Egg Size Difference among Three Populations of the Goby, *Tridentiger obscurus*

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Tridentiger obscurus (Temminck et Schlegel) is a common goby which lives in estuaries, rivers, ponds and lakes in Japan (Nakamura, 1942; Okada, 1960 : 654). In recent years Katsuyama et al. (1972) proposed that this species can be classified into two subspecies, *T. o. obscurus* and *T. o. brevispinis*, based on some morphological differences. In the present study, I investigated the size of eggs and larvae of these two types of *T. obscurus* during the summer of 1976.

Materials and methods

The following three different populations were examined.

1) The estuary population (E-population) found in an estuary, Hirakata Bay, locating at the western part of Tokyo Bay.

2) The lake population (L-population) living in a freshwater lake, Nakanuma, in Ibaraki Prefecture.

3) The river population (R-population) living in the Shimoyama River in Kanagawa Prefecture.

As for E-population, I also examined an additional subpopulation, the freshwater-adapted E-population (E_f-population) found in a small freshwater pool in the campus of Yokohama City University. This population consists of the descendants of some fish that had been collected from Hirakata Bay and then transplanted into the pool some ten years ago. According to the classification by Katsuyama et al. (1972), E- and E_f-populations belong to *T. o. obscurus*, whereas L- and R-populations to *T. o. brevispinis*.

Eggs were obtained either by collecting fertilized ones of early developmental stages in respective habitats or in aquaria; or by squeezing easily extrusible eggs out of ripe females. Larvae were obtained either by giving a slight mechanical stimulus to the pre-hatching eggs attaching to nest sites in natural habitats or by collecting larvae just after hatching in aquaria. The egg-shell length, egg-shell width, egg length (major axis of the egg proper), egg width (minor axis of the egg proper), and the total length of the larvae were measured on these materials by using a microscope with an ocular micrometer.

Two kinds of average values were determined for these terms. "Clutch mean" was calculated based on ten individual eggs or larvae obtained from a female or a cohort in a nest. On the other hand, "population mean" (in some cases, monthly population mean) was calculated based on several or more of "clutch-mean" values obtained in each population.

Results

Table 1 summarizes the population-mean values of egg size and larval length for the three populations and the one subpopulation (E_f). Practically, the eggs and the larvae of R-population and those of L-population were of the same size. Moreover, E_f-population had the eggs of just the same size as those of E-population. From the data presented in Table 1, it is roughly estimated that the eggs of E- and E_f-populations are twice as large as those of L- or R-population in volume.

The difference in egg size might merely reflect the body size difference of females. This possibility was examined in L- and E-populations as shown in Fig. 1. In both populations the egg

Table 1. Egg size and larval length of four different populations of *Tridentiger obscurus* expressed as population means±SD. Figures in parentheses indicate the number of clutch-mean values used for the calculation. E_f, the freshwater-adapted estuary population.

(mm)	Estuary population	E_f-population	River population	Lake population
Egg-shell length	1.39±0.05 (9)		0.88±0.07 (7)	0.88±0.06 (8)
Egg-shell width	0.72±0.04 (9)		0.58±0.01 (4)	0.56±0.04 (8)
Egg length	0.73±0.04 (19)	0.71±0.03 (3)	0.57±0.04 (4)	0.55±0.04 (9)
Egg width	0.65±0.05 (19)	0.66±0.05 (3)	0.51±0.02 (4)	0.49±0.02 (9)
Total length of larva	3.45±0.25 (9)		2.75±0.05 (3)	2.60±0.08 (3)

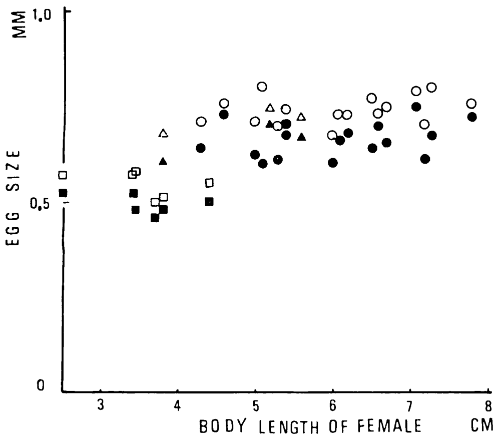

Fig. 1. Scatter diagram showing the correlation between egg size and standard length of female in *Tridentiger obscurus*. Solid and hollow circles (●, ○) respectively represent clutch-mean values of egg width and egg length measured in the estuary population, solid and hollow triangles (▲, △) those in the freshwater-adapted subpopulation of the estuary-type goby, and solid and hollow squares (■, □) those in the lake population.

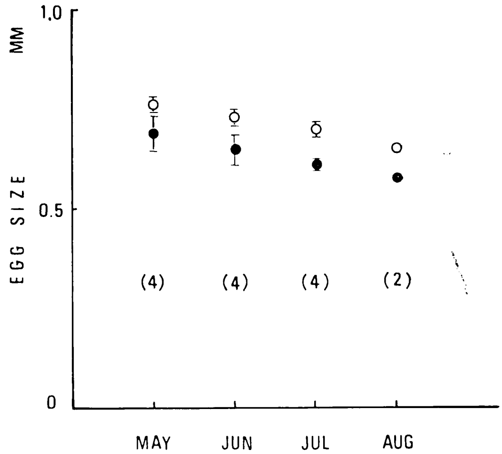

Fig. 2. Monthly change of egg size in the estuary population of *Tridentiger obscurus*. Solid and hollow circles (●, ○) respectively represent monthly-population-mean values of egg width and egg length. Figures in parentheses indicate the number of clutch-mean values used for the calculation. Ranges of SD are shown by vertical bars.

size seemed to be virtually independent of the size of the females from which the eggs were derived. Thus, though the females of L-population are usually much smaller than those of E-population, the smaller size of eggs in L-population may not be due to the body size difference in females.

Incidentally, the average size of the eggs seemed to decline during the breeding season in E-population as shown in Fig. 2. This suggests that differences in seasonal conditions or in maturation process of each reproductive female may somewhat influence the size of the eggs which it produces. However, the average egg size for the August population (egg length=0.65 mm, egg width=0.58 mm), which was the smallest of all the monthly-average-size values for E-population, was still larger than the average egg size for R-and L-populations.

To sum up, the results described above suggest that the two subspecies of *T. obscurus* can be also distinguishable on the basis of the size of the eggs or larvae, perhaps irrespective of the size of the females. Moreover the fact that the E_f-population, a freshwater-adapted subpopulation of E-population, has eggs of just the same size as those of E-population suggests that the difference in egg size between the two types of *T. obscurus* may not be due to the difference in the external factors such as salinity of the water. Although it is not clear as yet whether the egg size difference reflects any divergent adaptive features of the two "subspecies", it seems quite possible that it may have some genetic basis.

Acknowledgments

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河口域・河川・湖産のチチブ個体群間にみられた卵径の差違

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河口域，河川，湖の3カ所のチチブ個体群で卵径を比較した結果，河口域型のチチブ (*T. o. obscurus*) は，淡水の2個体群 (*T. o. brevispinis*) にくらべて体積で約2倍の大きさの卵を産むことがわかった．また，河口域と湖の両個体群では卵径と雌親魚の体長の間に相関がみられず，さらに，淡水中で約10年間飼育された河口域型チチブの卵径は元の個体群のものと変わらなかった．観察された卵径の差には遺伝的な基礎があるものと推定される．

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