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Gonadal Maturation,Courtship Behavior And Parental Care In Oreochromis Mossambicus

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Abstract: ***Courtship behavior and parental care in Oreochromis mossambicus was studied in laboratory conditions. Adult mature male and female were kept in aquarium in the ratio 3:1.When they get acclimatized only male body color became black with orange tips at the edges of fins and both male and female show protruding genital papillae. Courtship behavior, indicative of spawning such as pairing, chasing and touching bodies was observed in this study. Brooders were found to be cruise together frequently, come together prior to releasing eggs and sperm. Fertilization is external, soon after fertilization female keeps all fertilized eggs in her mouth, this is the peculiar character, hence the name mouth brooder. Female keeps the eggs in her mouth as many as 12 to 15 days until hatchlings became independent.***

Keywords: Courtship, parental care, mouth brooder.

I. INTRODUCTION

Tilapia the super-fish, is a commercially cultured fish that is easy to grow, fast to reproduce, adaptable to farming settings and conditions, while at the same time is resilient to disease and highly acceptable by American consumers.

Tilapias are native to Africa and the Middle East. Once foreign to the United States, populations of Tilapia are now established in Arizona, California, Hawaii, Florida, Wyoming, Nevada, New Jersey, North Carolina, and Texas. Tilapia was introduced to North America, South America and the Caribbean islands in the early 1950's.In California; tilapia has been used for weed control in irrigation channels. As in Africa, tilapia was introduced as a sport fish in the rivers and lakes of Alabama.

Courtship can be defined as mating system of species is specific pattern of male and female association [Shuster and Wade 2003] .Since male only provide the sperm to female, hence male reproductive success is generally is limited by assess to females. As a consequence males tend to be the sex that searches for females, initiates courtship fight for mate, finally trying as many mates as possible. Female reproductive success is limited by access to resources.

Courtship behavior involves all the behavioral interaction between female and male which lead up before the fertilization. Courtship behavior in goldfish started with the event of male chasing the female rapidly often nudging her flanks with his snout and attempting to lead her to a spawning site. Male sometimes tried to attract the female by encircling the female in order to retain her in a given area. [Kavita Sharma et al, 2011].

Zebra fish have previously been characterized as group spawners and egg scatterers, although there is evidence that the mating system is influenced by both intra-sexual competition and female mate preferences. Further, competition for high quality sites for oviposition may be a key feature of mating behavior in nature, zebra fish display complex breeding behavior [Darrow &Harris, 2004].The presence of a male is essential for females to spawn eggs. Females kept in isolation or older females can become "egg-bound" which can be lethal in severe cases.

Tilapia species can be divided into three groups according to differences in their breeding behavior; 'guarders', 'male mouth-brooders', and `female mouth-brooders'. Both the species O.niloticus and T. karomo considered as female mouth-brooders.

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According to [Goncalves-de-Freitas and Nishida, 1998] descriptions. Courtship act in Nile tilapia was undulation and parallel movements around the female and near aquarium bottom.

Tilapia belong to a large family of fish (Cichlidae) that are found naturally in the warm, fresh and brackish waters of Africa, South and Central America, southern India and Sri Lanka. Approximately 150 species have been imported into Australia as aquarium fish.

Mozambique mouth brooders are hardy fish, tolerating a wide range of temperatures and surviving in high salinities and low dissolved oxygen. Consequently they have colonised a variety of habitats including reservoirs, lakes, ponds, rivers, creeks, drains, swamps and tidal creeks. They usually live in mud bottomed, well-vegetated areas, and are often seen in loose aggregations or small schools. Males grow slightly larger than females. Females and non-breeding males are mainly silver in color with 2-5 blotches along the midline and occasionally the dorsal fin. Breeding males are black in color.

Different mouth brooding patters are studied in fishes showing the parental care [George W. Barlow, 2003]. *Table 1.*

Category	Subcategory	Definition
Postponocavus		The parents postpone picking up the adhesive eggs for several hours typically until near hatching
Promptocavus		The non-adhesive eggs are picked up soon after spawning.
Duocavus		Both parents pick up and continue to care for the eggs or fry.
Cedocavus		One parent picks up the eggs soon after spawning, but later cedes them to the other parent.
	1) Male leads	Male is the first parent to pick up the eggs.
	2) Female leads	Female is the first parent to pick up the eggs.
	3) Cede fry	Parent retains young until they can swim; both parents then care for the fry.
	4) Cede wrigglers	Parent gives embryonic young to its mate.
	5) Intraspecific	Parent gives offspring to foster parent of the same species. Also called farming out.
	6) Interspecific	Parent gives offspring to parents of a different species. Also called farming out.
Unicavus		One parent picks up the eggs and becomes their sole caretaker.
	1) Patricavus	The male is the caretaker.
	2) Matricavus	The female is the caretaker.
Iterocavus		After the fry are released, they remain with the parent(s) and re-enter the parent's mouth to escape danger or to overnight.
Semelcavus		After the fry are released, they depart, never to re-enter the parent's mouth.

Table 1: Classification of Mouth brooding

Experimental fish, Oreochromis mossambicus is a mouth brooder and known for its peculiar parental care which is well known. However studies related to courtship behavior and parental care are rare in this fish under laboratory conditions. This study is an attempt to study both courtship behavior and parental care in this fish under laboratory condition.

II. MATERIALS AND METHODS

The adult fishes were procured from the local tanks of Hubli Dharwad area and were kept in aquaria under laboratory conditions to acclimatize for about one month. Breeding of Tilapia was conducted in aquaria in the ratio of (3:1) three females and one male under laboratory conditions providing all the necessary conditions like temperature ranging between 26 -28,ph,photo period of 10hours light, 12hours dark and providing artificial food in the form of pellets. The young ones procured after the breeding were reared in the laboratory for the gonadal development studies and Courtship behavior and parenting.

III. OBSERVATIONS

During breeding season males acquire black color and orange color at the tips of dorsal and anal fins, where as female does not change the body colour.Both mature male and female during breeding show a protruding genital papilla near the ventral fins. This is used for passage of milt in males and ova in females. Male displays characteristic courtship behavior by selecting one of the female and chasing the female for some days about a week. If female is ready for courtship, both fishes swim in circular fashion rapidly again for two to three days, during these movements sometimes male touches the ventral part of female and similarly female pokes ventral region of male .Finally female lays eggs on flat surface of at the bottom of aquarium Immediately then female keep fertilized eggs in her mouth cavity and protects the eggs. The breeding female can be identified by swollen hyoid region of fish.

Many breeding males surround the female fish, but the dominant male drives away all the males the fertilized eggs are immediately picked up by the female and then she keeps them in her mouth cavity. The breeding female can be easily identified by her swollen hyoid region or somewhat swollen buccal cavity. The females are hardly seen opening their mouth for food during the entire mouth brooding stage.

In oreochromis mossambicus social bond between the mother and young are formed by the process of mouth brooding, by this method extra attention is paid to young ones.

Mother can keep eggs in her mouth until hatching and even after hatching till yolk dissolves and even sometimes after yolk absorption to protect from enemies. If they are set free from the mouth of mother all hatchlings were gather near mother mouth any disturbance in the aquarium suddenly mother take hatchlings back into her mouth. Juvenile fish are

kept into the mother's mouth until she believes they are independent. At this stage, they are released into shallow waters and continue autonomous growth. . At this stage, they are released into shallow waters and continue autonomous growth. They swim in schools and keep relatively close to their mother so they can easily return into her buccal cavity if threatened.

IV. DISCUSSION

Present study about courtship behavior in O.mossambicus is found to be similar in almost all tilapian species for example in tilapia niloticus [Goncalves-de Freitas and Nishida,1998]T. karomo [Lowe 1956] congregate on the spawning grounds and each male establishes a territory wherein he prepares a nest. The males have a brightly colored breeding dress, (becomes black in color) including a long genital papillae, they are slightly larger than the females, which are less brightly colored. Similar pattern of behavior has been observed in Gold fish.[Kavita Sharma et al,2011].Where as in Zebra fish, competition for high quality sites for oviposition may be a key feature of mating behavior in nature, zebra fish display complex breeding behavior [Darrow & Harris, 2004], involving competition among both males and females [Spence & Smith, 2005; Gerlach, 2006], as well as preference for mates [Pyron, 2003; Gerlach & Lysiak, 2006; Spence & Smith, 2006]and spawning substrate [Spence et al., 2007b]. The presence of a male is essential for females to spawn eggs. Females kept in isolation or older females can become "eggbound" which can be lethal in severe cases.

In Oreochromis mossambicus, social bond between the mother and young one are formed by the process of mouth brooding. By this method extra attention is paid to the young and extensive care is portrayed. The mother carries a mouthful of eggs or fry for about a period of 13 to 14 days under these circumstances, feeding and breathing movements are constrained for the benefit of the young. In some cases, the young fish swim out of the mother's mouth before twelve days. The mother considers this unfavorable and snaps them back into her mouth until she believes that they are ready to be released. After the young are released, they usually keep close proximity to their mother. Parental care is shown in the face of danger where they are allowed to return to the mother's mouth if threatened by a predator.

Present observation reveals the courtship behavior and mouth brooding feature of after brief period of courtship female releases eggs and male sprays milt thus fertilization is external and female picks immediately fertilized eggs in her mouth for development until hatching and even after hatching for period of 13 to 15 days until they became independent which is similar in Oreochromis niloticus,which is well known for its uniparental custodial care that is carried out solely by the female [Balshine-Earn & Earn 1998].

Those familiar with mouthbrooding cichlids know this behavior is expressed in different ways. A female *Satanoperca leucosticta*, for instance, lays sticky eggs that after a long interval are picked up by both the male and the female, whereas the female *Pseudotropheus zebra* alone takes up her eggs just after spawning; and her eggs are loose and do not stick to one another. Some mouthbrooders, such as the Mozambique tilapia, care for the fry for weeks after they have emerged from the mother's mouth, but in marked contrast the fry of *Tropheus moorii* leave the mother as soon as she releases them. Such diversity indicates an array of evolutionary stories.

The mouth brooding pattern in O.mossambicus is found to be matricavus,i.e female parent is caretaker of the eggs and also iterocavus,i.e,after the fry are released, they remain with the parent and re-enter the parents mouth to escape from danger.

In *Sarotherodon melanotheron*, the blackchin mouthbrooder, the male alone broods the eggs [Shaw and Aronson, 1954; Aronson, 1949; Oppenheimer and Barlow, 1968]. Other species in the genus may do the same [Trewavas, 1983]. Recent research has been stimulated by this unusual *patricavus* behavior in a cichlid, with the possibility that males and females may have reversed their sexual roles [Balshine-Earn and McAndrew, 1995; Barlow, 1991].

Exclusively female care of the brood recurs among cichlids of most lineages of mouthbrooders [Goodwin et al., 1998]. It is prevalent, for instance, among tilapiine cichlids of the genus Oreochromis [Lowe, 1956; Trewavas, 1983]. The African haplochromines are entirely matricavus [Eccles and Lewis, 1981; Seehausen, 1996]. And in the Neotropics, in the few known cases of unicavus behavior, all are matricavus [Newman, 1993; Leibel, 1993b; Leibel, 1993a].

Parent-young relationship can last a number of weeks in some of the tilapiine cichlids [Trewavas, 1983]. Same is observed in the present study. South American cichlids also have prolonged *iterocavus* behavior, and they can be either *duocavus* or *unicavus* [Leibel, 1992].

The typical *semelcavus* mouth brooder is a single female who lays among the biggest eggs reported in cichlids, carries them in her mouth for up to one month, and releases large, well-developed young that immediately leave the mother when set free, never to return. Lake Tanganyika provides numerous instances of *semelcavus* parenting [Kuwamura and Nagoshi, 1987; Ochi, 1993; Yanagisawa and Nishida, 1991].

A peculiar courtship behavior has been observed in Oreochromis mossambicus, under laboratory conditions, otherwise in nature the eggs are deposited in the small pits created by the sand on pebbles at the bottom of the ponds and male releases the milt over them.

Gonadal maturation plays an important role in initiating the courtship behavior and hormones play an important role here.

V. CONCLUSIONS

Breeding behavior is the indicator of gonadal maturation and in turn gonad maturation is under the control of hormones. When gonads mature its activity is initiated by the secretion of hormones leading to morphologically changing body color. Courtship ends in release of gametes and their fertilization. Fertilized eggs taken by female parent are kept in her mouth cavity for protection, which is a peculiar phenomenon of "Mouth brooding" observed in Oreochromis mossambicus.

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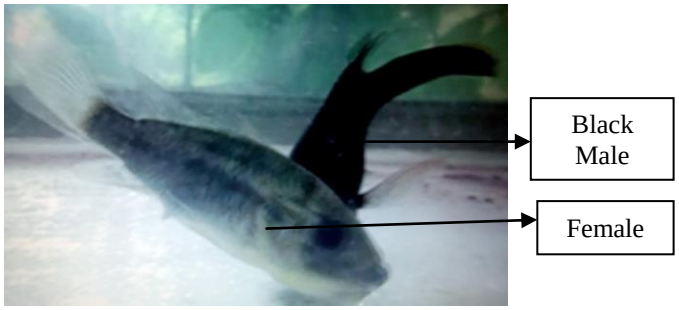
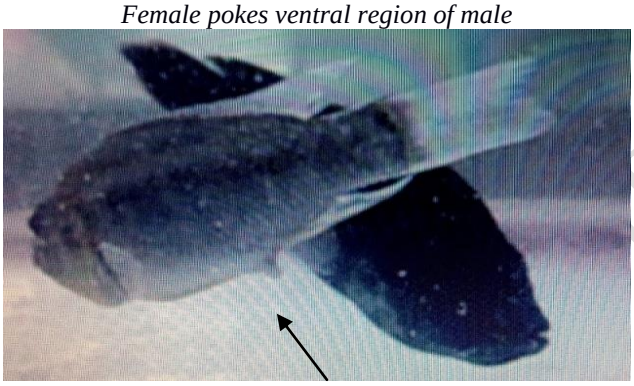
Pictures to display Courtship behavior and parenting in Oreochromis mossambicus

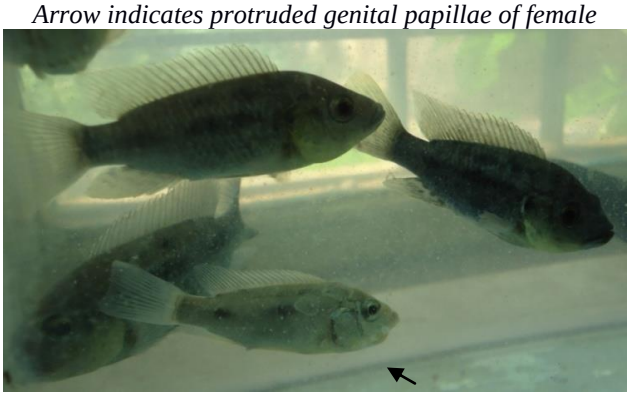


Selecting and chasing the female by male

Female pokes ventral region of male



Arrow indicates protruded genital papillae of female



Arrow indicating swollen hyoid region of brooding female

Female with mouthful of eggs

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REFERENCES

[1] Aronson, L. R. 1949. An analysis of reproductive behavior in the mouth breeding cichlid fish, Tilapia macrocephala (Bleeker). Zoologica 34: 133-158.
[2] Barlow, G. W. 1991. Mating systems among cichlid fishes, pp. 173190. In: Cichlid Fishes. Behaviour, Ecology and Evolution. M. H. A. Keenleyside (ed.). Chapman and Hall, New York.
[3] [3].Balshine-Earn, S., and B. J. Mc-Andrew. 1995. Sex-role reversal inthe black-chinned tilapia, Sarotherodon melanotheron (Rüppel) (Cichlidae). Behaviour 132:861-874.
[4] [4].Balshine-Earn, S., and D. J. D. Earn. 1997. An evolutionary model of parental care in St. Peter's Schwanck, E., and K. Rana. 1991. Male-female parental roles in Sarotherodon galilaeus (Pisces: Cichlidae). Ethology 89:229-243
[5] Eccles, D. H., and D. S. C. Lewis. 1981. Midwaterspawningin Haplochromis Chrysonotus (Boulenger) (Teleostei: Cichlidae) in Lake Malawi. Env Biol. Fish. 6:201-202.
[6] Gerlach G. 2006. Pheromonal regulation of reproductive success in female zebrafi sh: Female suppression and male enhancement. Anim Behav 72:1119-1124.
[7] Gerlach G, Lysiak N. 2006. Kin recognition and inbreeding avoidance in zebrafi sh, Danio rerio, is based on phenotype matching. Anim Behav 71:1371-1377.
[8] Goodwin, N. B., S. Balshine Earn, and J. D. Reynolds. 1998. Evolutionary transitions in parental care in cichlid fish. Proc. Roy. Soc. London (B) 265:2265-2272.
[9] Gonclaves-De-Freitas,E.and S.M.Nishida.1998. Sneaking behavior of the Nile tilapia. Boletim Técnico do CEPTA 11: 71-79.

[10] George W. Barlow, 2003. How to observe and report mouth-brooding in cichlid fishes Published 08-Apr-2003 in Cichlid News Magazine, Jul-00 pp. 24-31,
[11] Kavita Sharma, Nitish Bansal, Shashank and Gajender Singh, (2011) Studies on breeding and feeding patterns of the goldfish, Carassius auratus under captive conditions for sustainable ornamental fish hatchery management. Department of Zoology and Aquaculture, CCS HAU Hisar, Haryana.
[12] Kiersten.O.Darrow and William. (2004) A Harries Characterization and development of courtship in Zebrafish Danio rerio.Zebrafish.Vol.1, No: 40-45.
[13] Kuwamura, T., M. Nagoshi, and T. Sato. 1989. Female-to-male shift of mouthbrooding in a cichlid fish, Tanganicodus irsacae, with notes on breeding habits of two related species in Lake Tanganyika. Env. Biol. Fish. 24:187-198.
[14] Leibel, 1992. Lowe (McConnell), R. H. 1956. The breeding behaviour of Tilapia species (Pisces; Cichlidae) in natural waters: Observations on T. karomo and T. variabilis Boulenger. Behaviour 9:140-163.
[15] Leibel, W. 1992. Goin' south - Part 8: Cichlids of the Americas. Maintaining and spawning the demonfish. Aquar. Fish:27-36.
-. 1993a. Goin' south - Part 12: Cichlids of the Americas. The key to success with these fish is excellent water quality. Aquar. Fish: 43-51.
-. 1993b. Goin' south - Part 9: Cichlids of the Americas. Maintaining and spawning the demonfish. Aquar. Fish:45-51.
-. 1998. The evolution of mouthbrooding in South American geophagine cichlids. Lafayette
[16] Lowe (McConnell), R. H. 1956. The breeding behaviour of Tilapia species (Pisces; Cichlidae) in natural waters: Observations on T. karomo and T. variabilis Boulenger. Behaviour 9:140-163.
[17] Newman, L. 1993. Maintenance and breeding of the red hump eartheater, Geophagus steindachneri Eigenmann and Hildebrand 1910. Cichlid News 2:14-16.
[18] Ochi, H. 1993 Maintenance of separate territories for mating and feeding by males of a maternal mouthbrooding cichlid, Gnathochromis pfefferi, in Lake Tanganyika. Jap. J. Ichthyol. 40:173-182.
[19] Oppenheimer, J. R., and G. W. Barlow. 1968. Dynamics of parental behavior in the black-chinned mouth breeder, Tilapia melanotheron (Pisces: Cichlidae). Z. Tierpsychol. 25:8899
[20] Pyron M.(2003). Female preferences and male-male interactions in zebrafi sh (Danio rerio). Can J Zool 81:122-125.
[21] Seehausen, O. 1996. Lake Victoria Rock Cichlids: Taxonomy, Ecology, and Distribution. Verduyn Cichlids, Germany.
[22] Shaw, E. S., and L. R. Aronson. 1954. Oral incubation in Tilapia macrocephala. Bull. Amer. Mus. Nat. Hist. 103:375-416.fish. J. Theor. Biol. 184:423-431.
[23] Shuster S.M and Wade M.H, 2003.Mating system and strategies, 533pp.Prinston; Princeton University Press.(A theoretical treatment of mating systems and strategies with several key insights).
[24] Spence R, Smith C (2005) Male territoriality mediates density and sex ratio effects on oviposition in the zebrafish, Danio rerio. Anim Behav 69:1317–1323
[25] Spence R, Smith C. 2006. Mating preference of female zebrafi sh, Danio rerio, in relation to male dominance. Behav Ecol 17:779-783.
[26] Spence R, Ashton R, Smith C. 2007b. Oviposition decisions are mediated by spawning site quality in wild and domesticated zebrafi sh, Danio rerio. Behaviour 144:953-966
[27] Trewavas, E. 1983. Tilapinefishes of the Genera Sarotherodon, Oreochromis and Danakilia. Comstock Publishing, Ithaca, New York.
[28] Yanagisawa, Y., and M. Nishida. 1991. The social and mating system of the maternal mouth brooder Tropheus moorii (Cichlidae) in Lake Tanganyika. Jap. J. Ichthyol. 38: 271-282.