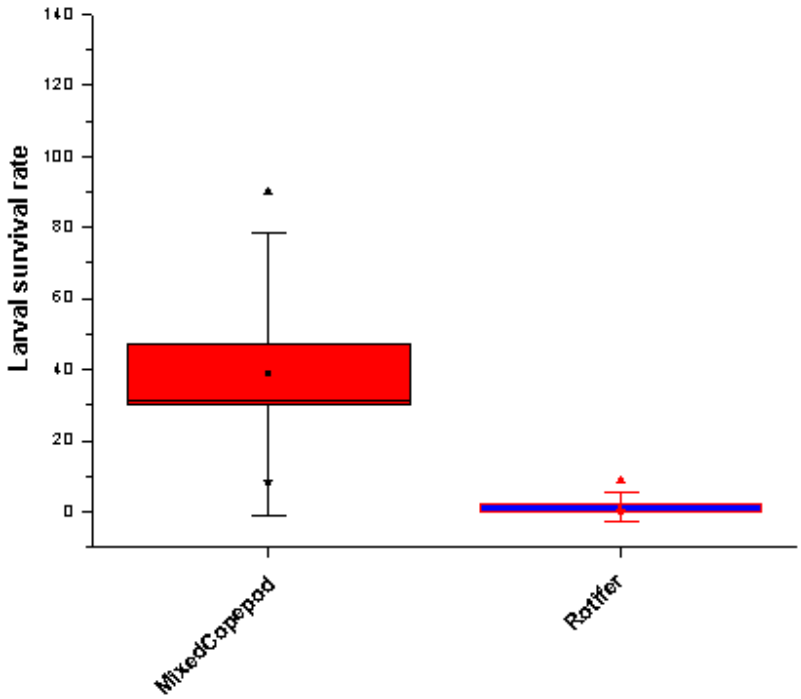

Fig. 1 Survival rate of the Yellow Tail Damsel larvae during the Culture period

The clutch size varied from 3000 – 4000 eggs. The freshly laid eggs were yellowish, translucent and capsule shaped. Egg size was about 0.95 mm. The incubation period ranged from 86 to 107 h. And normally hatching took place between 1900 to 2100 hrs. Hatching rate was about 95 to 98%. Newly hatched larvae were active and swim near the water surface and the yolk sac was completley observed during the 2nd day. Pigmentation was very light. Eyes, mouth, gut and finfold had changed on the 4th day (Fig.2 and 3). On the tenth day the larvae swam activeley in the bottom area.

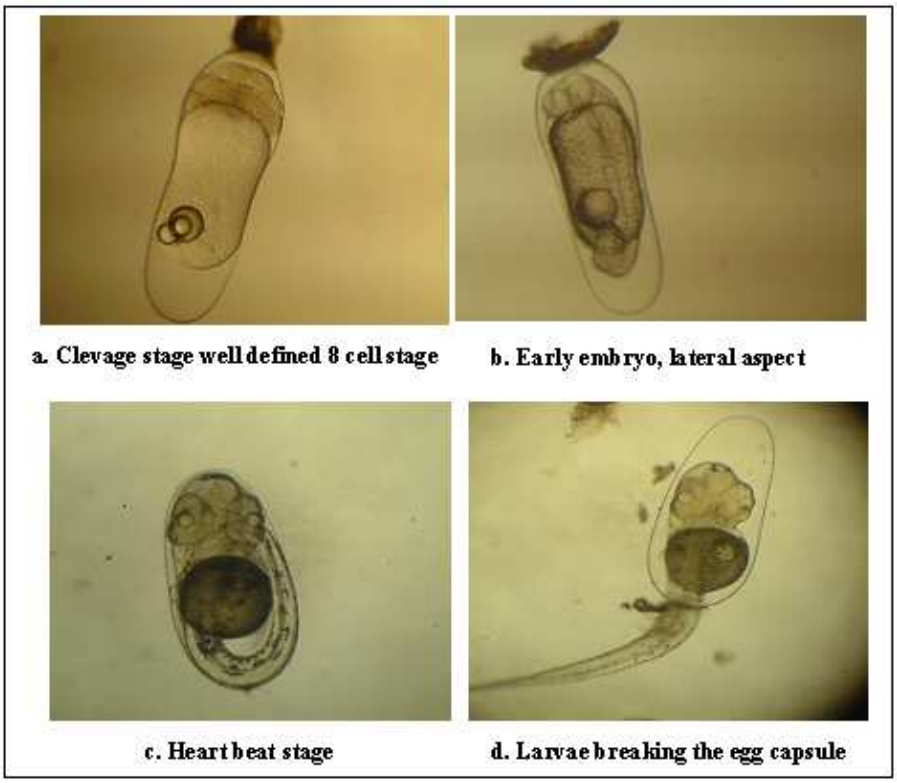

Fig. 2 Embryonic Development of *N. nemurus*

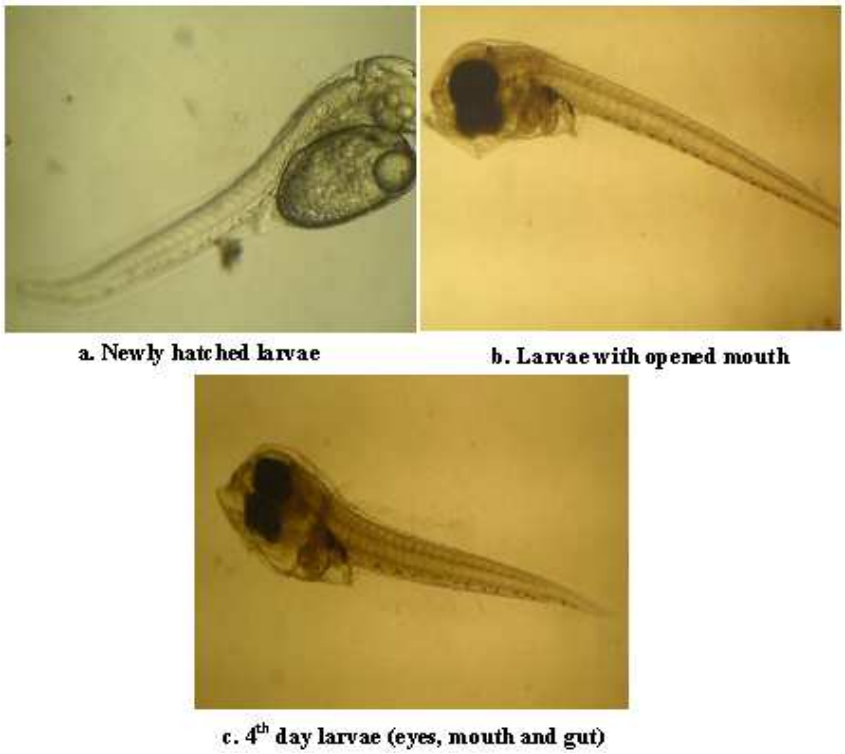

Fig. 3 Larval Development of *N. nemurus*

In mixed copepod culture the *Calonoids* sp. and *Cyclopods* sp were found predominant (fig. 2d). The average production of the nauplii was about 37,573 per liter and in *B. plicatilis* the production rate of the nauplii was about 19,178/liter. Mortality rate of the larvae fed with *B. plicatilis* was (90%) and almost all the larvae died on the 3rd day. In mixed copepods system the percentage of survival rate 90 ± 3, 61 ± 4, 35 ± 2, 27 ± 1.5, 10.6 ± 2.08 and 8 ± 1.52 respectively during the day 1, 3, 5, 7, 9 and 10. Significantly higher survival rate was observed in larvae fed on the mixed copepod culture. The one way ANOVA results were performed between the two experiments are significant.

DISCUSSION

Damselfishes can be divided into two groups in terms of social systems, those in which both are permanently territorial and those in which both sexes are non territorial Thresher (1985). Reproductive development can be divided into several distinct sequential process gonadal growth, development, and final maturation and spawning. Providing suitable husbandry and appropriate environment variables, many species undergo gonadal maturation in captivity. Even if a large number of marine ornamental fish and invertebrates have been spawned, only a few have been successfully reared in captivity Olivotto et al.(2003). The species investigated are monodomous and protogynous hermaphrodites in which the larger fishes establish territories and finally become males. The mating system was promiscuous in which both males and females spawn with several mates. The size advantage model predicts a close relationship between functional female to male sex change (protogyny) and a polygynous mating system (Ghiselin 1969; Warner 1975; Warner et al. 1975). An individual is expected to change sex from female to male when its reproductive success as a male and as a female is a function of age or size, and it obtains higher reproductive success as a female when small or young, but as a male when it becomes older and larger. This condition occurs frequently under a single or single-male polygynous mating system, where a single large male defends resources such as food and sheltering sites required by females and mates with all the resident females, or in more open polygynous systems, in which a few large males defend limited spawning sites and mate with a large number of females (Warner 1984;1988a). Functional protogyny and a polygynous mating system are frequently observed in fishes, and the mating advantages of large males in polygynous systems has been considered as the major factor favoring protogyny (Warner 1984;1988a; 1988b). Providing a suitable substrate for the fish couples creates a good environment to spawn naturally Ostrowsky (2000). The yellow tail damsel fish deposits demersal adhesive eggs on hard substrates, usually in sheltered areas Shaw (1955). The eggs are elliptical and are attached to the substrate with their adhesive filaments. Four to five days after fertilization, the embryos hatch right after sunset, when potential diurnal predators have retired to the reef structure (Foster 1987; McAlary ; McFarland 1993), and they develop into planktonic larvae. In our study the courtship begins on the 4th day before spawning. In *Gobiosoma* sp. male started approaching the female by vibrating vigorously before half an hour to the spawning and attract the female to the nest site. Olivotto et al.,(2003). The male drove all the fishes except paired female and male maintained its territory. Often the male moved near the female facing her and inviting her to the cleaned nest.

The social organization share a suite of reproductive charecters that include diel timing of spawning, presence and options of colonial synchronous spawning, female spawning frequency

and interval and spawning duration. They produce demersal eggs which are tendered by male parent until hatching Thresher (1985). Our data showed that the females entered into the nest several times but did not spawn. On the fourth day the females entered the nest with distended venter and courtship consisting of side to side shaking motions with close contact with males. The female lays eggs during early morning hours and rarely extend up to noon. During incubation period, the male carefully looked after the eggs and it involved two basic activities fanning and mouthing. Male takes responsibility of caring the eggs and spent 70% time at the nest. All the eggs were encased in a flexible, transparent, spherical capsule surrounded by several threads. Even if a large number of species undergo gonadial maturation and spawn in captivity, the early life stages remain the critical bottleneck in the production of most marine ornamentals (Holt, 2003; Olivotto et al., 2003). In the present investigation the hatching time was between 1900 to 2100 hrs and the hatching rate was about 95 to 98%. Karino and Arai, (2006) observed that hatching success of eggs within male nests showed positive correlation with the time spent by males in fanning eggs and the clutch size. In contrast, the hatching success did not show any significant correlation. They also states that the time spent by the males in fanning behaviour was influenced by the clutch size within the nest.

Gopakumar et al. (2002) reported that the larvae metamorphosed and the characteristic colour pattern of the adults appeared within 30-40 days and the survival rate was 3%-4% for the three species of damselfishes. In the present study revealed that two feeding system to find out suitable feed. Survival rate of the larvae in fed with mixed Copepods is 8.33% and other system fed with rotifer is 0%. In mixed copepods system the mortality rate is high on the 3rd day and in rotifer culture system the mortality rate (90%) is very high on the 10 day. On day, 7% of survival was noticed so it is confirm mixed copepod is suitable for the feed for the yellow tail damsel larvae when compared to rotifer culture system. The fecundity of copepods is also higher, the average production of the nauplii was about 37,573 per liter and in *B. plicatilis* the production rate of the nauplii was about 19,178/liter. Olivotto et al., (2005) states that wild copepod nauplii and copepodites are the natural food of fish larvae and they also observed that higher survival rates were observed that in larvae fed on naked ciliates *Euplotes* sp than *B. plicatilis.* Copepods are having higher nutritional value than Artemia and it plays a vital role in initial feeding for survival and growth (Rajkumar, 2004). The study conclude that the male takes the major responsibility in parental care and the mixed copepod culture (*Calonoids sp*. and *Cyclopods sp*) is the suitable and initial feed for the larvae of yellowtail damsel fish.

REFERENCES

[1] Allen, G.R.**1991**. Damsel fishes of the world. Mergus publications, Melle, Germany, 272p.
[2] Andrews, C.**1990**. *J. Fish. Biol.*, 37:53-59.
[3] Basleer, G.**1994**. *Info fish International*., 5(94):15-17.
[4] Foster, S.S. **1987**. *Mar Biol.*, 95:333–343
[5] Gerstner, C.L., Ortega, H., H, Sanchez ,D.L. Graham, **2006**. *J. Fish. Biol.*, 68(3): 862-875.
[6] Ghiselin, M.T. **1969**. *Q Rev Biol*., 44:198-208.
[7] Gopakumar, G, R. M, George ,S. Jasmine, **2002**. Breeding and larval rearing of the clownfish, Amphiprion chrysogaster, *CMFRI Newsletter*.
[8] Henley, G, **1984**. US imports millions of ornamental fish annually. *TRAFFIC*, 5(1): 18-20.

[9] Holt, G.J., **2003**. Research on culturing the early life history stages of marine ornamental species. *In*: Cato,J.C., Brown, C.L., Brown, C.L. (Eds.), Marine ornamental species: collection, culture and conservation. Iowa State Press. p 251-254.
[10] Landau, M., **1992**. Introduction to aquaculture, wiley, Newyork, 440 pp.
[11] McAlary, F.A, W.N. McFarland, **1993**. *Environ. Biol*., 37: 237-244.
[12] Olivier, K., 2001. FAO/Globefish Research Programme, Vol. 67. United Nations Food and Agriculture Organisation, Rome, Italy.
[13] Olivotto, I., Cardinali, M., Barbaresi, L., F. Maradonna, and O. Carnevali, **2003**. *Aquaculture*, 224: 69-78.
[14] Ostrowsky, A.C., **2000**. Dolphins (Mahimahi) culture. In: Sticckney, R.R.(ed.), Encyclopedia of Aquaculture. Wiley, New York, p 232-239.
[15] Shaw, E.S. **1955**. *Copeia.,* 2:85–89
[16] Thresher, R.E., P.L. Colin,L.J. Bell, **1985**. *Copeia*., 420-434.
[17] Warner, R.R. **1975**. *Am Nat.*, 109:61-82.
[18] Warner, R.R. **1988a**. *Am sci*., 72:128-136.
[19] Warner, R.R. **1988b**. *Ecol. Evol.*, 3:133-136.
[20] Warner, R.R., D. R. Robertson, E.G Jr. Leigh, **1975**. *Science*., 190:633-638.
[21] Warner, R.R,D.R. Robertson, **1978**. *Smithson Contrib Zool.*, 524:1-27.
[22] Wilkerson, J.D., **1998**. Clownfishes.A Guide to Their Captive Care, Breeding and Natural History.1st ed.Microcosm, Shelburne,VT.p. 240-260.