The Quantitative Effect of Releasers on the Attack Readiness of the Fish *Haplochromis burtoni* (Cichlidae, Pisces)

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Summary. Observations suggest that the color patterns of *Haplochromis burtoni* act as primary stimuli in eliciting different responses from a territorial conspecific male. 15 dummies which represented various combinations of form and color patterns of a conspecific male were presented to males in order to determine changes in attack readiness (measured in bites/min) caused by different color patterns.

Of all the territorial colorations of a male comprising a distinctive head pattern and body and fin coloration (cf. Fig. 3c), only two components were found to affect the attack readiness: the vertical component of the head pattern and the orange patch above the pectoral fins. The former, if presented without the latter, increased the attack rate by 2.79 bites/min. The latter, if presented without the former, decreased it by 1.77 bites/min. A dummy with both colorations present increased the attack rate by 1.08 bites/min, i.e. the sum of the effect of both components if presented separately (2.79 - 1.77).

It is suggested that these color patterns keep levels of attack readiness within limits amongst territorial males in a colony. Similar explanations may apply to the function of conspicuous color markings in other cichlids.

Zusammenfassung. Verhaltensbeobachtungen an *Haplochromis burtoni* lassen darauf schließen, daß Farbmerkmale dieses Fisches verschiedene Reaktionen eines territorialen arteigenen Männchens auslösen. 15 Attrappen mit verschiedenen Kombinationen aus Form- und Farbmerkmalen eines arteigenen Männchens wurden männlichen Tieren geboten, um den Einfluß auf deren Angriffsbereitschaft (gemessen an der Zahl der Bisse pro Minute) zu bestimmen.

Unter allen Farbmustern eines Männchens, seiner markanten Kopfzeichnung und Rumpf- und Flossenfärbung, hatten nachweislich nur zwei Komponenten Einfluß auf die Angriffsbereitschaft: ein vertikaler Strich in der Kopfzeichnung und ein orangener Fleck über der Brustflosse. Die Bißrate wuchs um 2.79 Bisse/min, wenn die erste Komponente ohne die zweite geboten wurde, nahm hingegen um 1.77 Bisse/min ab, wenn die zweite ohne die erste geboten wurde. Eine Attrappe mit beiden Färbungskomponenten zusammen ließ die Bißrate um 1.08 Bisse/min ansteigen. Dies aber ist die Summe aus den beiden Werten, die jede Komponente für sich allein hervorruft.

Vermutlich dienen solche Farbmerkmale dazu, den Grad an Angriffsbereitschaft in einer Kolonie aus männlichen Tieren in Schranken zu halten. Ähnliche Erklärungen mögen bei der Deutung auffälliger Färbungen bei anderen Cichliden ebenfalls zutreffen.
A. Introduction

The mouth-breeding African cichlid *Haplochromis burtoni* shows a rich variety of color patterns. Various components are observed to appear and disappear within seconds. To some extent they reflect the animal’s state of readiness to act, e.g. a frightened fish usually shows typical camouflaging colors — black or pale all over — whereas a territorial fish shows its complete pattern of bright colors. With this in mind, one may ask, whether and how much these body colorations in turn affect the state of readiness of a conspecific which sees them. In this paper the effects of color patterns on a conspecific’s readiness to attack are analysed in detail. Single components of these color patterns as well as various combinations of them are tested as to whether and to what extent they influence aggressiveness.

B. Basic Observations

1. Color Patterns

*Haplochromis burtoni* shows a high degree of sexual dimorphism: Males are brightly colored and larger than females. Each adult male holds a territory whereas females and juvenile males do not. However, females with young defend small territories for short periods. Males exhibit various color patterns under different conditions. The following is a list of the patterns which may be observed. In Fig. 1 only the more conspicuous features are shown.

1. Males

   a) Juveniles (Fig. 1a) are grey and the black eye stands out clearly from this background. The fins are transparent with pale blue vertical stripes.

   b) Adults, ready to establish territories (Fig. 1b), are grey like juveniles. However, the head is made prominent by the presence of a distinctive, though still incomplete, head pattern. A black bar runs vertically from the eye to the corner of the lips. Two black stripes run frontolaterally across the head, the upper one joining both eyes. There are a few round orange spots on the anal fin which only become conspicuous when the fin is spread.

   c) Territorial adults (Fig. 1c) show the head pattern described in b) together with a blackening of the ventral part of both the head and pelvic fins and sometimes of the opercular spot. The body coloration is metallic light blue with a bright orange patch above the pectoral fins. Dorsal and anal fins show blue vertical lines with orange spots in between.

   d) Spawning males (Fig. 1d) have the same color pattern as in c). However, the opercular spot is always pale.