J. Fish Biol. (1990) **36**, 615–616

Comparison of the social behaviour of an endemic Lake Malawi cichlid in the field and laboratory

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(*Received 17 October 1989, Accepted 30 November 1989*)

Key words: behaviour; Lake Malawi; *Hemitilapia oxyrhynchus*.

Many ethological studies on cichlid fishes have been carried out in the laboratory, especially those concerning communication and parental roles. Some comparisons between field and laboratory behaviour have been made for generalized riverine species. Behavioural plasticity is to be expected in such species (Bayliss, 1974; Fernald, 1977; Neil, 1966; Schwanck, 1987) which are frequently likely to find themselves in small crowded pools—conditions similar to those found in laboratory aquaria.

Here we report some preliminary comparisons of the field and laboratory behaviour of a species which is confined to, and has evolved within, the 30 000 km^2 of Lake Malawi. *Hemitilapia oxyrhynchus* is morphologically and behaviourally highly specialized for feeding on epiphytic algae, to the extent that the genus is considered monotypic. Like all other L. Malawi haplochromines, it is a maternal mouthbrooder, and it is strongly sexually dichromatic when breeding (Fryer & Iles, 1969).

Field observations were carried out by snorkelling on Chembe beach, in front of the Cape Maclear field station. It was found that individuals forage, mainly on epiphytic algae but occasionally on plankton, in large groups, and maintain a characteristic three-spot pattern. These groups showed a marked diurnal rhythm, starting to move into shallow water (1–3 m) at 10.00 hours and steadily increasing in numbers throughout the day to a peak at 16.00–18.00 hours, before retreating to deeper water (> 3 m) to spend the night asleep. During the earlier part of the day, they could be observed feeding on the *Vallisneria* and *Potamogeton* beds on patches of sand between rocks at Otter Point, Thumbi West Island, and at the Ilala Gap. It is likely that they migrate from those areas onto Chembe beach later in the day. Males in breeding colours wandered around with the feeding shoals, and did not seem to hold fixed territories. Aggression was never observed and individual territories were non-existent.

Individual *H. oxyrhynchus*, caught from the same locality by beach seining, were marked and acclimatized to laboratory conditions for a few days, and observed in three laboratory situations. Two individuals were kept in a $90 \times 30 \times 30$ cm glass tank, two in a $1{\cdot}5 \times 1{\cdot}8 \times 0{\cdot}4$ m deep concrete pond, and six in a similar sized pond. All tanks were provided with a large number of *Vallisneria* plants which were regularly replaced. For the first 3–5 days the fish were non-aggressive. In groups of two they were pale, in the group of six blotchy. Generally, in the laboratory, fish were much more aggressive, spent less time feeding, and more time motionless than in the field. They never formed feeding groups.

In each group of two, one fish became dominant, and adopted a black eye bar and faint vertical stripes, while the subordinate showed the normal wild pattern of blotches, especially after an attack by the dominant. In the pond with six fish, a complicated mixture of dominance hierarchy and territoriality was established. One fish, PG, which was always pale, ranged over most of the area, chased all the others and was rarely challenged. G was subordinate to PG, but chased the others; it was normally pale or blotchy with faint vertical stripes, but when chased became blotchy. Fish P controlled a small territory in the corner,

0022–1112/90/040615+02 $03.00/0

remained blotchy, and was rarely involved in aggression. R, PB and PR were subordinate and usually blotchy.

After 3 weeks, the subordinate fish from the glass tank was released on Chembe beach and followed by snorkelling at the surface for 30 min. It retained its blotchy pattern throughout, and joined groups of conspecifics immediately. After 26 min it began feeding on *Vallisneria*. The dominant fish from the tank was released and followed for 11 min, but was lost due to poor visibility. It was initially pale and striped, but adopted the blotched pattern after 5 min. It rarely joined conspecifics. Extensive rains rendered the water opaque for the rest of the field trip, so the planned release and observation of all the other fish had to be abandoned.

The observations indicated that *H. oxyrhynchus* is behaviourally flexible, adopting colour patterns and social behaviour rarely, if ever, used in the lake. The faint vertical bars and loss of blotches by dominant fish was also characteristic of breeding males, which, however, have a bright blue body colour not seen in the laboratory-kept fish. A black eye stripe sometimes adopted in the laboratory was never seen in the field, but is common in riverine haplochromines, such as *Astatotilapia burtoni* and *A. calliptera*, which must be closely related to the ancestor of *H. oxyrhynchus*.

We suggest that the system of dominance and territoriality seen in the laboratory, and its associated colour patterns, is an adaptation to exploit defensible food resources in small pools, or to establish dominance over potential reproductive competitors (our fish were immature) in small populations. This suite of behavioural traits, probably inherited from distant riverine or swamp-dwelling ancestors, is almost certainly never used in the lake today. The results of laboratory studies shed light on the behavioural flexibility of the species, and, while they may not be relevant to the natural behaviour of the animals, they cannot necessarily be dismissed as merely artefacts and stress-related behaviour. In evolutionary terms it suggests that cichlid fishes may retain a complex suite of social and behavioural characteristics which are never expressed in nature, while developing an entirely different social system.

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