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Karyotype of Tetraploid Origin in a Tropical Asian Cyprinid, *Acrossocheilus sumatranus*

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Tetraploid origins of karyotypes have been demonstrated in six species of the Cyprinidae, i. e., *Cyprinus carpio* Linnaeus, *Carassius auratus* (Linnaeus), *Aulopyge hugeli* Heckel, *Barbus plebejus* Valenciennes, *Barbus meridionalis* Risso and *Tor putitora* (Hamilton) (Ohno and Atkin, 1966; Wolf et al., 1969; Fontana et al., 1970; Kobayasi et al., 1970, 1973; Ojima et al., 1972; Berberović et al., 1973; Sofradzija and Berberović, 1973; Cataudella et al., 1977; Khuda-Bukhsh, 1980). Except for *T. putitora* which occurs in India, all of them are species from temperate Eurasia. No tropical Asian cyprinids other than *T. putitora* show polyploidy (having 2n=50 or rarely 52 chromosomes against 2n=100 as in tetraploid species) (Nayyar, 1964; Ohno et al., 1967; Taki et al., 1977; Taki and Suzuki, 1977; etc.).

The cyprinid species reported in this study, *Acrossocheilus sumatranus* (Weber et de Beaufort), is known from Sumatra, Indonesia (Weber and de Beaufort, 1916, described as *Lissochilus sumatranus*) and Thailand (Fowler, 1934, described as *Lissochilus hutchinsoni*; Fowler, 1939, as *Acrossocheilus hutchinsoni*; Smith, 1945, as *Acrossocheilus sumatranus*). Chromosome analysis of this species revealed its karyotype of tetraploid origin, and provided a second known example of polyploidy in the Cyprinidae occurring in tropical waters.

Material and methods

Three specimens of *Acrossocheilus sumatranus* were obtained at an aquarium fish dealer's in Tokyo. It was stated there that the specimens were collected from natural water, but their collecting locality was unknown. One of the three was used for the identification of species based on Weber and de Beaufort (1916) and Smith (1945), and the other two, 97.0 mm and 106.2 mm in standard length, were used for chromosome analysis. The three specimens are deposited in the fish collection of the Institute for Breeding Research, Tokyo University of Agriculture (IBRP), with catalogue numbers of IBRP 7700~7702.

Each of the two fish was given an intraperitoneal injection of colchicine at a dose of 1 μg/g body weight three hours prior to sacrifice. Chromosome slides were prepared from gill epithelial and kidney cells treated with 0.075 M KCl hypotonic solution and fixed in 3:1 methanol-acetic acid. Chromosome spreading was achieved by means of the routine flame-drying method. Staining was made with Giemsa solution. The classification of chromosomes followed Levan et al. (1964).

Results

Sixteen cells with excellent metaphase nuclear plates were obtained from the two fish specimens. Fifteen of these showed 98 chromosomes (Fig. 1),

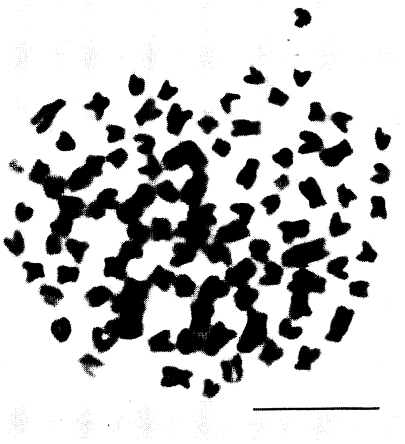

Fig. 1. Metaphase chromosomes from a kidney cell of *Acrossocheilus sumatranus*. Scale indicates 10 μm.

and the remaining one 97 chromosomes. From these counts the diploid chromosome number of *Acrossocheilus sumatranus* is determined as 98. The karyotype was composed of 8 metacentric, 36 submetacentric, 16 subtelocentric and 38 acrocentric chromosomes (Fig. 2). No heteromorphic pair was observed.

Discussion

Speciation through polyploidy in the Cyprinoidei has been indicated in many chromosome

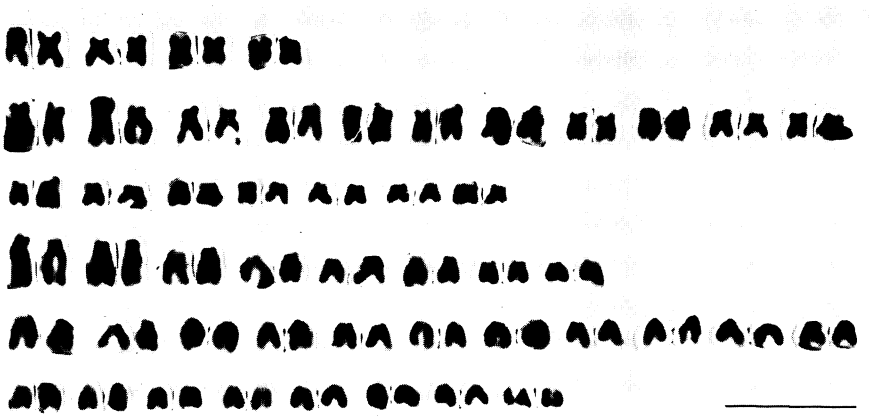

Fig. 2. Karyotype of *Acrossocheilus sumatranus*. Top row, metacentrics; second and third rows, submetacentrics; fourth row, subtelocentrics; fifth and sixth rows, acrocentrics. Scale indicates 10 μm.

studies. Uyeno and Smith (1972) showed the tetraploid origin of the Catostomidae (2n=100 or less frequently 96～98). Diploid-tetraploid relationships were noticed among species or even among populations of a single species of the Cobitidae (2n=48, 50, 86, 94, 96, 98, 100: e.g., Muramoto et al., 1968; Raicu and Taisescu, 1972; Ueno et al., 1980). In the Cyprinidae, relationships even involving higher ploids (2n=156, 206) are also demonstrated in subspecies of *Carassius auratus* (Kobayasi et al., 1970, 1973). The concept of polyploidization is reinforced by analyses of nuclear DNA content (Ohno et al., 1967; Ojima and Hitotsumachi, 1969; Wolf et al., 1969; Hinegardner and Rosen, 1972; Schmidtke et al., 1979; etc.) and by analyses of isozymes as gene markers (Klose et al., 1969; Ferris and Whitt, 1977).

On the basis of these karyological and biochemical findings, we consider the karyotype with 2n=98 chromosomes in *Acrossocheilus sumatranus* to represent a diploidized tetraploid derived from an ancestral 50-chromosome karyotype.

Among the Cyprinidae, the subfamily Barbinae are morphologically hardly distinct from the subfamily Cyprininae (e. g., Bănărescu, 1968, 1972). Moreover, according to the junior author's observations (unpublished), some barbine species appear more closely related to cyprinines than to other members of the Barbinae and the classification of these two subfamilies awaits rearrangement. In this connection it is of interest that, while there are as many as about 10 subfamilies in the Cyprinidae, all known polyploid-origin species belong to either the Cyprininae (*Cyprinus carpio* and *Carassius auratus*) or Barbinae (*Acrossocheilus sumatranus, Aulopyge hugeli, Barbus plebejus, B. meridionalis* and *Tor putitora*).

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Japan)

熱帯アジア産のコイ科魚種にみられた四倍体起源の核型

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スマトラとタイに分布する *Acrossocheilus sumatranus* の染色体を通常の flame-drying 法を用いて観察した結果，本種が 2n=98 の染色体をもつ四倍体起源の種であることが判明した．その核型は 8 本の中部着糸染色体，36 本の次中部着糸染色体，16 本の次端部着糸染色体，38 本の端部着糸染色体で構成されていた．

コイ科ではこれまでに倍数性種が 6 種知られているが，インド産の 1 種を除きいずれもユーラシア温帯部の産である．コイ科には一般に 10 亜科が認められているが，*A. sumatranus* をも含め倍数性種がすべてコイ亜科かバルブス亜科に属するものであることは興味深い．

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