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AGGRESSION COLOUR PATTERN OF *ASTATOTILAPIA FLAVIIJOSEPHI* (TELEOSTEI: CICHLIDAE) IN THE AQUARIUM

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Astatotilapia flaviijosephi (Lortet, 1883) is a small cichlid endemic to the Jordan River system. This species was included within the widespread genus *Haplochromis*, until Greenwood (1978) split *Haplochromis* into a number of genera and assigned *flaviijosephi* to *Astatotilapia*. Reproduction of *A. flaviijosephi* in the aquarium was described by Werner (1976), who mentioned six colour patterns and their possible significance in the behaviour of the species. This note describes an additional pattern, which may be of considerable significance in intraspecific aggression.

In August 1978, I collected nine specimens of *A. flaviijosephi* (eight males and one female) in the Gan HaShelosha Springs (Israel Grid 192212), near Bet She'an. They were brought to the laboratory in Jerusalem, where they were kept in a 120 X 50 X 40 cm aquarium, furnished with sand, a few basalt stones and some dead vine branches. Aeration and filtration were not used; no artificial illumination was provided, but the room in which the aquarium was kept received direct sunlight during the afternoon. In the aquarium one blenniid, *Blennius fluviatilis*, was also kept, a species which occurs in nature together with *A. flaviijosephi* in the litoral zone of Lake Kinneret (personal observation). The fish were fed daphnia, fly maggots and dry food ("Tetra-min"), and grew from about 2 cm TL up to 8–10 cm TL within 12 mo. In November 1979, a year after they were brought to the laboratory, all the fish died because of accidental mistreatment.

The fish displayed some of the colour patterns described by Werner (1976), namely, silverish-grey when not disturbed, barred when afraid and striped when encountering another fish.

Soon after the fish were put into the aquarium, one male, the largest (ca. 10 cm TL), started to behave territorially by taking possession of about two-thirds of the aquarium and by chasing away the others, which crowded into the remaining third. Only during feeding time or when there was a disturbance in the aquarium, such as cleaning the glass, would he tolerate other fish in his territory. The colour repertoire of this large territorial male was similar to that of the other fish, but with one important difference: whether silverish, barred or striped, he almost always possessed a conspicuous black vertical bar running from beneath the eye to the corner of the mouth (Fig. 1). This eye bar was very bold and prominent when the male was chasing other fish and was paler when he was at rest. Changes in its intensity were remarkably

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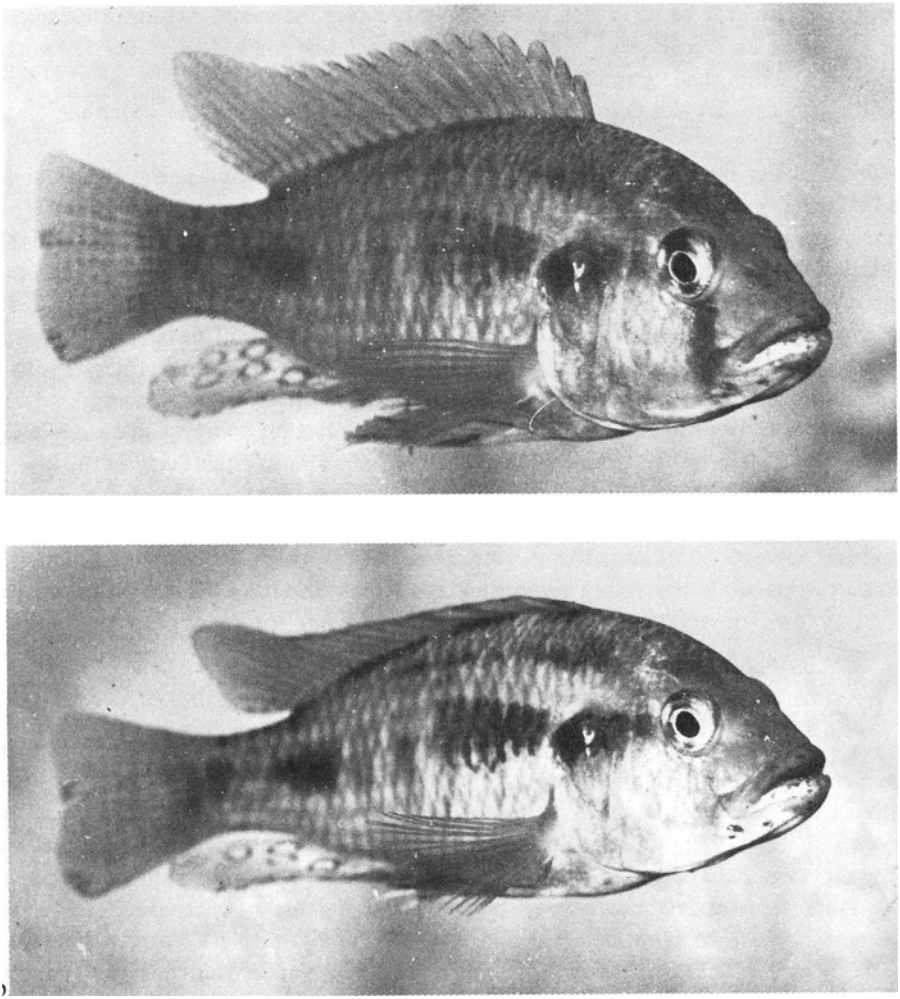

Fig. 1. (a) Territorial male in aggressive mood, while chasing away other fish. The black eye bar is very prominent. Notice also how spread the dorsal fin is. (b) Territorial male in quiet mood. The eye bar is very pale, barely discernible.

rapid. When chasing away an intruder, the bar would change within 3–4 s from very pale (before the chase) to full prominence (during the chase), and then within a few seconds, it would become pale as he returned to rest. In other males either no bar was present at all, or it was represented by very faint traces only.

During March and April the males assumed courting colouration: black on ventral fins and venter, dummy egg spots bright yellow with black (or seemingly black) rims,

lower jaw pale blue or turquoise, black bands crossing the snout, and on the flanks a red center on each scale. This courting pattern was most prominent in the territorial male, and diminished gradually in its intensity with decreasing size of the non-territorial males. To this colouration the territorial male, and only he, added the black eye bar.

Towards the end of April the territorial male dug a shallow pit in the sand, and on 25.IV.79 he courted the female. A day later the female had eggs in her mouth. This female was isolated in a separate aquarium (30 X 20 X 15 cm) and fed daphnia until the juveniles appeared a few days later. When he attained a length of only 1.5–2.5 cm, the largest juvenile began to show antagonistic behaviour towards the other six, biting them and chasing them from one corner of the aquarium to the other. This large juvenile was the only one of all the fry to possess black ventral fins and a conspicuous black eye bar.

In the main aquarium, the largest territorial male kept both his bar and his territory, even when reproductive activity was over and he lost his courting colouration.

The fact that in *A. flaviijosephi* the eye bar appears almost exclusively in the largest and most aggressive individual among both adults and juveniles, and that it is more prominent when the fish is actively aggressive than while resting, suggests that this bar expresses aggression and dominance. Interestingly, in Werner's (1976) photograph of a female resting while her young are feeding, the female also has a black bar (unfortunately, my own observations of the female guarding her fry overlooked this point). Perhaps females while guarding their young are aggressive towards conspecific adults, expressing their aggressiveness (as in *A. burtoni*, Ferald & Hirata, 1979) in the temporary possession of a bar.

An eye bar is found in at least three other species of the *Haplochromis* group. In *Haplochromis dichrourus*, Greenwood and Barel (1978) picture a sexually active male with an eye bar and a sexually quiescent one without. In *Thoracochromis fasciatus*, Fryer and Iles (1972) illustrate that when signalling "I am quietly going about my business" (fig. 231) or "I am frightened and am taking shelter" (fig. 236), the stripe is very faint, whereas in preparedness for combat in defense of a territory (fig. 233), it is very bold. In *A. burtoni*, Fryer and Iles (1972) picture (plate 8) an encounter at the boundary of the contiguous territories of two males and (frontispiece) the act of spawning; in both cases the males involved have a very prominent eye bar. Ferald and Hirata (1979) have recently found that in *A. burtoni* the eye bar, which first appears at 7 wk of age in correlation with the development of aggressive behaviour, becomes very intensified in highly aggressive males; in females it develops prior to spawning, during incubation of the eggs and during the first weeks of brood care. The use of an eye bar as an expression of aggression thus appears to be very widespread amongst the small cichlids of African origin.

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ESTABLISHMENT OF AN ISRAELI SOCIETY FOR HISTOCHEMISTRY AND CYTOCHEMISTRY

An organizing committee intends to form an Israeli Society for Histochemistry and Cytochemistry. We plan a first meeting for Spring 1982, in which a scientific session and elections for the society's institutions will be held. Those wishing to join as founding members should contact Dr. Edith Gaton, Dept. of Pathology, Sackler School of Medicine, Tel Avi University, Ramat Aviv, Tel Aviv 69978, and send a cheque for the equivalent of US$8.00 as membership fees for 1982.

Members are invited to submit summaries (up to 200 words) of lectures they would like to deliver at the meeting, before 1 January 1982.