

Research Article

BREEDING BEHAVIOUR OF SPIKETAIL PARADISE FISH, *PSEUDOSPROMENUS CUPANUS* (CUVIER, 1831)

B.K. Sneha Chandran, V. Jayaprakas and A. Biju Kumar*

Department of Aquatic Biology and Fisheries, University of Kerala, Kariyavattom, 695581,
Thiruvananthapuram, Kerala, India

Article History: Received 28th August; 19th September 2013; Published online 7th November 2013

ABSTRACT

The spike tail paradise fish *Pseudosphromenus cupanus* (Cuvier), a hardy indigenous ornamental fish inhabiting a wide variety of inland aquatic ecosystems in India, can be bred easily in the aquarium tanks. As a typical anabantoid fish it exhibits bubble nest building and interesting breeding behaviour. The nest building behaviour shown by the male indicates its readiness to spawn and the process include leading-to-the-nest behaviour by males, scratching behaviour, mating behaviour including anabantoid embrace, and placing eggs into the bubble nest both by the males and females. The one male: one female ratio was found to be good ratio for successful breeding; on an average about 438 eggs were extruded by single female during complete spawning.

Keywords: Anabantoid embrace, nuptial colouration, bubble nest, ethology.

INTRODUCTION

The spike tail paradise fish *Pseudosphromenus cupanus* (Cuvier) (Family Osphronemidae) is distributed in the freshwater and brackish water bodies of India, Sri Lanka, Bangladesh, Myanmar, Malaysia and Indonesia (Froese and Pauly, 2011). This anabantoid or labyrinth fish (order Perciformes and suborder Anabantoidei) possess accessory respiratory organ (labyrinthiform organ) and therefore survive in a wide variety of inland aquatic ecosystems (Jayaram, 2010; Abraham, 2011). Primarily carnivorous in nature, this species is effective in controlling mosquito larvae (Shen *et al.*, 1991) and are exported from India as an ornamental fish (Jayalal and Ramachandran, 2012). Labyrinth fish are well known for their fascinating reproductive behaviour, including bubble nesting and parental care. Reproductive behavior of *P. cupanus* was studied by Pal and Southwick (1965), while Indira (1986) studied

the biology and Padmanabhan (1955) reported on the breeding habits and early embryology. Norman and Greenwood (1963) also mentioned about breeding behaviour of *P. cupanus*. This paper describes the breeding behaviour of *P. cupanus* and provides photo documentation of the ethology of the species during breeding.

MATERIALS AND METHODS

Fishes for the study were collected from the Vamanapuram river, Thiruvananthapuram district, Kerala using mosquito net and brought to the laboratory. The fishes were transferred to glass tanks (size 44 cm length x 30 cm width and 30 cm height) filled with freshwater; temperature of water ranged between 26-28°C and pH around 7. All specimens selected for pairing were above 20 mm in standard length to ensure maturity. Initially male and female fishes were acclimatized and conditioned in separate tanks by giving natural food items such as mosquito larvae, chopped earthworm and tubifex worms.

*Corresponding author e-mail: abiju@rediffmail.com; Tel: +91 9447216157

For breeding, conditioned males were introduced in the tank initially, followed by females after a gap of few days. Various combinations of males and females were tried in the trials and one male for one female ratio was found to be effective for better results. One male and one female fish were introduced in each tank and they were fed with mosquito larvae, chopped earthworm and tubifex worms. Vegetation (*Pistia stratiotes* L.) was provided in each tank. The breeding behaviour of the fish was recorded for a set of 10 tanks, with the help of videos and the process was photo documented.

RESULTS

The first sign indicating readiness to spawn is nest building behaviour displayed by the male. The male gulped air into his mouth and ejected it as a bubble coated with mucus; the bubbles were released towards the water surface, often along the inner margins of the aquarium or at the sides of the floating vegetation. This process was repeated several times and the numerous minute bubbles expelled out adhered together as to form floating frothy nest. The final shaping of the nest by the rearrangement of bubbles was done by the male fish with his snout (Figure 1). The bubble nest was usually anchored to the floating vegetation (Figure 2).

A distinct intensification of colouration was noticed in males indicating readiness to spawn. The females ready to spawn were characterized by round belly. The nuptial colouration exhibited by the males includes fluorescent sky blue colour along the outer margin of dorsal, caudal and anal fins and prominent easily distinguishable dark spots on the body (Figure 3). Male and female in the ratio 1:1 was found to be ideal for successful breeding.

The male fish always initiated the mating behaviour. On spotting the female, the male starts chasing it and the next step is leading-to-the-nest behaviour by which the male leads the female to the bubble nest (Figure 4). After completing the process of nest building, male

turns his attention to the female beginning with 'scratching behaviour' to turn on her for a courtship (Figure 5). Female displays unusual body posturing before she follows the males to the bubble nest.

Mating behaviour begins with the circling movements, in which the male circles around the female when both of them reach beneath the bubble nest (Figure 6). The degree of readiness of both individuals to spawn determines the duration of circling movements. On the termination of the circling movements, the male places himself at the mid-region of the female and curved his body over female's such that his head and tail region touches each other. The female rotates through 180° and lies ventral side up. The pair remains motionless in this posture and this is typical "anabantoid embrace" (Figures 7, 8). After 2 to 3 seconds, when the pressure is relaxed, they slowly sink down to the bottom resulting in the extrusion of a batch of eggs (Figures 9, 10). The fertilization of eggs was effected at the time of extrusion. The eggs which sink down the water were immediately picked up by the male and also by female and blown into the nest (Figure 11). The duration of mating varied from 2 to 3 hours during day hours. Each separate enfolding during the mating act had a mean duration of 15 seconds. There was no extrusion of eggs during the first few enfoldings and the last few enfoldings and have been termed as 'pseudo spawning'.

During the first 8 extrusions the number of eggs extruded in a batch was only up to 8. The maximum eggs were produced in the subsequent 15-17 extrusions, in each batch. After this the number again slowly decreased down. During last 2-3 enfoldings no eggs were extruded. Each separate enfolding has duration of about 12 seconds. The interval between successive enfoldings ranged from 2 to 10 minutes. On an average about 438 eggs were extruded by single female during complete spawning. The eggs hatched out within 32 hours after extrusion; hatching percentage recorded was 80%.



Figure 1. Bubble nest making and maintenance by the male of *Pseudosphromenus cupanus* (photos © Dr. A. Biju Kumar).



Figure 2. Bubble nest attached to *Pistia stratiotes*.



Figure 3. Male and female *Pseudosphromenus cupanus* in-nuptial colouration.



Figure 4. Male leading the female to the nest during leading-to-the-nest behavior.



Figure 5. Scratching behaviour exhibited by the breeding pair.



Figure 6. Circling movements exhibited by the breeding pair.



Figure 7. Beginning of anabantoid embrace (stage 1).



Figure 8. Anabantoid embrace (stage 2).



Figure 9. Extrusion of eggs (stage 1).



Figure 10. Extrusion of eggs (stage 2).



Figure 11. Eggs picked up by the male in its mouth.



Figure 12. Participation of male and female fish in placing egg in the bubble nest.

The spike tail paradise fish *Pseudosphromenus cupanus* belongs to the Family Osphronemidae, in which many of the members are bubble nest builders. During the present study it was observed that an intensification of colouration was seen indicating readiness to spawn. It also shows specific nuptial colouration. The onset of courtship is marked by increased territoriality, development of nuptial colouration, and nest-building in the male gouramies (Low and Lim, 2012). The first sign of readiness to spawn was nest building behaviour which was strictly performed by the male. The nest building process is a male oriented job in many members of the family Osphronemidae such as *Betta*, *Trichopodus*, *Macropodus opercularis* (Haung and Cheng, 2006). Plants or other substrates are necessary to hold the nest in place *Macropodus opercularis* (Degani, 1989). In this study also floating aquatic plant such as *Pistia* was found effective to hold the nest in place. *Salvinia natans*, *Lemna minor*, and *Pistia stratiotes* are floating plants to which the fish's bubble nests are commonly found to be attached in Taiwan (Huang *et al.*, 1998). There is considerable disparity in the size of nest built by the males of *P. cupanus*. Jones (1940) stated that the diameter of nest ranged from 8 to 13 cm in the field. Nest sizes observed during the present study under the laboratory conditions were from 6 to 10 cm in diameter.

According to Padmanabhan (1955), non-availability of the female for a longer period to the conditioned male results in the neglect of the nest by the male and its subsequent degeneration. This was also recorded during the present study. The "nest posting" behaviour shown by *P. cupanus* is also exhibited by other anabantoids such as *Colisa*, *Trichogaster* and *Bodis* (Forselius, 1957; Barlow, 1962).

A noteworthy observation with regard to the initiation of mating behaviour in the present investigation was that, as in the case of the nest building activity positive initiative was taken by the males. However, earlier studies on the same species by Pal and Southwick (1965) suggested

that the initiative may be taken either by the male or the female. *P. cupanus* differs from the related species like *Trichogaster trichopterus*, where the female initiates the spawning sequence by approaching and butting a dark, nest building male (Liley, 1969).

Mating behaviour begins with the circling movements leading to 'anabantoid embrace' which results in the extrusion of the eggs. The enfolding movements observed during the present study, substantiated by the works of Jones (1940), Padmanabhan (1955), Pal and Southwick (1965), Indira (1986) in the same species, are basically similar to that of other anabantoids. The first few enfolding do not lead to the extrusion of eggs and have been termed 'pseudo spawning' by Forselius (1957) and Pal and Southwick (1965). 'Pseudo spawning' was observed during the present study also. It occurred during the beginning and at the end of the mating cycle.

During the present study the number of eggs laid by the female ranged between 418 and 449. Pal and Southwick (1965) reported 646 eggs per mating while Jones (1940) and Padmanabhan (1955) reported the number of eggs as around 400 per spawning. Indira (1986) stated that number of eggs laid by the female ranged between 240 and 760.

A noteworthy observation in this study was found that females also picked the eggs that sunk down in the water and blown into the nest. It was also noticed that the time of spawning was normally around midday. This may be attributed to the fact that at night, the female could not see the colour display of the male to get excited and moreover, if mating took place at night, the males could not possibly detect the eggs to be picked up and deposited in the nest. If the mating took place at night, the breeding colouration would not have its significance as well.

CONCLUSIONS

P. cupanus is a prolific breeder, when fed with natural feed such as mosquito larvae and

chopped earthworm. They are bubble nest builders and exhibit synchronized natural behaviour and therefore for successful breeding programmes should ensure ideal conditions in the tank for successful spawning.

ACKNOWLEDGEMENT

The authors are thankful to the head of the institutions for providing the necessary facilities.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest associated with this article.

REFERENCES

- Abraham, R., 2011. *Pseudosphromenus cupanus*. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1. <www.iucnredlist.org>. Down loaded on 13 August 2013.
- Barlow, G.W., 1962. Ethology of the Asian teleost *Badis badis* sexual behaviour. *Copeia*, 2: 346-360.
- Degani, G., 1989. The effect of temperature, light, fish size and container size on breeding of *Trichogaster trichopterus*. *Isr. J. Aquacult. Bamid.*, 42: 67-73.
- Forselius, S., 1957. Studies of Anabantid Fishes. *Zool. Bid. Fran. Uppsala*, 32:93-302.
- Froese, R. and Pauly, D., 2011. (Eds.) FishBase. World Wide Web Electronic Publication. URL: <http://www.fishbase.org> [version 08/2011].
- Huang, W.B. and Cheng, F.L., 2006. Effects of temperature and floating materials on breeding by the paradise fish (*Macropodus opercularis*) in the non-reproductive season. *Zool. Stud.*, 45(4): 475-482.
- Huang, Y.H., Lee, T.H., Liao, Y.C. and Yo, S.P., 1998. Observation on the reproductive behaviour of the paradise fish, *Macropodus opercularis*. *Chinese Biosci.*, 41: 21-28.
- Indira, B., 1986. Studies on air breathing fishes *Macropodus cupanus* and *Anabas testudineus*. Ph.D. Thesis, University of Kerala, India.
- Jayalal, L. and Ramachandran, A., 2012. Export trend of Indian ornamental fish industry. *Agric. Biol. J. N. Am.*, 3(11): 439-451.
- Jayaram, K.C., 2010. The Freshwater Fishes of the Indian Region. 2nd (ed). Narendran Publishing. New Delhi.
- Jones, S., 1940. Notes on the breeding habits and early development of *Macropodus cupanus* (Cuv. & Val.) with special references to the cement glands of the early larvae. *Rec. Indian. Mus.*, 42: 269-269.
- Liley, N.R., 1969. Hormones and reproductive behaviour in fishes. In: Fish Physiology. Vol. 11, (Eds. W.S. Hoar and D. J. Randal). Academic Press. New York, pp. 73-116.
- Low, B.W. and Lim, K.K.P., 2012. Gouramies of the Genus *Trichopodus* in Singapore (Actinopterygii: Perciformes: Osphronemidae). *Nature Singapore*, 5: 83-93 .
- Norman, J.R. and Greenwood, P.H., 1963. A History of Fishes, Ernest Benn Ltd., London, p. 450.
- Padmanabhan, K.G. 1955. Breeding habits and early embryology of *Macropodus cupanus* (Cuv. & Val.). *Bull. C.R.I*, Trivandrum, 4(1): 1-46.
- Pal, B.C. and Southwick, C.H., 1965. Reproductive behaviour of the Indian spike tailed paradise fish *Macropodus cupanus* (Cuv. & Val.). *J. Bombay Nat. Hist. Soc.*, 62: 463-474.
- Shen S.C., Tzeng, C.S. and Shoang, C.Y., 1991. Studies on the mosquito control by using endogenous fishes. Institute of Zoology, National Taiwan Univ., Taipei, Taiwan.