6,9 mm (range 6,5–7,2 mm; S.D. 0,117; n = 19). This is larger than the mean of 6,6 mm (range 6,0–7,1 mm) given by Meester & Lambrechts (1971) for *S. v. varilla*. The difference in means is statistically significant (Students t test, Simpson, Roe & Lewontin, 1960; $t = 2{,}07$; $p < 0{,}05$). *S. v. orangiae* is regarded as a smaller race than nominate *S. v. varilla* and the similarly sized race *S. v. warreni* Roberts that occurs in the north western Cape Province. The possibility of a larger race of *S. varilla* in the northern Cape must be considered and the eventual examination of a series of specimens from the area may prove interesting.

Tadarida bocagei. Bats are seldom taken by barn owls. Vernon (1972) recorded Bocages free-tailed bat in diets of barn owls at two localities, both cliff roost sites. It is interesting that so many free-tailed bats were taken at the Heuningvlei roost site and this is probably the owls' exploitation of locally abundant species.

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POSSIBLE STIMULI FOR SOCIAL BEHAVIOUR IN THREE SPECIES OF FRESHWATER FISH

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Social behaviour in fish is manifested in many situations and one form of this phenomenon is especially interesting. Some species of fish have the tendency to form schools or to clump together. According to authorities on fish behaviour these fish either maintain a remarkably constant geometric orientation to their fellows or merely live in close proximity to their kind (Shaw 1962). The first situation is referred to as schooling, and the second has no specific nomenclature but could be termed clumping. The essential difference is that schooling fishes swim together, feed, approach, turn and flee together and do not have leaders (Shaw 1962). Clumping fish on the other hand, mostly come together only when startled, otherwise feeding and swimming on their own.

The potential adaptive advantages of schooling or clumping are many (Shaw 1962). The stimuli necessary for this behaviour, however, remain obscure. Keenleyside (1955) showed that vision is crucial in maintaining schools of fish and that blinding may eliminate this response (*Pristella*). Shaw (1962) found that fish of similar size school, that a head-to-tail approach is important and that movement outweighs colour and species as far as visual stimuli are concerned (*Menidia*). Apparently the lateral line organs are important in this respect. Hearing, taste and smell are not regarded as effective stimuli by Shaw, but according to Goz (1941) the nasal sacs are important in schooling in non-predatory fish (*Phoxinus* and *Gobia*).

In an effort to obtain further information on this behaviour in fish, three species of freshwater teleosts were investigated with regard to body shape and odour and preliminary results

are reported in this communication. Young specimens of *Barbus holubi*, *Cyprinus carpio* and *Sarotherodon mossambicus* (*Tilapia mossambica*) were obtained in local waters. The yellowfish (*B. holubi*) varied in length from 10–13 cm and the carp (*C. carpio*) and bream (*S. mossambicus*) from 9–12 cm. Field observations indicate that bream of this length definitely show schooling behaviour but that carp and yellowfish of similar lengths are more prone to clumping (Schoonbee, personal communication).

The experimental procedure used for studying the reflex of following in these animals was similar to that used by Voronin & Kholodov (1964). Three of the dummies used in this study, cut from thin aluminium plate are shown in Figure 1. In any one experiment two live fish of a given species were tested with five dummies. A positive following reflex was evaluated as one in which the two experimental fish followed the dummies for at least five minutes, first in a clockwise direction and then anti-clockwise (five minutes in each direction). At least 10 experiments with different fish were done with each set of dummies.

In the first instance the live fish were tested

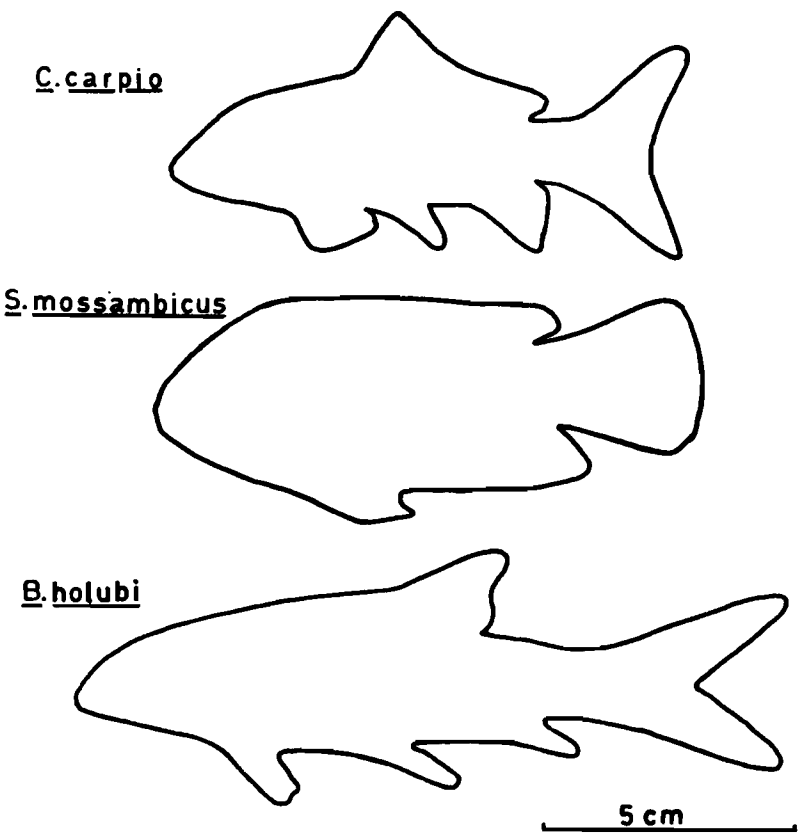

FIGURE 1

Dummy forms used for studying following reflexes in yellowfish, carp and bream.

with circular and rectangular forms. These forms were boiled in water for 15 minutes so as to rid them of any human or other odours and subsequently handled with forceps. No positive following reflex could be elicited. The fish were then tested with boiled dummies of their own species and it was found that carp and bream usually followed the dummies for 1–3 minutes but that the yellowfish showed no response at all. This was regarded as a negative response for all three species. Subsequently the dummies were again boiled and coated with mucus of the particular species obtained from healthy individuals. In the case of the carp and bream immediate positive responses were obtained with the experimental animals following the dummies for periods ranging from 10–60 minutes. The yellowfish, however, showed negative responses. In the case of the carp, positive responses could only be obtained before 1000 h and after 1500 h. This corresponds to observed activity rythms in the field (Schoonbee, personal communication). The bream, on the other hand, could be stimulated to follow at any time of the day, provided the water temperature was above 22 °C. At lower temperatures they were not very responsive.

In the last instance, carp and bream were tested against each other's dummies and negative results were obtained. However, if carp were tested against bream dummies with carp mucus, positive results were obtained. The same applied to bream tested with carp dummies but with bream mucus. The test fish, however, strayed often from the dummies and then returned again. This can therefore not be regarded as such a good stimulus as in the previous case. It was even found that round and square forms coated with the appropriate mucus would stimulate following behaviour but to a lesser degree than a fish-form with mucus.

The quantitative evaluation of the reflex of following is difficult and often arbitrary. In the experiments reported above the positive following reflexes obtained with carp and bream when following their own dummies and mucus, can be regarded as sufficient seeing that all fish tested in this manner followed the dummies for at least 10 minutes. The amount of mucus applied to the dummies obviously varied and it is not known what the decay time of the effective stimulus in the mucus is. The response of the experimental fish diminished with time, but when fresh mucus was applied, the fish reverted back to their original swimming pattern. It would therefore seem that in the case of the carp and bream tested, odour is more important than shape in eliciting following behaviour but that the best results are obtained when odour is combined with the appropriate visual stimulus (body shape in this case). Seeing that no coloration was applied to the dummies, the effect of this visual cue must still be investigated. In the case of the yellowfish, no following reflexes could be elicited and it would appear that shape and odour are not involved in their clumping behaviour.

Finally it must be mentioned that the following reflexes investigated do not necessarily indicate schooling or clumping behaviour. The fish might merely have been curious. On the other hand it was found that the carp and bream investigated always lay between the dummies when they were stationary if the dummies were of the correct body shape and had the correct mucus applied. This would therefore imply definite schooling or clumping behaviour and not merely following reflexes.

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