50. Chromosomal Study on the Three Local Races of the Striated Spined Loach (Cobitis taenia striata)

By Kenji Saitoh,*) Akinori Takai,**) and Yoshio Ojima**)

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Introduction. Ueno et al. (1980) distinguished two chromosomal races, diploid and tetraploid, in the striated spined loach (Cobitis taenia striata). However, Minamori reported five local races (Minamori, 1955), which might be separated into three species (Minamori, 1960). Considering the Minamori's statements, there should be another speciation besides that by polyploidy. In order to examine this assumption, we performed karyological study for the three local races, the large, middle, and small races, which are representatives of the three species asserted by Minamori (1960).

Materials and methods. Both the middle and small races were collected from the Asahi River, Okayama Pref. The large race was obtained from Lake Biwa. They were distinguished mainly by the color pattern on their caudal region. The chromosome preparations were made following the routine air-drying method with conventional Giemsa stain. The Giemsa C-banding technique (Sumner, 1972) was applied for the chromosome analysis.

Chromosomal preparation was successful in one male and three females for the large race, four males and four females for the middle race, and six males and four females for the small race.

Results. The middle race had 50 chromosomes (Fig. 1A) in 2n with 8 pairs of meta- or submetacentrics and 17 pairs of acrocentrics. Whole bi-armed chromosomes showed very characteristic features to arrange the homologous pair by C-banding patterns. Among them, however, a pair was submetacentrics (arrows). Though Ueno et al. reported two pairs of submeta- or subtelocentrics, it was not clear in this study.

Two types of the chromosome number such as 49 and 50 in diploid were found in the small race. Four individuals among 6 males showed 49 chromosomes in 2n (Fig. 1B), while the rest and all females possessed 50 chromosomes. In male specimens with 49

*) Department of Fisheries, Faculty of Agriculture, Kyoto University, Kyoto 606.
**) Department of Biology, Faculty of Science, Kwansei Gakuin University, Nishinomiya 662.
Fig. 1. Karyotypes and C-band patterns (lower row) of the three local races of the striated spined loach. A: Middle race, a pair indicated by arrows is submetacentric. B: A male of small race with a large metacentric chromosome (LM), a pair (arrows) is submetacentric. C: Large race with some duplicated C-band markers (arrows).
chromosomes, a large metacentric chromosome instead of two acrocentrics was observed. There was no significant difference detectable between the two types of the small race in the morphological and ecological features.

The chromosomal complement and C-band pattern of the small race except the large metacentric chromosome were very similar to those of the middle race, but centromeric heterochromatins on the submetacentric pair of the middle race showed weaker affinity to the staining than the small race's. Moreover, the arm ratio of this pair of the middle race was usually larger than that of the small race.

The large race was a tetraploid type with 98 chromosomes having 21 pairs of bi-armed and 28 pairs of mono-armed as reported by Ueno et al. (Fig. 1C). Some of the C-band markers were found in duplicated number, though they were slightly changed in their arm ratio or length.

Discussion. Three races were distinguished by the karyological feature. The large race was tetraploid having some duplicated C-band markers, while the other two races were both diploid in the chromosome number. The middle and small races were different in the arm ratio and C-band pattern of a submetacentric pair.

In addition, the chromosomal polymorphism was observed among the males of the small race in the Asahi River, Okayama Pref. This fact seems an initial differentiation of \(X_1X_2Y/X_1X_1X_2X_2\) system through the sex chromosome evolution. A large metacentric chromosome which appeared in some males would be constituted by the Robertsonian translocation. Such situation is the first step of the sex chromosome differentiation in teleosts which seems to be sexually undifferentiated: One of the X chromosomes in the female or the male with 50 chromosomes may act as an autosome at the beginning of chromosomal differentiation. The fact that the large metacentric chromosome was not found among the middle race so far examined, suggests a reproductive isolation between the two sympatric races.

It is clear from these results that the speciation with chromosomal differentiation occurs at the diploid level as well as that through the effect of polyploidization asserted by Ueno et al. (1980).

Summary. Three local races of the striated spined loach (\(Cobitis taenia striata\)) are studied karyologically. The large race is tetraploid, while the middle and small races are diploid. Aneuploidy is found among males of the small race. Speciation at the diploid level is supposed to occur besides that by polyploidy. Morphological differentiation of the sex chromosome is also discussed.

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References