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ORIGINAL ARTICLE **OPEN ACCESS**

Courtship Behavior in Indigenous and Exotic cichlids in Batticalloa Lagoon, Sri Lanka

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ABSTRACT
Data presented on the courtship behavior of three chichlids. Etroplus suratensis and E. maculatusare indigenous cichlids found in Sri Lanka. The two Etroplusspecies are sympatric and show segregation of habitat. The exotic O. mossambicus plays a key role in the inland fishery of the man-made water bodies of Sri Lanka. The African cichlid O.mossambicuswas introduced in Sri Lanka in 1952. The objective of this study is to record courtship behavioural patterns found in the different stages of reproduction of the three cichlids. In this study, the courtship behaviour of all three species inhabiting the same area are compared. Behaviours associated with courtship including quivering: One-way ANOVA ($F_{2,22}$=0.77, p=0.474), Finflickering: ($F_{2,22}$=0.69, p=0.512), Chaffing: ($F_{2,22}$=1.18, p=0.325), Skimming: ($F_{2,22}$=1.45, p=0.256), and Nipping: ($F_{2,22}$=0.01, p=0.986) were similarin all three species of chichlids.
Keywords: Cichlids, Courtship behaviour, Communication, Reproductive tactics.

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INTRODUCTION

Various aspects of the reproductive biology of many cichlid species, particularly of the *Tilapia*s, have also been documented in their natural habitats [1, 2] as well as from the waters into which they have been introduced [3]. The courtship plays different roles in animals [4], advertise their quality to the potential mates (e.g. flies[5]; fish[6] ; birds: [7] and/or location (e.g. crabs[8]; flies[9]; fish [10]; frogs[11, 12] ; birds[13, 14].

Courtship has been considered that it is more complex and interactive process. Courtship between male and female can prolong extended periods in many species. Studies have reported how this type of courtship process link to decision of mate selection. Further, the same studies that examine mate searching by comparing the time that individuals invest in potential mates[15, 16, 17, 18].Although there is general agreement on the strategies adopted by the mouthbrooders and the guarders [3], there are few comparative studies on any one species in this range of distribution and on relationships of aspects of the reproductive biology to environmental and or other variables introduced by man.

The objective of this study is to record courtship behavioural patterns found in the different stages of reproduction of the three cichlids. In this study, the courtship behaviour of all three species inhabiting the same area are compared.

MATERIALS AND METHODS:

Study Species:

The only endemic cichlid species in Asia are *Etroplus suratensis* (Bloch, 1790), green chromide and *E. maculates* (Bloch, 1795), orange chromide. Their distribution is confined to Southern India and Sri Lanka[19] . These sympatric species are found in brackish water, coastal lagoons, large reservoirs, rivers and estuarine in Sri Lanka and India [20]. The exotic *O. mossambicus* plays a key role in the inland fishery of the man-made water bodies of Sri Lanka. The African cichlid *O.mossambicus* was introduced in Sri Lanka in 1952.

Data collection:

Behavioural interactions between adjacent pairs and other species were evaluated by means of direct observations. Some observations were done from the elevated bund of the brush pile as in [21]. Focal sampling method [22, 23] of observation of one pair for 15 minutes was made. A total of 15-18

pairs/nests were observed for each species; 3-4 days a month were required to collect data on behaviour. The fish were randomly selected. A total of 225 hours observation was made for each species. Data were collected between 10.00 and 14.00 when visibility was best [21]. During the reproductive season more frequent data were collected. I maintained a distance of at least 1-2 m from the focal pair of fish. Recording commenced after a 15 minute acclimation period. All quantitative behavioural records and field notes were written with the pencil on water resistant paper.

Statistics

A two way ANOVA was done with species and the two stages as factors (SAS, v6.12 Windows package). Significant overall ANOVA (GLM) was followed with a DMRT. Results were considered significant at the probability level of 0.05 or less. SAS v6.12 for Windows. Significant overall analysis was followed by post hoc tests (Duncan Multiple Range Test).

Behaviours that were rarely observed were not included in the analysis but were included in the behavioural repertoire of each phase of reproduction. This included lateral display, Lateral display was only observed in *O.mossambicus* and only during pair formation.

Behavioural Patterns Recorded

The following behavioural patterns related to reproduction were recorded in the study. Data sheets were used to record behaviour.

Lateral Display: Presentation of side of body to another organism. Erections of medial fins may be partial or complete. It is classified according to identify of organism displayed Viz., Lateral display to conspecific (Ldc) [24].

Quiver (Qu): Rapid vibration of the body. Sometimes the body tilted diagonally upward as it quivered [24, 25, 26].

Fin Flicker (Ff): Rapid extension and folding of pelvic fins usually several times in quick succession [24, 27].

Chafe mate (CfM): Approaching mate caudally or medially and making sidelong contact with its lateral body surface. Either a station or moving fish was thus contacted. While making contact the chafing fish swam in the same direction as the other [24].

Skim (Sk): Gliding along the spawning surface with the ventral body surface in contact with it [26].

Nip (Np): Pick up individual pieces of some solid or substratum or inanimate objects from the brooding pit, clean and spit out [26].

Table 1: Behaviour observed in the five phases of reproduction in the three cichlids. Em- *E.maculates*, Es – *E.suratensis*and Om- *O. mossambicus.*

	Pair formation			Acquiring territories			Spawning			Nest care/territory			Juvenile care		
	E.m	*E.s*	*O.m*	*E.m*	*E.s*	*O.m*	*E.m*	*E.s*	*O.m*	*E.m*	*E.s*	*O.m*	*E.m*	*E.s*	*O.m*
1. lateral display			+												
2. quivering	+	+	+	+	+	+			+						
3. fin flickering	+	+	+	+	+	+									
4. chaffing	+	+	+	+		+									
5. skimming							+	+	+		+	+			
6. nipping	+			+	+				+						

RESULTS AND DISCUSSION:

Quivering: The ANOVA for mean frequencies of quivering was not significant between the three species; (One-way ANOVA $F_{2,22}$=0.77, p=0.474) (Fig. 5.8). Mean frequency of *O. mossambicus, E. maculatus* and *E. suratensis* were 4.375 (±1.38), 2.66 (±1.12) and 5.25 (±2.01) respectively (Fig. 1.).

Fig. 1. Mean frequency of quivering (SE) in three cichlids. *E. maculatus* (Em), *E. suratensis* (Es) and *O. mossambicus* (Om). Mean with same letter indicate (ABC) are not significantly different between the three cichlids.

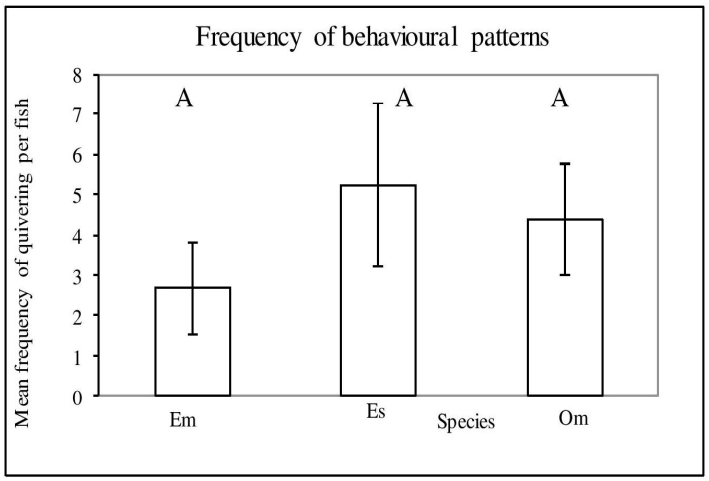
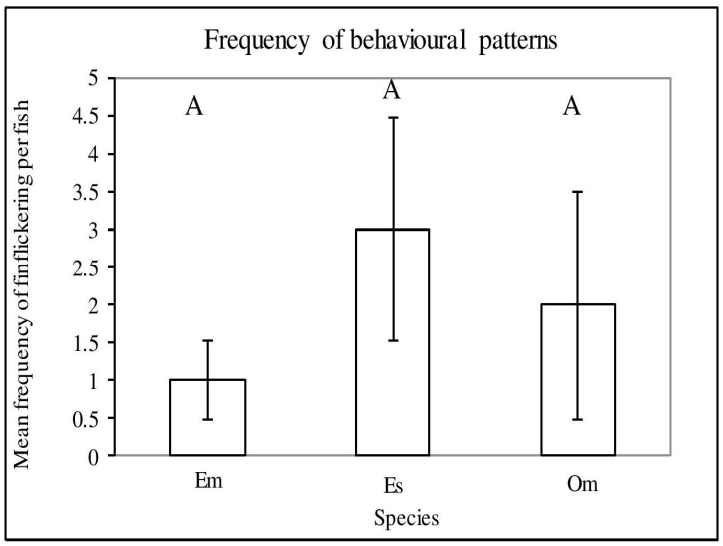


Fig. 2. Mean frequency of finflickering (SE) in three cichlids. *E. maculatus* (Em), *E. suratensis* (Es) and *O. mossambicus* (Om). Mean with same letter indicate (ABC) are not significantly different between the three cichlids.



Finflickering: The ANOVA for mean frequencies of fin flickering was not significant between the three species; (One-way ANOVA $F_{2,22}$=0.69, p=0.512) (Fig. 5.9). Mean frequency of *O. mossambicus, E. maculatus* and *E. suratensis* were 2.0 (±1.51), 1.0 (±0.527) and 3.0 (±1.51) respectively (Fig. 2.).

Chaffing: The ANOVA for mean frequencies of chaffing mate was not significant between the three species; (One-way ANOVA $F_{2,22}$=1.18, p=0.325) (Fig. 5.10). Mean frequency of *O. mossambicus, E. maculatus* and *E. suratensis* were 0.125 (±0.125), 1.0 (±0.667) and 2.0 (±0.125) respectively (Fig. 3.).

Fig. 3. Mean frequency of chaffing mate (SE) in three cichlids. *E. maculatus* (Em), *E. suratensis* (Es) and *O. mossambicus* (Om). Mean with same letter indicate (ABC) are not significantly different between the three cichlids.

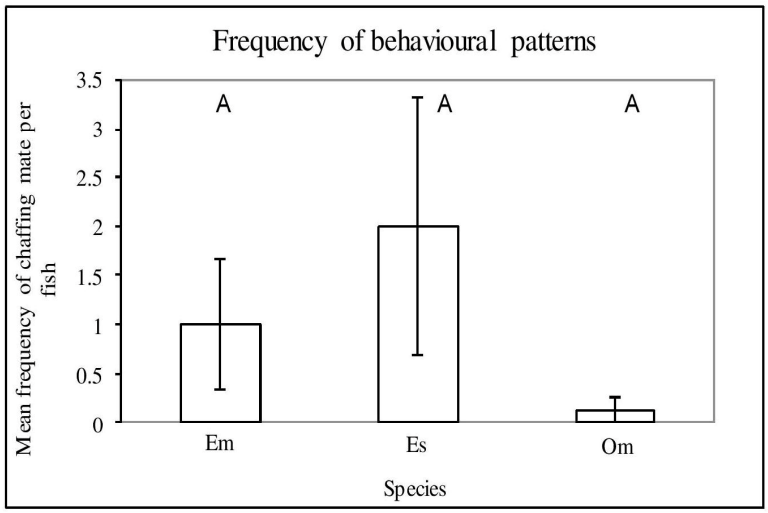
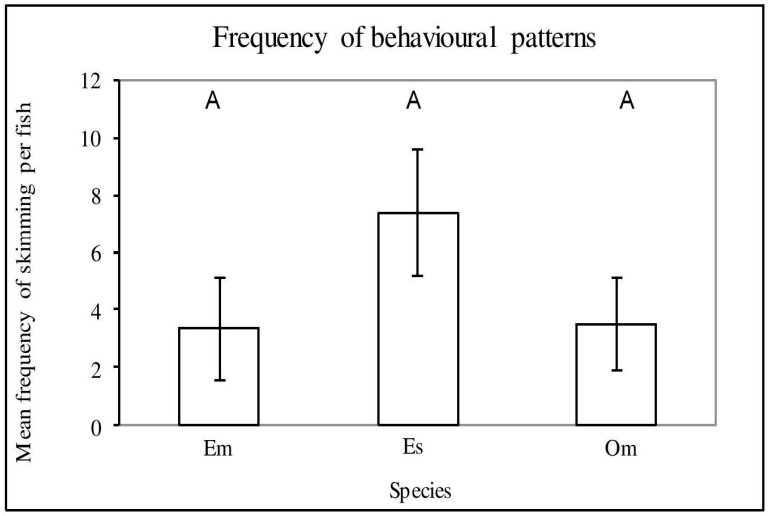


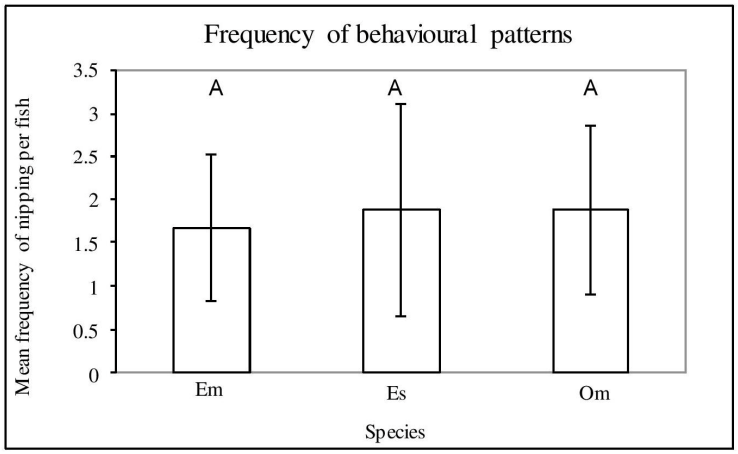
Fig. 4. Mean frequency of skimming (SE) in three cichlids. *E. maculatus* (Em), *E. suratensis* (Es) and *O. mossambicus* (Om). Mean with same letter indicate (ABC) are not significantly different between the three cichlids.



Skimming: The ANOVA for mean frequencies of skimming was not significant between the three species (One-way ANOVA $F_{2,22}$=1.45, p=0.256) (Fig. 5.11). Mean frequency of *O. mossambicus, E. maculatus* and *E. suratensis* were 3.5 (±1.63), 3.33 (±1.77) and 7.375 (±2.21) respectively (Fig. 4.).

Nipping: The ANOVA for mean frequencies of nipping was not significant between the three species (One-way ANOVA $F_{2,22}$=0.01, p=0.986) (Fig.5.12). Mean frequency of *O. mossambicus, E. maculatus* and *E. suratensis* were 1.875 (±0.972), 1.66 (±0.85) and 1.875 (±0.972) respectively (Fig. 5.).

Fig. 5. Mean frequency of nipping (SE) in three cichlids. *E. maculatus* (Em), *E. suratensis* (Es) and *O. mossambicus* (Om). Mean with same letter indicate (ABC) are not significantly different between the three cichlids.



A previous study has been done on the reproductive interactions between the two *Etroplusspp* in a brackish water system Sri Lanka in order to understand the evolutionary relationship between them[21]. It is vital that we understand the reproductive behavioural interactions of the introduced and indigenous cichilids to evaluate the impact of the introduced species on the local fauna.

Behaviours associated with courtship: quivering, finflickering, chaffing mates, skimming and nipping were similar in all three cichlids in stage. Among substrate brooding cichlids different stimuli maintain the pair bond before and after spawning. Prior to spawning the pair bond is maintained by characteristics of the partners, but after spawning it is maintained by their mutual attraction to the brood [28].

Finflickering was observed only in stage. Therefore, the function of fin flickering is probably associated with courtship and pair formation in all three cichlids. Ithad observed a difference in the context in which these behaviours occurred[21]. Quivering, fin flickering and chaffing against the mate in *E. suratensuis* occurredin the stage of pair formation in the Negombo lagoon. Whereas, in *E. Maculates* finflickering occurred while foraging and wandering. In contrary, some reports have indicated that finflickering is associated with alarm signals [29]. Finflickering behaviour in *Hemigrammuserythrozonus,* showed a conspicuous visual display upon detecting a conspecific alarm signal [29]. Finflickering also seem to serve as predator-deterrent signal.

Even though the frequency of occurrence was not different between the three species, the frequency was the lowest in *E.maculatus*. It has been also reported that *E. suratensis* superficially differs in two aspects of finflickering that exhibited by *E. maculatus.* First, the frequency of finflickering in *E. suratensis* is greater than that for *E. maculatus*. Secondly, non-parental *E. suratensis* often perform rapid bouts of fin-flickering when it sees other parental *E. Suratensis* with a school of. When doing so, the non-parental fish often attracts the school and temporarily tends them until they are attracted back to the parents when they fin-flickeryoung[24]. It has been demonstrated that fin flickering served to maintain compactness of the juvenile brood[27].

There was no significant difference in chaffing mate in the three cichlids. Chaffing has been observed in 30 families of fish including Cichlidae. Even though chaffing was observed in *O. mossambicus* the frequency of occurrence was very low. Chafing seems to be multifunctional. Chafe like behaviour in young *Etroplus* species is directed toward their parents. Secondly, it is also known that chaffing is associated with the cleaning symbiosis in *Etroplus*. The study reported that chaffing is a cleaning symbiotic behaviour between genus *Etroplus*. Removal of fungus from fins and tail appears to be an important adaptive function of this symbiosis [24]. A third function of chaffing is associated with courtship and pair formation in *E. suratensis*[30] and *E. Maculates* [12]. The observations of this study indicate that chaffing is associated with courtship and pair bonding especially in the two *Etroplus* species.

In conclusion, it could be said that Behaviours associated with courtship (quivering, finflicking, chaffing, skimming and nipping) were not different between the two species.

REFERNCES

1. Welcomme R.L. (1967). The relationships between fecundity and fertility in the mouth brooding cichlid fish *Tilapia leucostica*. *Journal of Zoology*, London,151: 453-468.

2. Fryer G, & Iles, T.D. (1972). *The cichlid fishes of the great lake of Africa: their biology and evolution*. Oliver & Boyd, Edinburgh, pp. 572.
3. Noakes, D.L.G &Balon, E.K. (1982). Life histories of *Tilapias*: an evolutionary perspective, In: *The biology and culture of tilapias*, (Ed). Pullin, R.S.V and Lowe-McConnel, R.H. ICLARM Conference proceedings, 7, Manila.
4. Baerends, G. P. (1986). On causation and function of the prespawning behaviour of cichlid fish. Journal of Fish Biology,Supplement A, 29:107–121.
5. Hoikkala, A., Aspi, J. &Suvanto, L. (1998). Male courtship song frequency as an indicator of male genetic quality in an insect species, Drosophila montana. Proceedings of the Royal Society of London, Series B, 265:503–508.
6. Knapp, R. A. & Kovach, J. T. (1991). Courtship as an honest indicator of male parental quality in the bicolor damselfish. Behavioral Ecology, 2:295–300.
7. Reid, M. L. (19870. Costliness and reliability in the singing vigour of Ipswitch sparrows. Animal Behaviour, 35:1735–1743.
8. Christy, J. H., Blackwell, P. R. Y. &Goshima, S. (2001). The decision and production of a sexual signal: hood and hood building by male fiddler crabs Ucamusica. Behaviour, 138:1065–1083.
9. Ritchie, M., Townhill, R. M. &Hoikkala, A. (1998). Female preference for fly song: playback experiments confirm the targets of sexual selection. Animal Behaviour, 56:713–717.
10. Itzkowitz, M. & Haley, M. (1999). Are males with more attractive resources more selective in their mate preference? A test in a polygynous species. Behavioral Ecology, 10, 366–371.
11. Arak, A. (1988). Female mate selection in the natterjack toad: active choice or passive attraction? Behavioral Ecology and Sociobiology, 22:317–327.
12. Gerhardt, H. C. (1994). Reproductive character displacement of female mate choice in the gray treefrogHylachrysoscelis. Animal Behaviour, 47:959–969.
13. Dale, S., Amundsen, T., Lifjeld, J. T. &Slagsvold, T. (1990). Mate sampling behaviour of female pied flycatchers: evidence for active mate choice. Behavioral Ecology and Sociobiology, 27:87–91.
14. Hasselquist, D. &Bensch, S. (1991). Trade-off between mate guarding and mate attraction in the polygynous great reed warbler. Behavioral Ecology and Sociobiology, 28:187–193.
15. Real, L. (1990). Search theory and mate choice. I. Models of single-sex determination. American Naturalist, 136:376–405.
16. Sullivan, M. S. (1994). Mate choice as an information gathering process under time constraint: implications for behaviour and signal design. Animal Behaviour, 47:141–151.
17. Luttbeg, B. (1996). A comparative Bayes tactic for mate assessment and choice. Behavioral Ecology, 7, 451–460. Luttbeg, B. (1996). A comparative Bayes tactic for mate assessment and choice. Behavioral Ecology, 7:451–460.
18. Wiegmann, D. D., Real, L. A., Capone, T. A. &Ellner, S. (1996). Some distinguishing features of models of search behavior and mate choice. American Naturalist, 147:188–204.
19. Ward J.A and Wyman R.L. (1977). Ethology and Ecology of the cichlid fishes of the genus *Etroplus* in Sri Lanka: preliminary findings. *Environmental Biology of Fishes,* 2:137-145.
20. Pethiyagoda, R. (1991). *Freshwater Fishes of Sri Lanka*. The Wildlife Heritage Trust of Sri Lanka, Colombo, 362 p.
21. Samarakoon, J.I. (1981). Parental behaviour and ecology of the Asian cichlids *Etroplussuratensis* and *Etroplusmaculatus*. Ph.D thesis, Illinois State University.
22. Altman, J. (1974). Baboons, space, time and energy. *American Zoologist*, 14: 221-248.
23. Martin, P and Bateson, P. (1986). *Measuring behaviour: an introductory guide*. Cambridge University Press.
24. Wyman, R.L & Ward, J.A. (1972). The development of behaviour in the cichlid fish *Etroplusmaculatus*(Bloch). *Zeitschrift fur Tierpsychologie*, 33: 461-491.
25. Barlow, G.W. 1968. Ethological units of behaviour. In: *Central Nervous System and Fish Behaviour,* (Ed.) D. Ingle, pp. 217-232. Chicago University Press.
26. Baerends, G.P &Baerends Van Roon. (1950). An introduction to the study of the ethology of cichlid fishes.*Behaviour Supplement*, 1:1-242.
27. Cole, J.E. & Ward, J.A. (1969). The communicative function of pelvic fin-flickering in *Etroplusmaculatus* (Pisces, Cichlidae). *Behaviour*, 35:179-1969.
28. Winkler. (1973). *The Sexual Code*. Anchor Books. Garden City.
29. Brown, G.E., Goding,J.G.J& Pederson, J. (1999). Finflickingbehaviour: a visual antipredator alarm signal in a characin fish, *Hemigrammuserythrozorius. Animal Behaviour*, 58:469-475.
30. Ward, J.A &Klaper, R. (1976). *Etroplussuratensis*- reproductive behaviour. *Encyclopedia Cinematographica.* E2205.
31. Stafford, C.L & Ward, J.A. (1983). Effects of monochoramine on courtship and spawning in the cichlid fish *Etroplusmaculatus. Pp. 213-22o.* In: *Predators and prey in fishes* (Ed.)
32. Noakes, D.L.G.,(1999). Developments in Environmental Biology of fishes. *3.* Dr. W. Junk Publishers, The Hague.

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