

Effects of Fishes of Different Species on Oxygen Consumption of the Goby *Tridentiger obscurus*

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The investigations reported here are continuations of research on an aspect of the effects of grouping on the oxygen consumption of fishes (Umezawa and Watanabe, 1979; Umezawa et al., unpublished*). Shlaifer (1938) found that an isolated goldfish consumed more oxygen than did each fish in groups of two to four. Uematsu (1971) on the guppy and Itazawa et al. (1978) on the rainbow trout and the medaka also demonstrated an increased oxygen consumption when the fish were isolated rather than in a group. There remained, however, the conflicting reports of Bowen (1932) on the catfish, Schuett (1934) on the goldfish, and Umezawa and Watanabe

(1979) on the medaka, where there was no significant difference in oxygen consumption of test fishes. In addition, Umezawa et al. (unpublished)* found that an isolated goby consumed less oxygen than did fish with visual contact with other fish of the same species.

It was the purpose of the experiments reported here to analyze what factors in aggregation are involved in the now established "group effect" in oxygen consumption of the goby.

Materials and methods

For this study five genera (six species) of fishes were used. One of them was a goby, *Tridentiger obscurus*, employed as the test fish. These fish had been collected from a river and transferred into aquaria (30×60×36 cm deep) in the laboratory supplied with well-aerated tap water, and ranged in size from 4 to 8 cm TL. About six individuals were kept together in each aquarium which was paved with stones of various sizes. They were fed on a fish food, Tetra-Min. Water

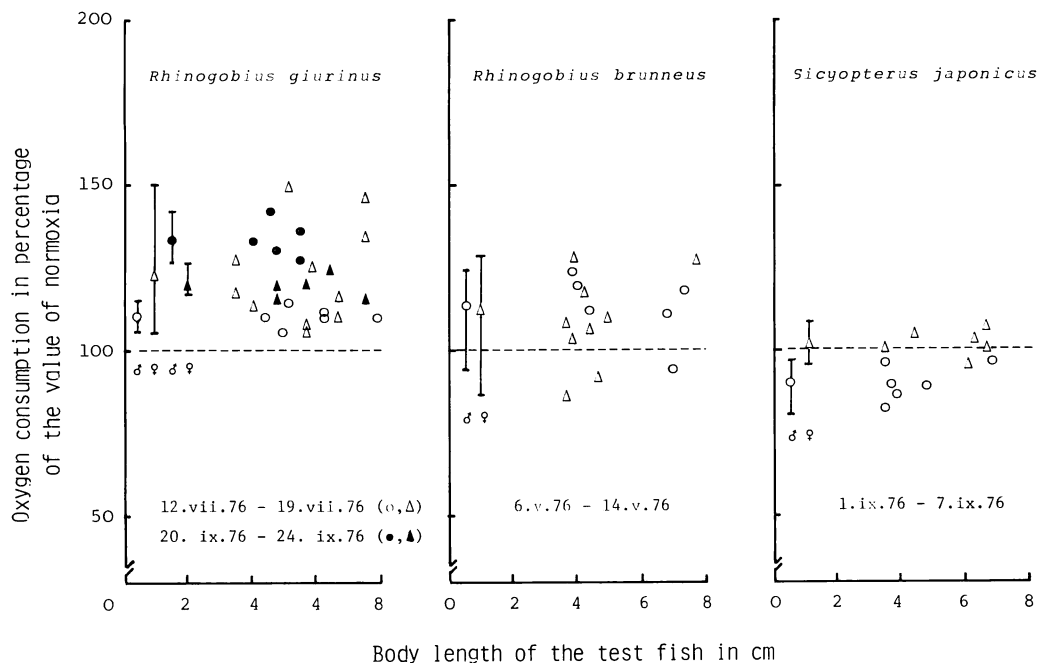


Fig. 1. Changes in oxygen consumption of various sizes of test fish (*Tridentiger*) in the respirometer, where each fish is placed in visual contact with two fish of *Rhinogobius* or of *Sicyopterus*. Temp.: 25°C.

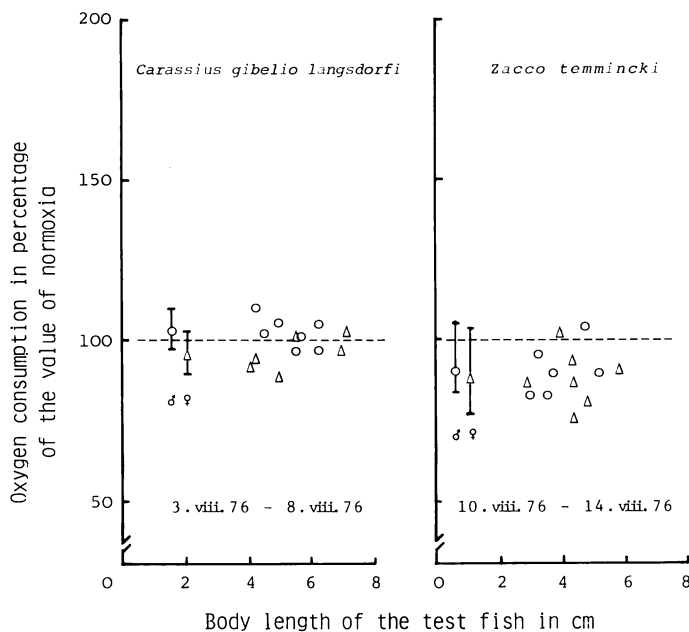


Fig. 2. Changes in oxygen consumption of various sizes of test fish (*Tridentiger*) in the respirometer, where each fish is placed in visual contact with two fish of *Carassius* or of *Zacco*. Temp.: 25°C.

temperature was about 25°C. Other fishes were used as “surrounding fish”. They were almost equal in length to the test fish and were kept in different aquaria under similar conditions in the laboratory. Three species were gobies, *Rhinogobius giurinus*, *R. brunneus* and *Sicyopterus japonicus*, which occur nearly syntopically with *T. obscurus*. Two other species included the crucian carp, *Carassius gibelio langsdorfi*, and the chub, *Zacco temmincki*.

Determinations of oxygen consumption were made on an isolated goby kept in the respirometer tube, when it was alternately placed in contact through vision alone with no surrounding fish and then with the fish, by means of a side septa, which was placed over the entire length of the tube and worked up and down with a miniature motor.

At least 12 test fish were used in each experiment, where two surrounding fish, being placed solitarily on each lateral side of the

* Umezawa, S.-I., H. Ueda, and H. Shibayama. (Unpublished). Group effect on the oxygen consumption and some observations on the habit of the goby, *Tridentiger obscurus*.

respirometer containing the test fish, were employed. The same surrounding fish were used two or three times in an experiment.

Results

Reactions of test fish to gobiid species.

Measurements were made of the oxygen consumption of an isolated goby in relation to changes in visual conditions. The results obtained (Fig. 1) indicate that the oxygen consumption of the test fish increased markedly when it was placed in contact through vision alone with *Rhinogobius giurinus* or *R. brunneus*, but the oxygen consumption decreased slightly when placed in visual contact with *Sicyopterus japonicus*. From these figures it is clear that the oxygen consumption of the goby was influenced by heterotypic combinations of closely related species such as *Rhinogobius*, but not by combinations of less related species such as *Sicyopterus*.

Reactions of test fish to cyprinid species.

Similar experiments were carried out in which an isolated goby was placed in contact through vision alone with *Carassius gibelio langsdorfi* and *Zacco temmincki*. Oxygen consumption

either decreased or did not change when the test fish was in visual contact with these species (Fig. 2). It is therefore clear that the oxygen consumption of the test fish was not affected by the presence of fishes of different families.

Discussion

According to Umezawa et al. (unpublished)* the oxygen consumption of an isolated goby kept in a respirometer tube increases when the fish is placed in contact through vision alone with fish of the same species, and this is opposite to the situation found in most fishes previously investigated. Umezawa et al. (unpublished)* have surmised that such a group effect is established depending on the habits of the gobies which exhibit a tendency to solitary living and aggressive behavior.

In the present experiments the goby was kept solitarily in the respirometer and placed in visual contact with fishes that in natural conditions live in nearly identical habitats as the test fish. Both closely related gobies and fishes from other families were used.

The results obtained here indicate that oxygen consumption of the fish was affected or not affected by changes in visual conditions. The fish in the respirometer consumed more oxygen in some cases but less oxygen in the other case when placed in visual contact with fishes living in nearly identical habitats as the test fish. These differences are probably related to differences in the habit of each species in relation to taking food. When the fish was placed in contact through vision alone with fishes of different families, its oxygen consumption decreased or did not change.

These results described here give evidence that the effects of grouping on the oxygen consumption of the goby exist among fishes of the same species and also of closely related species.

Thus, it is surmised that group effects, showing an increase in oxygen consumption in the goby, is caused naturally by its habit of solitary living and aggressive behavior.

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チチブの酸素消費量に及ぼす他種の魚の影響

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チチブの酸素消費量に及ぼす周囲の他種の魚の影響を調べた。酸素消費量はポーラログラフ酸素電極を用い、流水式の呼吸室により、チチブの呼吸前後の水の溶存酸素量の差から求めた。呼吸室に入れられた単独のチチブが両側に1個体ずつ配した同じ生息場所の他種の魚に接した場合、ゴクラクハゼおよびヨシノボリでは酸素消費量が増加したが、ボウズハゼではむしろ減少する傾向を示した。これらの違いは食性の違いによるものと思われる。また、ギンブナあるいはカラムツを周囲に配した場合はチチブの酸素消費量はそれぞれ変化がないかあるいは多少減少することがわかった。チチブにみられる、群よりも単独のときに酸素消費量が少ないという群効果は同種あるいは食性と遭遇可能性の等しい魚種の群に認められるものであろう。

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