

The Karyotype of a Chinese Bitterling, *Acheilognathus tonkinensis* (Pisces, Cyprinidae)

By

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Abstract Chromosomes of a Chinese bitterling, *Acheilognathus tonkinensis*, were observed. The diploid chromosome number is 44. The karyotype comprises 6 larger metacentric, 8 smaller metacentric, 14 submetacentric, 8 subtelocentric, and 8 acrocentric chromosomes.

A revision of the genera of the subfamily Acheilognathinae was recently reported (ARAI, 1988; ARAI & AKAI, 1988), which showed the importance of karyotypes in phylogenetic analysis of bitterling relationships, and $2n=44$ or 42 as one of the diagnostic characters of the genus *Acheilognathus*.

With respect to karyotypes of the subfamily Acheilognathinae, about 30 species including subspecies have been reported (ARAI, 1982; LEE, 1983; HONG & ZHOU, 1985; YU *et al.*, 1987; ARAI *et al.*, 1988; YU *et al.*, 1989), and karyotypes of all bitterling species in both Europe and Japan have been reported. However, there are many species of Chinese bitterlings whose karyotypes have not yet been observed.

In the spring, 1988, male bitterlings were imported into Japan from south China. These specimens have morphological features specific to *Acheilognathus*, and it was expected that their karyotypes are $2n=44$ or 42 .

Materials and Method

Two male specimens (cat. no. NSMT-P 29888) (Fig. 1) used for chromosome observation were obtained from an aquarium dealer in Tokyo. These two specimens and additional three specimens (cat. no. FAKU 56795–56797) loaned from Dr. Kazumi HOSOYA, which were obtained from the same source, were used for identification of

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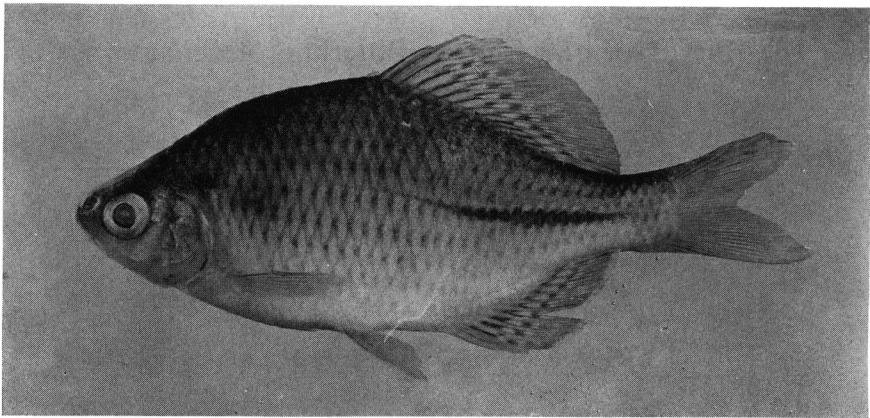


Fig. 1. *Acheilognathus tonkinensis*, 77.3 mm TL, male, cat. no. NSMT-P 29888-1.

Table 1. Some morphological characters of material fish and the holotype of *Acheilognathus tonkinensis*.

Cat. No.	Sex	TL* (mm)	SL* (mm)	HL* (mm)	BD* (mm)	OD* (mm)	BL* (mm)	Pored scales	Branched rays		VN*	GR*
									D*	A*		
NSMT-P 29888-1	male	77.3	61.7	16.2	27.1	5.4	0.9	34	12	10	35	
NSMT-P 29888-2	male	75.6	58.3	15.8	24.3	5.2	0.8	33	13	11	35	
FAKU 56795	male	76.7	60.5	14.5	27.0	5.6	0.9	34	12	10	34	8
FAKU 56796	male	73.2	58.3	15.4	27.0	6.4	1.2	34	14	11	34	9
FAKU 56797	male	74.0	60.0	16.0	28.1	6.0	1.0	34	14	11	34	8
MNHN 1892-46**	male		70.6	18.6	35.8	5.6	1.1	34	14	11	35	

* TL, total length; SL, standard length; HL, head length; BD, body depth; OD, orbit diameter; BL, barbel length; D, dorsal fin; A, anal fin; VN, number of vertebrae; GR, number of gill rakers.
** The holotype of *A. tonkinensis*.

material fish. Some morphological characters of material fish are shown in Table 1. These characters suggest material specimens to be *Acheilognathus tonkinensis* (= *Acanthorhodeus tonkinensis*). However, the identification of bitterlings is very difficult, and we had not precisely identified the material fish until we were able to examine the holotype of *A. tonkinensis*. In 1991, the holotype of *A. tonkinensis* (cat. no. MNHN 1892-46) was loaned from Dr. G. DUHAMEL, Museum National d'Histoire Naturelle, Paris, and we confirmed the material fish to be *A. tonkinensis* (VAILLANT, 1892).

Method of chromosome preparation followed OJIMA and KURISHITA (1980) and ARAI and TOKORO (1986). The diploid chromosome complement of the gill epithelial cells was based on counts of 52 metaphase plates. Classification of chromosomes is adopted from LEVAN *et al.* (1964). Metacentrics (M) and submetacentrics (SM) are described as two-arm chromosomes, and subtelocentrics (ST) and acrocentrics (A) as

one-arm chromosomes. The definition of the new arm number is referred to ARAI and NAGAIWA (1976).

Result and Discussion

Specimens of *Acheilognathus tonkinensis* showed a modal diploid number of 44 chromosomes, which comprise 6 larger metacentrics, 8 smaller metacentrics, 14 sub-metacentrics, 8 subtelocentrics, and 8 acrocentrics (Fig. 2). The first to third largest

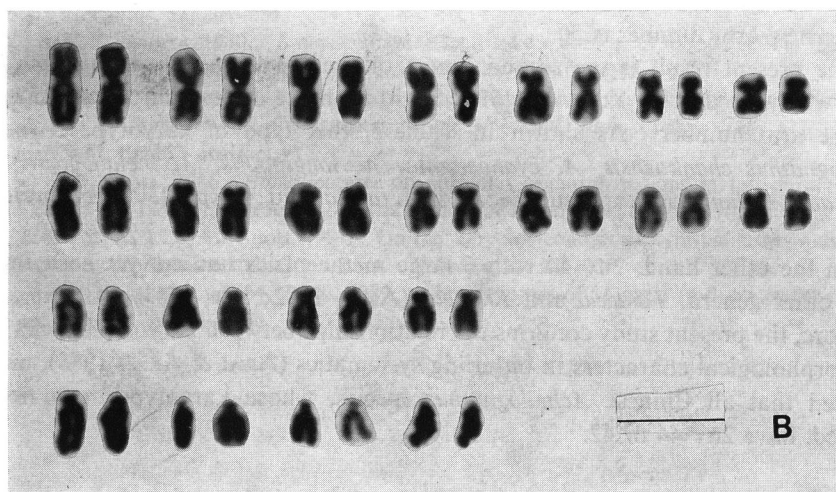
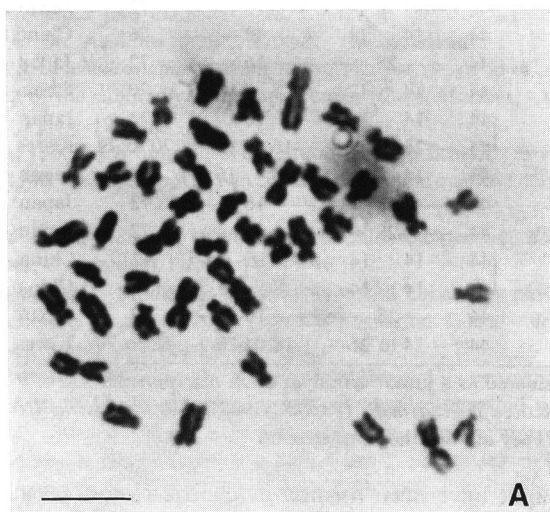


Fig. 2. A photomicrograph of mitotic metaphase chromosomes (A) and a karyotype (B) from the gill epithelial cell of *Acheilognathus tonkinensis* (cat. no. NSMT-P 29888-1). Each scale indicates 5 μ m.

Table 2. Karyotypes of the genus *Acheilognathus* sensu ARAI and AKAI (1988).
(Figures gotten between lines indicate numbers of M-SM or ST-A.)

Species	2n	M	SM	ST	A	NF	Locality	Literature
* <i>Acheilognathus asmussi</i>	44	—	24	—	20	—	68	Korea LEE, 1983
<i>A. chankaensis</i>	44	14	14	—	16	—	72	China HONG <i>et al.</i> , 1983
<i>A. cyanostigma</i>	44	14	14	0	16	—	72	Japan TAKAI & OJIMA, 1986
** <i>A. gracilis</i>	42	16	12	—	14	—	70	China HONG & ZHOU, 1985
** <i>A. gracilis</i>	44	—20 to 24	—	—20 to 24	—	—	64 to 68	Korea LEE, 1983
<i>A. imberbis</i>	44	14	18	—	12	—	76	China HONG <i>et al.</i> , 1983
<i>A. longipinnis</i>	44	—	28	—	16	—	72	Japan OJIMA <i>et al.</i> , 1973
* <i>A. macropterus</i>	44	14	18	—	12	—	76	China HONG <i>et al.</i> , 1983
<i>A. melanogaster</i>	44	—	28	—	16	—	72	Japan OJIMA <i>et al.</i> , 1973
<i>A. peihoensis</i>	44	14	12	8	10	—	70	China YU <i>et al.</i> , 1989
<i>A. rhombeus</i>	44	14	14	—	16	—	72	Japan TAKAI & OJIMA, 1986
	44	—26 to 28	—	—16 to 18	—	—	70 to 72	Korea LEE, 1983
<i>A. tabira tabira</i>	44	14	14	0	16	—	72	Japan TAKAI & OJIMA, 1986
<i>A. tabira</i> subsp. (a)	44	—	28	—	16	—	72	Japan OJIMA <i>et al.</i> , 1973
<i>A. tabira</i> subsp. (b)	44	—	28	—	16	—	72	Japan OJIMA <i>et al.</i> , 1973
<i>A. tonkinensis</i>	44	14	14	—	16	—	72	China YU <i>et al.</i> , 1989
	44	14	14	8	8	—	72	China Present study
<i>A. typus</i>	44	—	28	—	16	—	72	Japan OJIMA <i>et al.</i> , 1973
<i>A. yamatsutae</i>	44	—24 to 26	—	—18 to 20	—	—	68 to 70	Korea LEE, 1983

* *A. asmussi* is considered as a junior synonym of *A. macropterus*.

** *A. gracilis* from Korea is *A. gracilis* (REGAN, 1908), and *A. gracilis* from China is *A. gracilis* NICHOLS, 1926. They are not the same species.

metacentric pairs might have been formed by centric fusion because their two pairs are not found in the bitterling karyotype with $2n=48$. The arm number (NF) is 72, and the new arm number is 50.

The present result is the second report of the karyotype of *A. tonkinensis* and agrees well with that by YU *et al.* (1989: 56) in both the diploid chromosome number and the arm number. As shown in Table 2, this type of karyotype is found in *Acheilognathus chankaensis*, *A. cyanostigma*, *A. longipinnis*, *A. melanogaster* (= *A. moriokae*), *A. rhombeus*, three subspecies of *A. tabira*, and *A. typus* (= *Pseudoperilampus typus*).

On the other hand, $2n=44$ with 6 large metacentrics has not yet been reported in the other genera, *Tanakia* and *Rhodeus* (ARAI, 1982; LEE, 1983; YU *et al.*, 1989). Therefore, the present study confirms the relationships between karyological characters and morphological characters in bitterling systematics (ARAI & AKAI, 1988), and it is predicted that all Chinese *Acheilognathus* species, whose karyotypes have not been observed, have $2n=44$ or 42.

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