INTRODUCTION

Within the last decade a considerable amount of research has been devoted to the study of motivational systems and their interactions but most of the studies dealing with reproductive behavior consist of the observation and analysis of interaction between two or more live animals. Consequently there is the possibility that the animal being studied is faced with a stimulus which is varying in some way unknown and uncontrolled by the investigator. A solution to this problem is to use a stimulus that is relatively constant and controllable. The use of dummies satisfies these criteria and they seem especially suited for the study of fish behavior (Seitz, 1943; Tinbergen, 1951; Simpson, 1968; Leong, 1969).

Seitz (1943) was able to elicit certain behavior patterns in the cichlid fish, Hemichromis bimaculatus Gill, by presenting them with dummies. The experiments on which he reported were based on short-term dummy presentations averaging less than 3 minutes each. However, pair formation and other forms of social interaction in cichlid fishes develop over a considerably longer time scale than this (Baerends & Baerends-Van Roon, 1950). The present study was undertaken to investigate the variation of the response of adult male H. bimaculatus toward dummies over a longer time scale in

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an attempt to understand the internal factors responsible for the variation in behavior directed to conspecifics, to gain insight into the initial stages of pair formation, and to provide a basis for further research with this system.

MATERIALS AND METHODS

*H. bimaculatus* were studied at the Zoological Laboratory of the University of Groningen, Netherlands and in my laboratory in the Department of Zoology, Indiana University in Bloomington, Indiana, U.S.A. The Dutch fish were obtained from stock that had been maintained at the Zoological Laboratory for approximately 20 years while those in the laboratory in Bloomington, Indiana were first generation spawn of fish obtained from local tropical fish suppliers.

All fish studied were between 10 and 24 months of age and measured 10-11 cm (total length) for males and 7-7.5 cm for females. Sex was confirmed by inspecting the genital papillae of anaesthetized fish held under a low power dissecting microscope.

In the laboratory in Groningen, Netherlands male fish were individually maintained in aquaria measuring 60 X 32 X 32 cm, of which the front panel was of glass and the other three side panels opaque and non-reflective. Each aquarium contained a 3 cm layer of fine gravel and a 10 cm diameter clay flowerpot placed in the corner to serve as a nest site and shelter. These aquaria were housed in a room whose temperature varied between 22 and 24°C. and were illuminated for 16 hours/day by fluorescent lighting. Fish were fed twice daily on a diet of *Daphnia, Tubifex* and cooked-liver pellets. The fish in the laboratory in Bloomington, Indiana were maintained similarly, except that aquaria measured 125 X 40 X 40 cm and were filtered and maintained at 25-26°C. All fish were fed a mixture of ground fish and liver twice daily.

Dummy presentations were begun after males had resided in their aquaria for a minimum of 1 week. The dummy used in the experiments reported here consisted of a red silicone rubber casting modelled from a 7 cm (total length) preserved specimen. This casting was furnished with glass eyes and suspended 1-2 cm off the bottom of the aquarium by a thin wire. The dummy was presented at a constant orientation 50 cm from the flowerpot shelter, in most cases by a remote control pulley system that allowed the observer to remain hidden behind a screen during observations.

All observations were recorded via a keyboard-activated Esterline-Angus event recorder run at a chart speed of 3 inches/minute. The results presented here are based on 54 hours of recordings made on a total of 16 fish.

RESULTS

The behavior of the fish in this study was consistent with that described in the literature for this species (PETERS, 1941; SEITZ, 1943; BAERENDS & BAERENDS-VAN ROON, 1950) and there were no apparent differences between the behavior of fish studied in the Netherlands and in Bloomington, Indiana.

The activities of relatively short duration which were recorded as frequencies include the following:

**Biting** — the fish opens its mouth and pushes against the dummy. Sometimes the fish was able to take hold of the fin of a dummy and tear off a chunk of rubber but in either case each push or tearing movement was scored as 1 bite.

**Lateral display** — the fish extends its medial fins, lowers its branchiostegal membrane and maintains a position lateral to the dummy. Such an activity, from its onset until the fins were lowered or another activity performed, was scored as 1 lateral display. Sometimes a male maintained a lateral display and passed in front of the dummy more